Comment – Greater Brisbane

Comment
We recommend that the Commission look closely at the city planning and infrastructure policies by large metropolitan councils — in particular Brisbane City Council — and the impact these have on firm creation, competition and growth. Many state government solutions to this in the past have been for special carve-outs and exemptions for large projects or priority precincts. While this approach might be preferred by large builders and developers, the nature of exemption-based approaches disadvantages start-ups and smaller firms. Recent movements by the Victorian and NSW Governments — and especially the very recent announcement by the ACT Government — of broad-based upzoning makes the entire market more tractable, accessible and open. We recommend that the Commission dedicate part of your attention on reducing the rationing of high amenity, inner city land by regulations. Council policies on height limits, lot minimums and character protections in residential zoning all severely limit the developable land to a handful of large sites, particularly in the inner city where transport access is barely relevant for access to employment. In fact, character restrictions apply to nearly 13% of all of Brisbane's residential zoned land, and the majority of residential lots in the highly desirable neighbourhoods within 5 kilometres of the CBD. Combined with Brisbane City Council's reactionary 2017 "townhouse ban", Council's decisions have put a squeeze on innovative mid-sized firms who would in a functioning market be developing luxury mid-rise apartments in highly-desirable areas. Our submission is an annotated bibliography of relevant research to back up our recommendation that the Commission focus on local government planning factors.

Tuesday 27 May 2025

Angela Moody and Dr Karen Hooper
Queensland Productivity Commission
by online portal only: **qpc.qld.gov.au/inquiries**

Dear Commissioners:

Inquiry into opportunities to improve the productivity of the Queensland construction sector

Thank you for the invitation to provide some comments on your ongoing inquiry into Queensland's construction sector.

Greater Brisbane is a fully volunteer grassroots collective of people who love our city and want to work to make it a prosperous and dynamic place for everyone who lives, works or plays here. We want a Brisbane where everyone is welcome and has the opportunity to live a good life wherever they want. We are supported by Abundant Housing Network, our national alliance of grassroots housing advocates including YIMBY Melbourne, Sydney YIMBY and Greater Canberra.

A dynamic, innovative and competitive construction sector is a key part of building a bigger, more affordable city. Unfortunately, decades of well-meaning — if, in hindsight, short-sighted — planning decisions, mostly by local governments, have reduced the sector's capacity to absorb regulatory disruption or even large scale market changes.

We imagine most submissions you will receive will focus on the very big end of the construction industry — large, unionised workforces working for large builders and developers, or greenfield developers and their independent subcontractors.

Our focus is instead on the "Missing Middle" of both housing and the kind of construction firms that typically deliver them.

We recommend that the Commission look closely at the city planning and infrastructure policies by large metropolitan councils — in particular Brisbane City Council — and the impact these have on firm creation, competition and growth.

Many state government solutions to this in the past have been for special carve-outs and exemptions for large projects or priority precincts. While this approach might be preferred by large builders and developers, the nature of exemption-based approaches disadvantages start-ups and smaller firms.

Recent movements by the Victorian and NSW Governments — and especially the very recent announcement by the ACT Government — of broad-based upzoning makes the entire market more tractable, accessible and open.

We recommend that the Commission dedicate part of your attention on reducing the rationing of high amenity, inner city land by regulations.

Council policies on height limits, lot minimums and character protections in residential zoning all severely limit the developable land to a handful of large sites, particularly in the inner city where transport access is barely relevant for access to employment. In fact, character restrictions apply to nearly 13% of all of Brisbane's residential zoned land, and the majority of residential lots in the highly desirable neighbourhoods within 5 kilometres of the CBD.

Combined with Brisbane City Council's reactionary 2017 "townhouse ban", Council's decisions have put a squeeze on innovative mid-sized firms who would in a functioning market be developing luxury mid-rise apartments in highly-desirable areas.

Ultimately, decisions on the rationing and release of land are a series of trade-offs.

Broadly, our view is that protecting our peri-urban green spaces, reducing flood risk and encouraging greater competition in the residential construction sector — all of which are predictable outcomes of an upzoning-led approach — is worth trading off third party appeals, overshadowing and height restrictions and nostalgia-fuelled blanket character protections.

We encourage the Commission to seriously interrogate the impact of local government — especially Brisbane City Council's — planning and zoning decisions on the productivity of Brisbane's residential construction sector.

We have also attached some previous submissions that are relevant to this inquiry:

Attachment 1: The Brick Book — Abundant Housing Network's six shovel-ready policies to get construction moving in Australia, May 2025

Attachment 2: Reforming car parking minimums in Brisbane, November 2024

Attachment 3: Barriers to homebuilding in Australia — Abundant Housing Network's submission to the Commonwealth Productivity Commission, August 2024

Attachment 4: The Woolloongabba Plan, July 2024

We also attached several academic articles and research papers that we think would be relevant to this inquiry.

Yours sincerely

Travis Jordan | Greater Brisbane lead organiser
e: hello@greaterbrisbane.org | **w**: greaterbrisbane.org

ANNOTATED BIBLIOGRAPHY

Attachment 5: Character contradiction: The exclusionary nature of preservationist planning restrictions - Gallagher et al (2023)

> The study examines the impacts of preservationist planning in Brisbane, Australia. Analyzing nearly 6,000 residential lots from 1951 to 2021, the authors find that preservation policies—especially the Character Residential zone—significantly restrict housing diversity and suppress multi-family housing construction, even in areas officially designated for increased density.

Attachment 6: The preservation of historic districts—is it worth it? - Waights (2018)

> This study finds that UK conservation areas lead to higher house prices and building costs due to lower housing productivity.

Attachment 7: Dispelling myths: Reviewing the evidence on zoning reforms in Auckland - Maltman and Donovan (2025)

> This paper thoroughly examines the literature on Auckland's upzoning and finds the body of work to be robust and the criticism is unsubstantiated by any evidence.

Attachment 8: Our home choices: How more housing options can make better use of Victoria's infrastructure - Infrastructure Victoria (2023)

> The nature of greenfield developments means unlike infill developments, there little to no infrastructure is present in these regions before they're redeveloped—however unlike in established suburban infrastructure, the relative costs of delivering it cost substantially more. The infrastructure to support new greenfield homes can cost up to 4 times more than in established suburbs. This in essence means that low-density inner-city living is subsidised excessively by taxpayers paying high premiums for outer suburban infrastructure.

Attachment 9: Can zoning reform increase construction productivity? Suggestive evidence from New Zealand - Maltman (2024)

This summarises the emerging evidence that indicates that Auckland's upzoning may be positively affecting construction productivity.

Attachment 10: Reexamining lackluster productivity growth in construction - Garcia and Molloy (2025)

This paper finds a link between productivity growth in construction and housing supply constraints, and tests the robustness of previous studies looking into declining productivity.

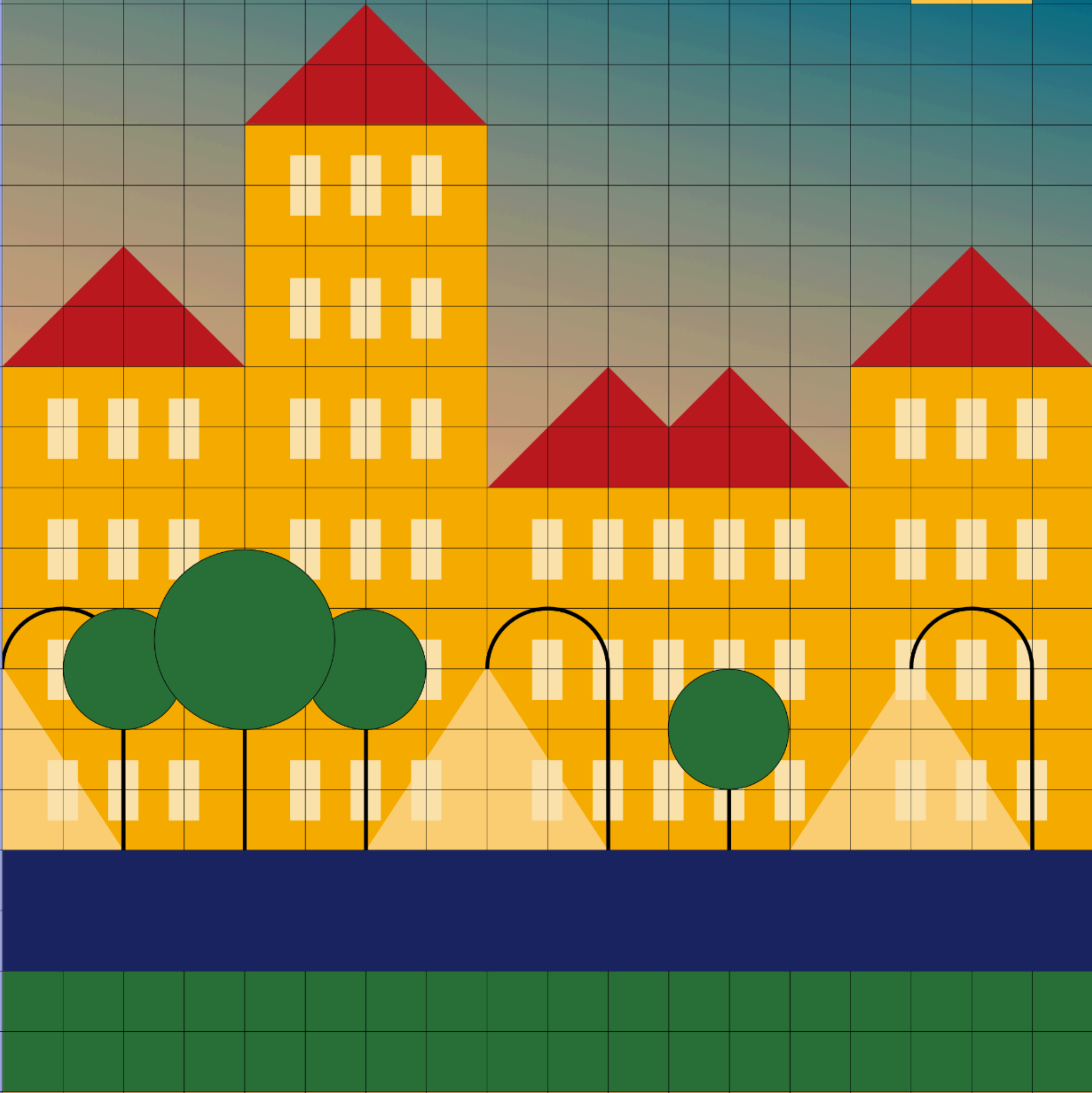
Attachment 11: Size matters: why constructions productivity is so weak - Wilson and Brooks (2025)

This report from the Committee for Economic Development Australia identifies firm size — and the associated bureaucratic overheads that plague very small and very large firms — as a key handbrake on construction productivity in Australia.

Attachment 12: The impact of upzoning on housing construction in Auckland - Greenaway-McGrevy and Phillips (2023)

The seminal paper on the Auckland experience which saw their experiment with "broad upzoning" lead to major productivity gains, increased housing affordability and significant positive urban design outcomes — as close to a "magic bullet" you can get.

THE BRICK BOOK



A national resource document for residential development policy

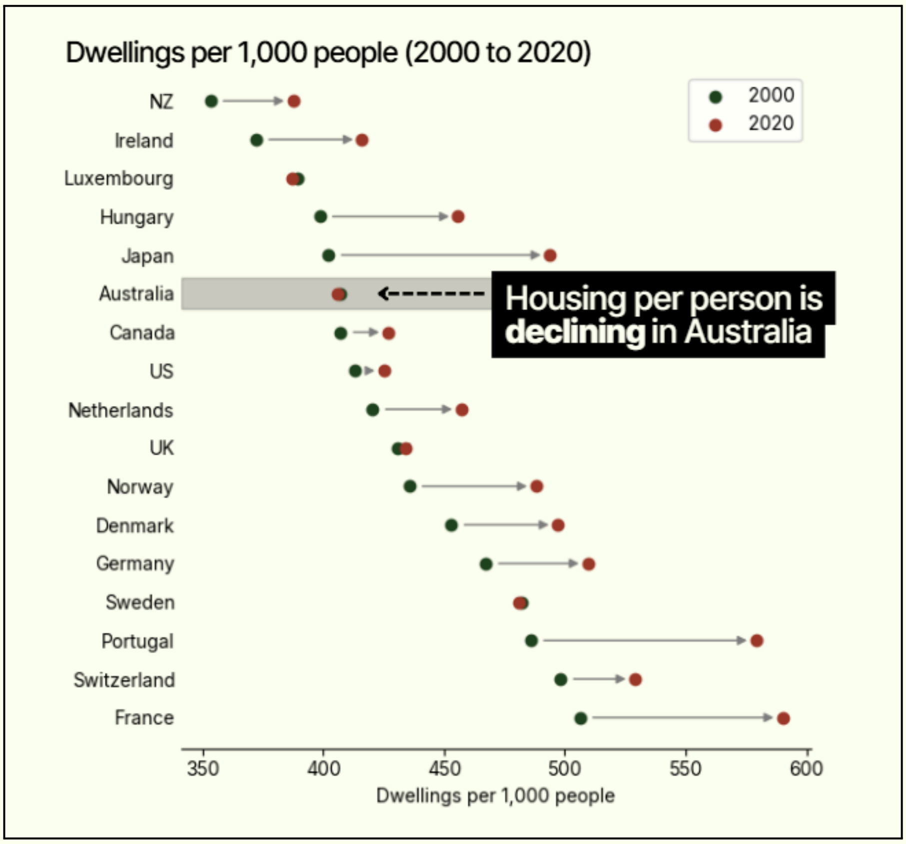
2025

EXECUTIVE SUMMARY:
The Housing Crisis is an Artificial Housing Shortage

> *"If we want to make it easier for young people to buy a home, we need to build more units and clear away some of the outdated laws and regulations that have made it harder to build homes for working people in this country."*

– Barack Obama
Democratic National Convention
2024

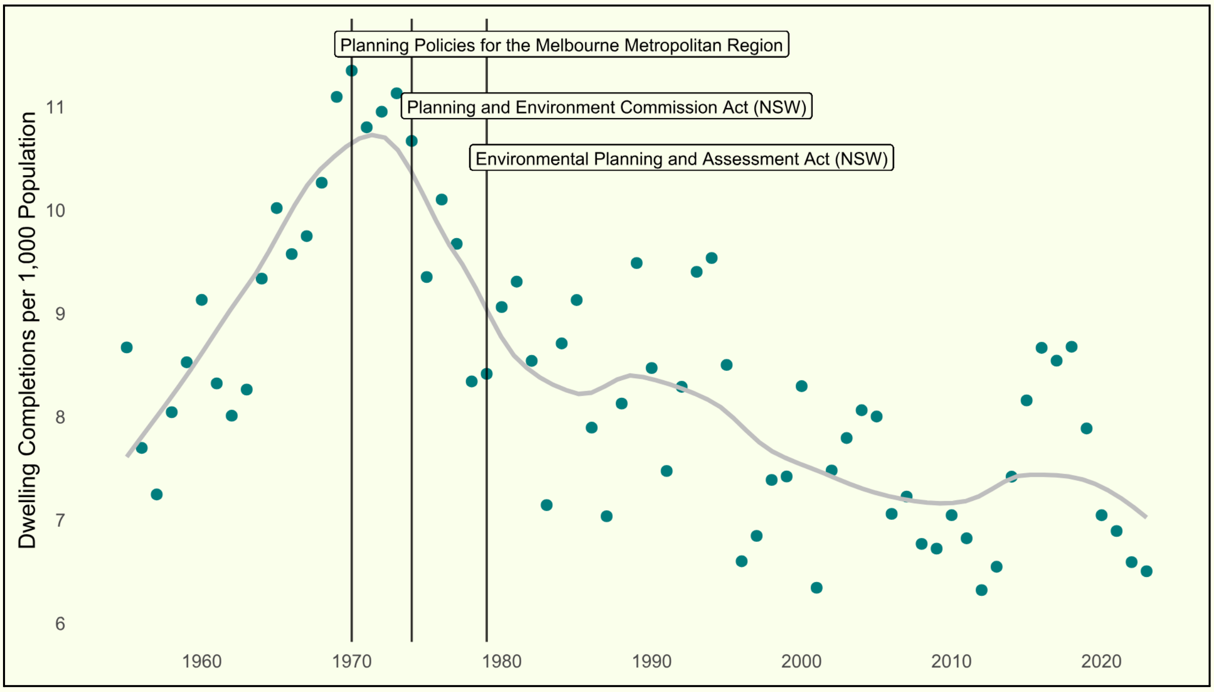
Australia has one of the lowest numbers of homes per person in the developed world—and it's only getting worse.[1] This is because we have made it incredibly difficult to build the homes people need in the places they most want to live.



Australian housing supply has declined in the 21st century.

[1] Sathanapally et. al (2025), '[Orange Book 2025: Policy priorities for the federal government](#)', Grattan Institute.

As per the chart below, ever since Australia's modern planning systems became legally enforceable, we've seen a long-term decline in dwelling completions per capita.



Modern planning systems have strangled housing supply across our nation.

Planning policies have only become more complex and restrictive over time, and now strictly limit the development of land, particularly in wealthy, inner-city suburbs. In combination with factors such as declining household size, growing incomes, and population urbanisation, the handbrakes on housing supply means it cannot keep up with the growing demand.

The vested interests of wealthy homeowners and process-oriented consultants, as well as the perverse incentives of under-resourced local governments, has made the planning systems historically resistant to meaningful reform.

As of 2023, the tide has begun to change. State Governments across Australia have begun to meaningfully undertake the planning reform necessary to increase housing supply for all Australians.

It is often said that there is no silver bullet to solve the housing crisis. But upzoning and planning reform are the closest we've got.

In our nation's policy discourse, land use is typically considered to be the exclusive purview of state and local governments, with the Federal government providing grants with varying degrees of targeting.

Indeed, the 2025 election thus far has almost entirely lacked supply-side policy ambitions from any of our political leaders. Instead we have been sold the same old policies: more demand subsidies that will satisfy voters in the short term, but drive up housing costs in the long term.

But the Federal disconnect from planning and housing policy is not the case historically, and should not be the case going forward.

During the 1980s to 1990s, the Commonwealth Government helped develop AMCORD, the Australian Model Code for Residential Development, setting a national best practice standard for planning and urban development, paving the way for the performance-based controls that dominated modern planning systems.

In 2024, the state and territory governments began negotiating a revitalised National Competition Policy to liberalise and standardise commercial zoning and planning to ensure that overly complex rules do not distort competition.

This document lays out the path for a Federal Government to continue growing their role in the most fundamental area of our nation's policy: that which governs how we use land, for where, and for what.

Australia should be a nation that builds. This document lays out six meaningful steps toward making that goal a reality.

RECOMMENDATIONS

1 | Introduce a National Townhouse Accord

Auckland-style upzoning—for all of Australia

A. Set a nation-wide ‘code-assessable’ framework for townhouse development, ensuring ample permissible residential density across all urban areas.

B. Remove local planning restrictions that are less permissive than the National Townhouse Accord framework.

C. Exempt all developments that comply with the National Townhouse Accord from any state's third party appeal processes.

2 | Fix the National Housing Accord incentives

Pay the states to fix planning bottlenecks and build homes faster

A. A new tranche of the National Productivity Fund should deliver incentive payments for implementing a number of deliverables such as:

   a. Upzoning around transit hubs, CBDs, and core town centres.

   b. Modernising and simplifying planning regulation.

   c. Codifying all residential and mixed-use development with a deemed-to-comply standard.

   d. Providing best-practice frameworks and cost-benefit analysis structures for land-use regulation and decision-making.

3 | Create a federal Targeted Infrastructure Feasibility Fund

A bang-for-buck fund to unlock homes in high-productivity areas

A. Create a Commonwealth-funded targeted apartment feasibility program, building on existing initiatives in Western Australia.

B. Focus government support on covering infrastructure connection fees (e.g. water, wastewater, electricity) for infill apartment developments.

C. Prioritise projects that are shovel-ready to maximise efficiency and reduce the risk of program misuse.

4 | Introduce a national occupational licencing regime

Empower tradespeople to build where they are needed most

A. Re-establish the National Occupational Licensing Authority with a mandate to focus on the construction sector and for the implemented scheme to be cost-positive or neutral for state/territory governments.

B. Expand the National Productivity Fund’s scope and funding to include national occupational licensing to incentivise state and territory involvement with a national scheme.

5 | Boost Commonwealth Rent Assistance

Bring payments up to a baseline—and ensure they stay there

A. Raise the maximum rate of Rent Assistance by 50% for singles and 40% for couples.

B. Index Rent Assistance to the cheapest 25% of rentals in capital cities in perpetuity.

6 | Create better incentives for public, community, and youth housing

Provide more homes for those who need them most

A. Enable public housing agencies to claim GST credits

B. Allow public housing tenants to get Commonwealth Rent Assistance

C. End the youth penalty by amending CRA criteria to give all social housing tenants the maximum Rent Assistance amount receivable.

CONTENTS

What the Commonwealth can do to solve the Housing Crisis

1 | Introduce a National Townhouse Accord

Auckland-style upzoning—for all of Australia

Australian cities face limited geographical constraints. Even our coastal cities are able to sprawl in multiple directions with relative ease, which has led capitals like Melbourne, Sydney, and Brisbane to be some of the world's largest in terms of surface area.

This sprawl has not come without a cost. With the bulk of housing being built on the outskirts of our cities, younger and poorer families are being pushed further and further out as time goes on. This creates poverty traps and enshrines geospatial inequality into our cities.

This has not happened accidentally; it is the result of policy decisions that have made detached, single-family homes on greenfield land the easiest form of housing to build. This reliance on sprawl has reached breaking point, and is no longer aligned with the needs of the highly urbanised and services-focused Australian economy.

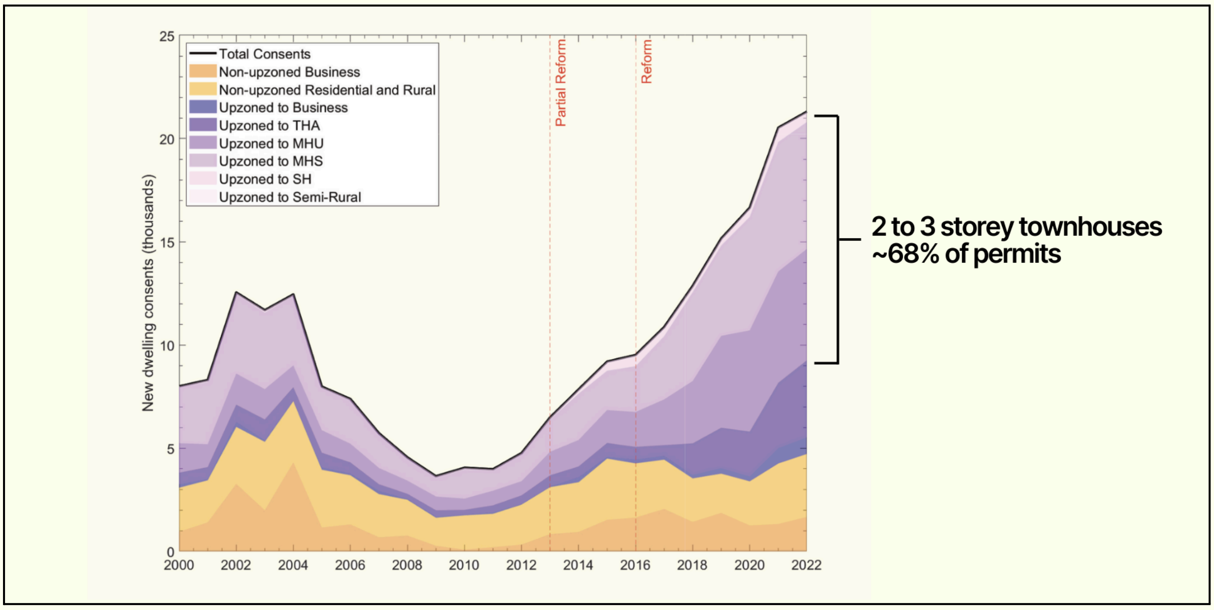
Times have changed, and the housing crisis demands our action.

The Federal Government should, through the National Competition Policy, introduce a National Townhouse Accord (NTA), enshrining a minimum residential density to be permitted without discretion across all of Australia.

This would, in effect, enable townhouses and units of up to three storeys to be built in all of our nation's established areas.

Townhouses offer a more affordable housing option that is both low-impact and well-suited for the middle-ring suburbs of our cities. Unlocking their potential on a national scale is critical to solving the chronic housing shortage, as townhouses are able to be built by a broad number of firms—including “mum and dad” developers looking to capitalise on their land when downsizing and ageing in place.

This policy recommendation would implement upzoning similar to that which was so successful in Auckland—where up to three storeys can be built without a discretionary permit. The success of the Auckland reforms underlines the critical role that townhouses can play in boosting housing supply, with 68% of the city's dwelling permits in 2022 taking advantage of the new, post-upzoning rules.[2]



Auckland's city-wide reforms are a housing supply success story that Australia should replicate.

The results from Auckland are consistent with the broader literature that highlights how non-discretionary processes result in faster approvals and greater certainty—crucial to unlocking the housing supply Australia so desperately needs.[3]

Building standards are already set federally through the National Construction Code, but planning standards are not. This has led to the development and enforcement of restrictive and arbitrary rules at the state and local levels, to the great detriment of Australian housing supply and economic efficiency.

Now is the time for the Commonwealth to show leadership, spearheading a National Townhouse Accord to develop consistent and clear rules around density that can be implemented nationwide to unlock a townhouse revolution.

[2] Greenaway-McGrevy & Jones (2023), 'Can zoning reform change urban development patterns? Evidence from Auckland', University of Auckland

[3] Manville, M., Monkkonen, P., Gray, N., & Phillips, S. (2022), 'Does Discretion Delay Development? The Impact of Approval Pathways on Multifamily Housing's Time to Permit', Journal of the American Planning Association, 89(3), 336–347. 1

They can use the revitalised National Competition Policy to incentivise the adaptation of the National Townhouse Accord for a consistent zoning code for townhouses and low-rise housing across Australia.

Example density standards	
Applicable zones	Residential zones
Types of homes permitted	Townhouses, flats, detached homes
Maximum height	3 storeys or 12m
Minimum setback from street	4m
Permitted site coverage	60% of site
Minimum landscaped area	20% of site
Assessment process	Code-assessed
Parking	Demand-driven

Planning rules should be simple, and provide a flexible envelope for development.

This reform can be modelled on Victoria's Townhouse and Low-rise Code and New Zealand's Medium Density Residential Standards, which have allowed for broad, consistent, and clear rules for building the diverse housing options that are desired by Australians.

Recommendations

A. Set a nation-wide 'code-assessable' framework for townhouse development, ensuring ample permissible residential density across all urban areas.

B. Remove local planning restrictions that are less permissive than the National Townhouse Accord framework.

C. Exempt all developments that comply with the National Townhouse Accord from any state's third party appeal processes.

2 | Fix the National Housing Accord incentives

Pay the states to fix planning bottlenecks and build homes faster

The National Housing Accord does not provide an effective set of incentives to ensure that states are able to achieve the program's desired housing outcomes.

While the Federal Government may believe that setting an ambitious housing supply target is important in and of itself, without empowering the states to undertake the work required to reach it, the $3.5 billion New Homes Bonus is dead in the water.

The Federal Government has the ability to provide both 'pull' and 'push' funding. While the New Homes Bonus does provide some 'pull' toward good housing supply outcomes, this pull is too far in the future to be effective. Without also providing nearer-term funding, states are unlikely to undertake the politically difficult process of reform.

This is underscored when considering the timing of the New Homes Bonus, which is set to be released five years *after* the signing of the National Housing Accord. This leaves the Bonus entirely misaligned with state and local government electoral cycles, meaning there is little incentive for governments to act in the near-term.

Without 'push' funding, state and local governments trying to meet their housing targets will incur both tangible and intangible costs now with little guarantee of a reward.

This is made even more fraught in the face of economic headwinds that make it challenging for even the most ambitious state to meet the housing target the Commonwealth has set for them.

The Federal Government should introduce a new tranche of the National Productivity Fund to be used as an incentive for states to embark on ambitious upzoning programs that enable homes to be built quickly and easily in the places where people want to live.

Recommendations

A. A new tranche of the National Productivity Fund should deliver incentive payments for implementing a number of deliverables such as:

   a. Upzoning around transit hubs, CBDs, and core town centres.

   b. Modernising and simplifying planning regulation.

   c. Codifying all residential and mixed-use development with a deemed-to-comply standard.

   d. Providing best-practice frameworks and cost-benefit analysis structures for land-use regulation and decision-making.

3 | Create a federal Targeted Infrastructure Feasibility Fund

A bang-for-buck fund to unlock homes in high-productivity areas

Over the past half-decade, Australia's housing shortage has reached a critical point—especially in well-located areas where demand is highest.

This problem has been compounded by the aftermath of the COVID-19 pandemic, which has seen soaring construction costs and mounting economic uncertainty are putting housing developments on ice across the country. The result? Fewer homes, stalled developments, and deepening affordability issues.

While government intervention on the supply side isn't easy—or cheap—the cost of inaction is far higher. If Australia is serious about addressing the housing crisis, then it is time to act decisively.

The Federal Government should introduce a Targeted Infrastructure Feasibility Fund (TIFF) with the scope to fund major core infrastructure upgrades directly, and provide interest-free and low-cost loans to overcome project bottlenecks in advance of unit sales and settlements.

Cross-party support is already emerging for apartment feasibility programs. In Western Australia, both Labor's Targeted Apartment Rebate and the Liberals' Apartment Support Program would offer direct project support by covering infrastructure connection fees—like water, wastewater, and electricity—for infill apartment developments.

As highlighted in a 2021 Housing Australia report, infrastructure contributions are often not finalised until after land has been purchased, meaning that land prices may not have all costs factored in.[4] This introduces the problems of unforeseen costs and unnecessary delays to the housing projects our cities so desperately need.

Targeted feasibility funding would help smooth housing delivery nation-wide. A focus on infrastructure connection fees enables governments to underwrite projects in a way that has a low risk of rorting, by being hyper-targeted, scaled on a per-dwelling basis, and focused on projects that are shovel-ready.

[4] 'Developer Contributions: How Should We Pay For New Local Infrastructure?', National Housing Finance and Investment Corporation

To ensure these programs deliver maximum impact, the TIFF should focus on unlocking homes in well-located urban areas, in support of the key National Urban Policy goal of building cities that are livable, equitable, productive, and innovative.

Recommendations

A. Create a Commonwealth-funded targeted apartment feasibility program, building on existing initiatives in Western Australia, such as Labor's Targeted Apartment Rebate and The Liberals' Apartment Support Program.
B. Focus government support on covering infrastructure connection fees (e.g. water, wastewater, electricity) for infill apartment developments.
C. Prioritise projects that are shovel-ready to maximise efficiency and reduce the risk of program misuse.

4 | Introduce a national occupational licencing regime

Empower tradespeople to build where they are needed most

Discussions of construction worker shortages have centred on migration pathways and apprenticeship incentives—but reforms in these areas are likely to yield only limited benefits.

This is because a major constraint remains unaddressed: an inefficient web of state-based occupational licensing regimes. Policymakers should work to reduce friction and bring down barriers that keep Australians from entering and remaining within the construction workforce, regardless of their life circumstances.

The Federal Government recently announced efforts in this direction, with a national licensing scheme for electrical trades.[5] This is a good start, and will finally achieve the outcomes detailed in a 2013 Regulation Impact Statement (RIS) for a national occupational licensing scheme for electricians estimated this alone would boost annual GDP by almost $30 million in today's dollars.[6]

Empowering construction workers to freely move within the borders of our nation will enable the construction sector to better respond to shortages within Australia's various markets, and will help reduce the barriers to introducing more migrant workers into our construction workforce.

Without such a scheme, efforts to increase the number of skilled professionals—drawn both from Australia itself as well as traditional source countries—will continue to face substantial barriers.

Recommendations

A. Re-establish the National Occupational Licensing Authority with a mandate to focus on the construction sector and for the implemented scheme to be cost-positive or neutral for state/territory governments.

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[5] National licensing for electrical trades, Commonwealth Treasury, March 2025
[6] National Licensing of Electrical Occupations – Decision RIS

B. Expand the National Productivity Fund’s scope and funding to include national occupational licensing to incentivise state and territory involvement with a national scheme.

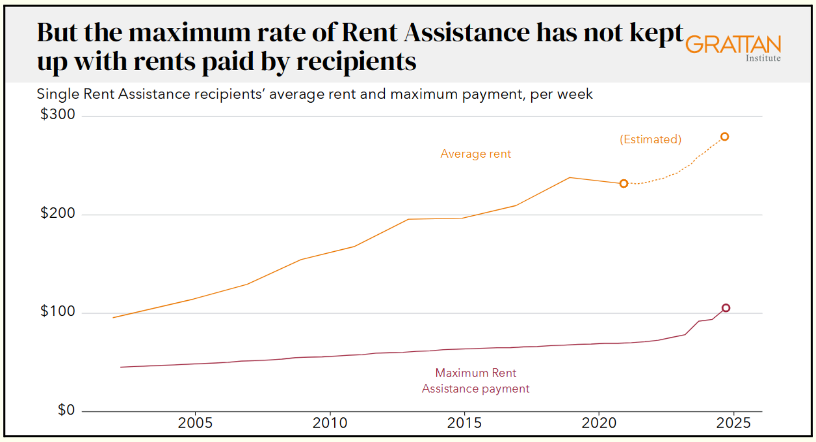
5 | Boost Commonwealth Rent Assistance

Bring payments up to a baseline—and ensure they stay there

No group is more greatly harmed by the housing shortage than low-income renters. Rates of financial stress are persistently higher among renters than among homeowners, and have particularly increased in the wake of the COVID-19 pandemic as rents have skyrocketed and income supports have been wound back.[7]

Rent Assistance is the main way that the Commonwealth supports low-income renters, by providing direct cash assistance to eligible welfare recipients who are renting on the private market, or through community housing providers. But the rate of the payment is too low—even after recent increases, a pensioner who relies solely on welfare payments has less than $300 to spend on rent after covering everyday essentials.[8]

Since 2001 rents paid by low-income renters have significantly outpaced the growth rate of Rent Assistance, which is indexed to CPI, leading to the payment being woefully inadequate to support welfare recipients in the rental market. And eligibility for the payment is too narrow, with low-income renters who don't receive welfare payments unable to receive any assistance. While increases in cash assistance aren't a comprehensive measure to fix the housing crisis, they're clearly the most efficient and immediate ways to provide relief to Australia's most vulnerable renters, before the benefits of increased housing supply and social housing investment can be realised.



Constrained housing supply has led rents to outpace broader inflation measures.

[7] Clarke (2025), Cost of living: Not everyone's crisis? ,E61 Institute.
[8] Coates, Bowes & Moloney (2025), Renting in retirement: Why Rent Assistance needs to rise, Grattan Institute.

Recommendations

A. Raise the maximum rate of Rent Assistance by 50 per cent for singles and 40 per cent for couples, as recently recommended by the Grattan Institute.
B. Index Rent Assistance to rents on the private market.
C. Work with the states to expand the housing assistance available to low-income renters who are not otherwise eligible for welfare payments, especially those most at risk of homelessness.

6 | Create better incentives for public, community, and youth housing

Provide more homes for those who need them most

Current Commonwealth policies on GST and Rent Assistance create a structural disadvantage for state and territory governments who attempt to increase their public housing stock.

Current taxation and funding policy incentivises states and territories to transfer stock to community housing providers, despite no evidence-based rationale for such a significant change to the social housing system.

The structural disadvantage manifests in two main ways:

1. Public housing agencies are charged GST on all goods and services used to build, repair or maintain public housing, whilst non-profit community housing providers (CHPs) are "exempt" from GST.
2. Public housing providers cannot receive Rent Assistance to help cross-subsidise operating costs, whilst community housing tenants can. The ability of CHPs to get Rent Assistance from their tenants means that their rental revenue is higher than that of their public housing counterparts, even when the out-of-pocket costs for the tenants are the same.

These two policies, in combination, work to make the construction and operation of public housing more expensive than their community housing for state governments.

Additionally, recent research conducted for *Home Time* highlights how the interaction between social housing rents that are set based on income, and lower income support rates for younger tenants, means that community housing providers are, in essence, penalised for providing housing to vulnerable youth.[9] This is why other countries, such as New Zealand, have specific social housing subsidies that are better suited to enabling social housing investment.[10]

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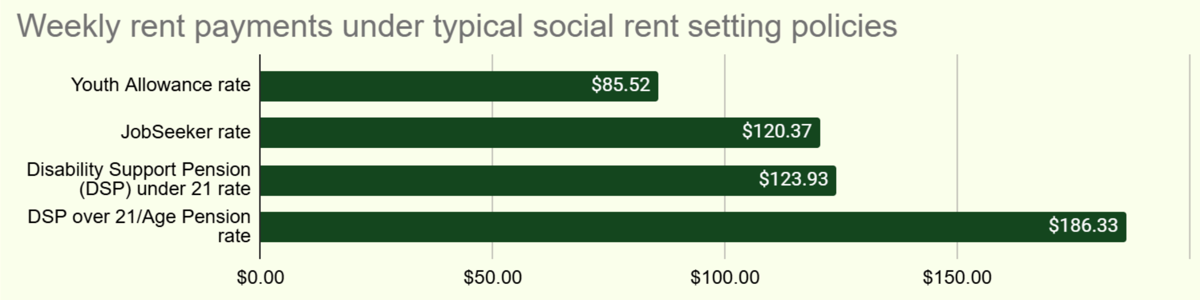
[9] Nouwelant, Aminpour & Martin (2025) 'Youth community housing: Rental gap and viability issues', City Futures Research Centre
[10] For instance, see the Income-related rent subsidy.



Young people receive the lowest levels of rental support from the Commonwealth.

Recommendations

A. Enable public housing agencies to claim GST credits.
B. Allow public housing agencies to receive Rent Assistance, as per existing arrangements that apply to community housing providers.
C. End the youth penalty for social housing providers by amending Rent Assistance criteria to base Rent Assistance payments on the market rents for social housing units rather than the rents paid by tenants.

THE BRICK BOOK

An election policy guide from Australia's leading coalition of pro-housing advocates.

Greater Canberra

YIMBY MELBOURNE

SYDNEY YIMBY

Greater Brisbane

AHNA

Friday, 1 November 2024

Strategic Planning
City Planning and Economic Development
Brisbane City Council
by email only: **strategic.planning@brisbane.qld.gov.au**

To whom it may concern:

Tailored amendment package — Car parking

Thank you for the invitation to provide feedback on the proposed amendment.

Greater Brisbane is a fully volunteer grassroots collective of people who love our city and want to work to make it a prosperous and dynamic place for everyone who lives, works or plays here.

We want a Brisbane where everyone is welcome and has the opportunity to live a good life wherever they want — and fixing our outdated approach to car parking in new developments is a key part of that.

Key points

- We support the proposal to expand both the City Core and City Frame boundaries to reduce parking requirements for new homes in our city.
- We note with concern that several inner city areas with frequent public transport options, local pedestrian and cycling links and nearby shops and schools are excluded from the expanded City Frame and recommend that the City Frame boundaries be expanded to include these areas.
- This change needs to be accompanied by both a significant boost in public and active transport and a commensurate draw-down or pricing-in of on-street parking within the City Frame.
- One immediate change to facilitate this would be to expand the Brisbane Central Traffic Area to the new City Frame boundary.
- To prepare our city for hosting the Olympics, Council should begin phasing out all on-street parking within the City Core, aiming for the precinct to be car-free by 2032.
- Greater Brisbane supports city-wide zoning reform that would remove parking minimums within 800 metres of a train or Busway station or a major bus interchange and 400 metres of BUZ and CityGlider stops.

Recommendations

1. Support the proposed amendment.
2. Expand the boundaries of the City Core precinct to include the area covered by the City West Neighbourhood Plan to facilitate greater uplift of the Victoria Barracks and Normanby renewal precincts.
3. Expand the boundaries of the City Frame precinct further to include high-frequency public transport corridors within five kilometres of Brisbane City Hall, as detailed on our map on page 4.
4. Amend car parking space standards in line with our schedule on page 7.
5. Tie the Brisbane Central Traffic Area to the City Frame boundaries.
6. Change parking limits within the Brisbane Central Traffic Area to increase the cost of resident permits, cap the number of resident permits per household, and remove the time restriction on the signed two-hour limit.
7. Introduce a Council mission to remove on-street parking for non-commercial vehicles within the City Core, along key active transport corridors and around Games precincts by 2032.
8. Begin a draw-down of 2,000 parking spaces per year within the City Frame.

One of the key reasons we started Greater Brisbane last year was to raise awareness of the damage parking minimums inflict on our city.

Greater Brisbane wants a future where our streets are for people, not cars.

Car parks, whether in apartments, on the street, or anywhere else, come at the expense of better public and active transport, street trees, and more productive uses like more curbside dining or shopping.

Research and evidence from around the world clearly show the prohibitive costs of mandated parking—it drives up the cost of dwellings, reduces the amount of housing that can be built, and devalues the streetscape.

Our car-centric planning even makes our housing more unaffordable, with a single car park adding up to $100,000 to an apartment's cost[1].

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[1] Andrew Messenger, "Brisbane city council plans to cut parking requirements in bid to slash $100,000 from housing costs" (16 May 2024) *Guardian Australia*

In fact, some estimates put the figure as high as $250,000 per space in expensive basement parking[2] — and even more conservative estimates put the cost at 10% of the final sale for mid-rise apartments[3].

Excessive parking might be popular with financiers, but the research is clear that it's hardly necessary for the people who live there. A wide range of research shows that parking requirements generally overestimate actual parking needs[4]. 40% of Australian households in the 2021 Census owned one or no cars, even though many parking mandates require multiple spaces per home, including these City Frame requirements.

In well-located areas with good amenity, public and active transport connections and that are within close proximity to universities, hospitals or central business districts, many parking spaces simply aren't needed. One in four residential parking spaces in inner Melbourne are consistently vacant[5].

Parking minimums are a huge handbrake on building affordable family-sized apartments. One of the things we hear time and again from industry who build beautiful medium-density flats in Melbourne and Sydney is that minimum parking requirements kill most medium-density projects.

You can't make a six-storey apartment stack up in inner city Brisbane — and until we rip these minimums away in more places, we never will.

Broad removals of parking minimums will change the calculus for building three- and four-bedroom apartments in our city, making our inner city more diverse and family-friendly.

This shouldn't just be for a few select inner city neighbourhoods either.

Many locations around the city are already well-provisioned with different transport options—train, metro, bus, bike, and walking—and are ripe for this kind of reform. The broader we can make these changes, the easier it will be to build and enable a more diverse housing market.

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[2] Harri Bancroft and Gabriel Metcalf for the Committee for Sydney, *Better Parking for Better Places* (August 2022); Chris De Gruyter, Paula Hooper, and Sarah Foster, "Do Apartment Residents Have Enough Car Parking? An Empirical Assessment of Car Parking Adequacy in Australian Cities" in *Journal of Transport Geography* (February 2023)

[3] NSW Productivity and Equality Commission, *Review of housing supply challenges and policy options for New South Wales* (final report, August 2024)

[4] Donald Shoup, "The Pseudoscience of Parking Requirements" in *Zoning Practice* (February 2022)

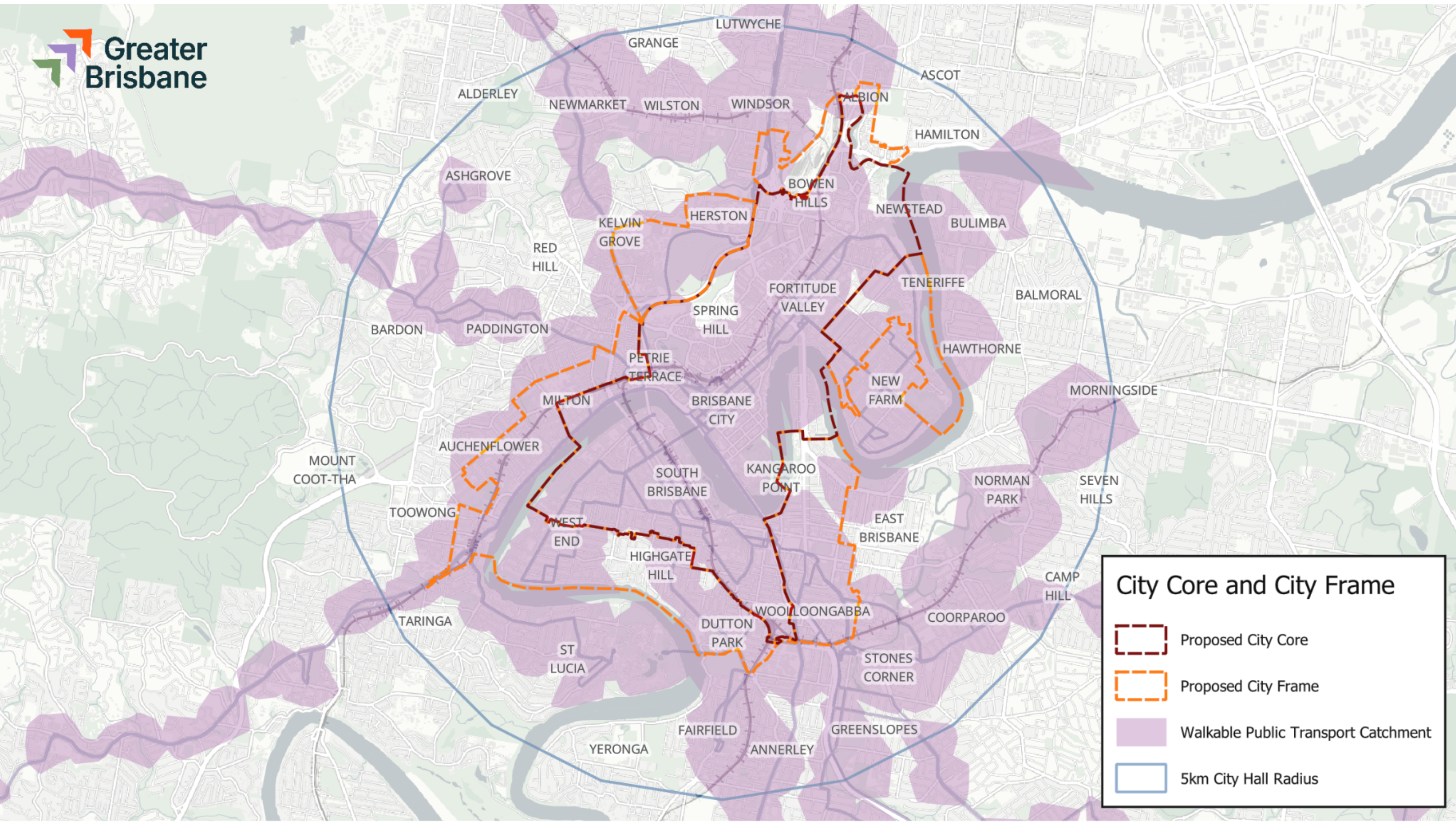
[5] Elizabeth Taylor and Rebecca Clements, "Empty car parks everywhere, but nowhere to park. How cities can do better." in *The Conversation* (20 July 2018)

According to Council's Vision 2031[6], every suburb is meant to have a diversity of housing options that actively facilitate people using public and active transport for the majority of their trips.

One of the best mechanisms we have available to achieve this is reducing parking minimums and greatly expanding the areas with parking maximums.

Expanding the City Core and Frame to more natural boundaries

It's for these reasons and many more that Greater Brisbane supports these proposals — and calls on Council to go further by expanding the City Frame to include everywhere within five kilometres of City Hall that's within 400 metres of a high frequency bus stop and 800 metres of a train or ferry station[7].



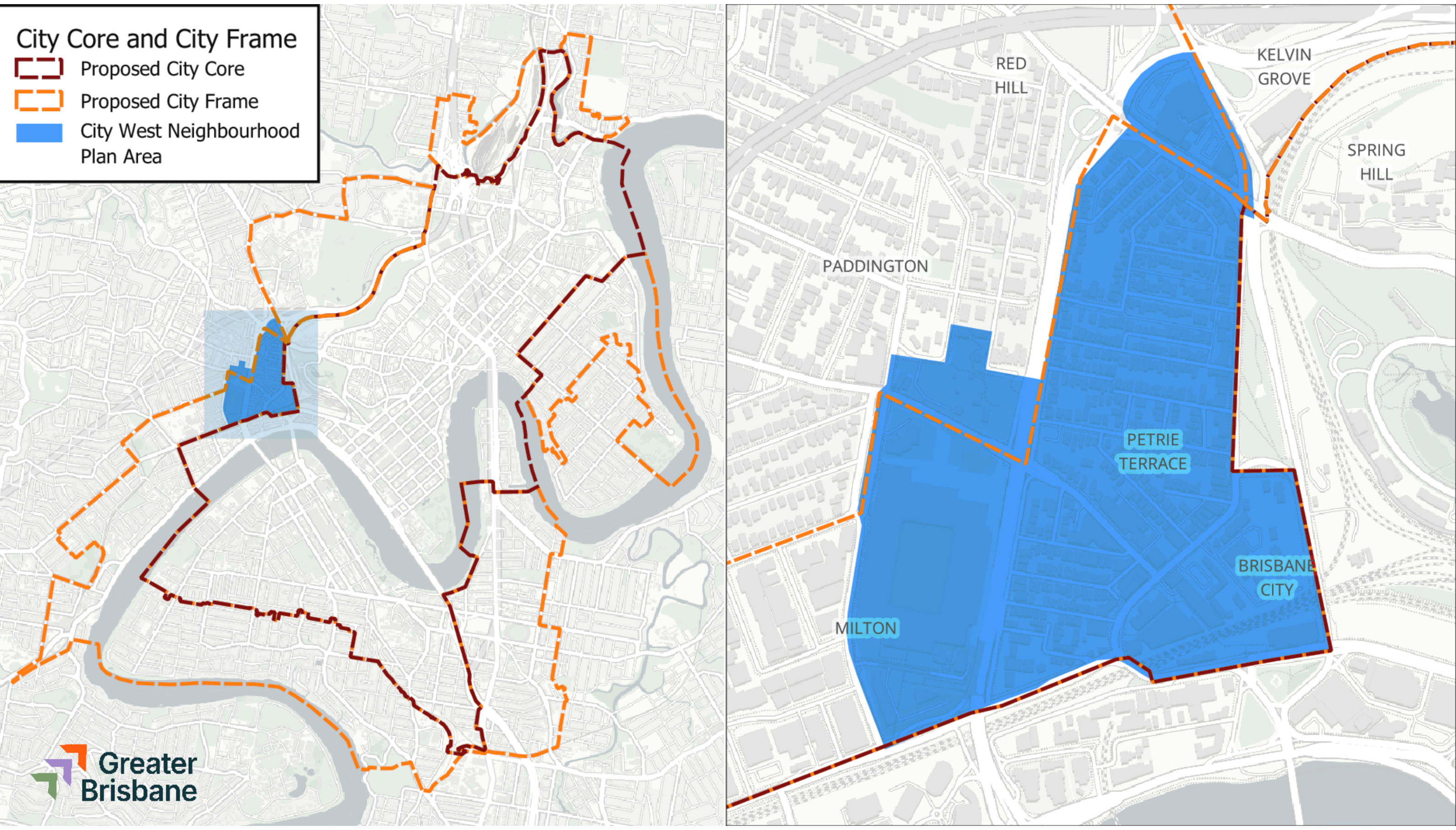
[6] Brisbane City Council, *Brisbane's Vision 2031*, page 36

[7] 400 metres for buses and 800 metres for trains or ferries are widely considered to be the walkable catchment for these services and have been adopted by the Department of Transport and Main Roads. However local geography — particularly hills and barriers — influences the actual catchments. Our map uses indicative isochrones for five and ten minutes walk respectively to represent the real application of these catchments. For guidance on comparing theoretical and actual walkable catchments, refer to the Department's Planning for Walking resource hub.

We note that the City Plan already has parking minimums for non-dwelling properties within 400 metres (walking distance) of a major public transport interchange, so this change would simply extend those restrictions to multiple dwelling developments as well.

While these moves to greatly expand the coverage of city suburbs with reduced parking minimums are a welcome step, Greater Brisbane thinks we can afford to be far more ambitious—particularly as we try to prepare our city for the Olympic and Paralympic Games.

Greater Brisbane wanted to draw the Council's attention to the exclusion of the City West Neighbourhood Plan area from the proposed expansion of the City Core. Despite its proximity to the CBD, the existing City West Neighbourhood Plan does not have reduced parking minimums.



In our view, this area—with many high-frequency public transport options, very active local shops, and easy pedestrian access to the CBD and Suncorp Stadium—should be included.

This is especially important to help facilitate uplift at the Victoria Barracks and Normanby renewal precincts and to justify greater interconnectedness between the precincts and Roma Street Parklands and the future Brisbane Arena site.

These changes combined with loosening of character protections and closure of Secombe Street, Petrie Terrace has the potential to be transformed into a world-class walkable neighbourhood, home to thousands.

Tweaking parking rates

To accompany these changes to boundaries, we want to encourage Council to tweak further the car parking space standards that apply to these boundaries[8].

The current schedule has reduced parking minimums within the City Frame boundaries and within 400 metres walking distance of a major public transport interchange[9].

We propose replacing the existing minimums within the City Frame with maximums — albeit at a higher rate than those in the City Core.

This is in addition to our previous recommendation that areas within five kilometres of City Hall that are within 400 metres of a high-frequency bus stop and 800 metres of a train or ferry station be included in the City Frame boundary. This applies to areas within 400 metres of a major public transport interchange further than 5 kilometres from Brisbane's City Hall.

Further, we are proposing aligning the minimums for multiple dwellings and rooming accommodation and reducing the commercial minimums.

In the same way that building more roads leads to higher traffic volumes, it is now recognised that building more parking leads to higher rates of car ownership. New parking supply does not ease the pressure of parking demand, it creates more demand.

Given the proximity of frequent public transport options and local shops, schools and amenities to everywhere within the new City Frame boundaries, adopting parking maximums in these precincts means a gradual draw-down on private vehicles in a much larger area and a higher uptake of mode switching.

Our schedule of changes can be found in a table on the next page.

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[8] Brisbane City Council Planning Scheme, "Section 6: Car parking space standards" in *SC6.31 Transport, access, parking and servicing planning scheme policy*

[9] Defined in this case as *"a railway station, bus station, ferry terminal or interchange which includes dedicated platforms, docks, bus parking bays, seating and ticketing facilities"*

	City Core	City Frame	Within 400 metres of a major public transport interchange
Multiple dwellings or rooming accommodation	Maximum 0.5 space per bedroom (up to 2 spaces maximum) Maximum of 1 visitor space for every 20 dwelling units	Minimum 0.9 spaces per 1 bedroom unit Minimum 1.1 spaces per 2 bedroom unit Minimum 1.3 spaces per 3 or above bedroom unit Minimum 0.15 spaces per unit for visitors	*For multiple dwellings*: Minimum of 1 space per 1 bedroom unit Minimum of 2 spaces per 2/3 bedroom unit Minimum of 2.5 spaces per 4 bedroom unit Minimum 0.25 spaces per unit for visitors *For rooming*: same as City Frame.
Our changes	None	Maximum of 0.75 spaces per bedroom (up to 3 spaces maximum) Maximum of 1 visitor space for every 10 units	Minimum 0.9 spaces per 1 bedroom unit Minimum 1.1 spaces per 2 bedroom unit Minimum 1.3 spaces per 3 or above bedrooms Minimum 0.15 spaces per unit for visitors
Short term accommodation	Maximum 0.25 spaces per room	Minimum 0.5 spaces per room	Minimum 0.25 spaces per room 1 staff space for every 20 rooms
Our changes	None	Minimum 0.25 spaces per room	None
Commercial and other	Maximum 1 space per $200m^2$ gross floor area	Maximum 1 space per $100m^2$ gross floor area	Maximum 5 spaces per $100m^2$ GFA at-grade, plus maximum 2 spaces per $100m^2$ GFA on other levels

Brisbane Central Traffic Area

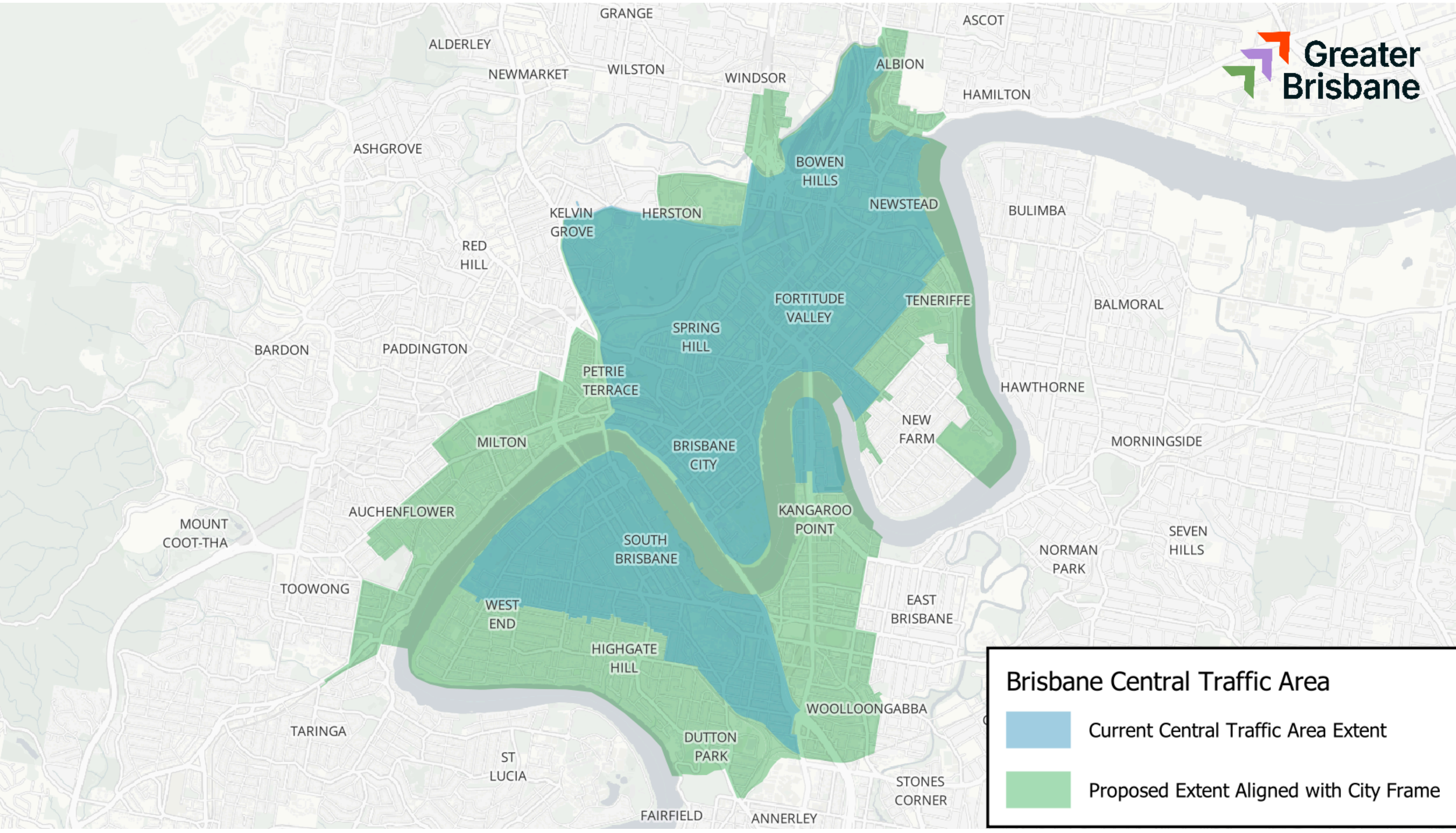
We should take advantage of these changes to off-street parking to make commensurate changes to on-street parking. While it isn't a perfect one-to-one match, the Brisbane Central Traffic Area roughly follows the contours of the existing City Frame boundaries.

The Brisbane Central Traffic Area imposes a two-hour parking limit on all on-street parking spaces within the Brisbane Central Traffic Area between 7am-6pm, Monday to Friday, and 7am to midday on Saturday unless signed otherwise.

It subsequently requires residents to apply for a parking permit to use on-street parking during these hours.

A very modest change would be to tie the Brisbane Central Traffic Area explicitly to the boundaries of the City Frame so that when one is changed, so does the other.

We also believe it would be appropriate to increase the cost of the residents parking permit by making the annual fee into a monthly fee, increase the maximum household charge to $250 per year, cap households at a maximum of two residents permits, and extend the parking limit period to 24 hours a day, 7 days a week.



More fundamental changes to the City Plan

Greater Brisbane has been advocating for significant changes to the City Plan to reduce the number of residential zones and neighbourhood plans — and introduce three much simpler and more permissive zones based on proximity to public transport.

Our plan, modelled on YIMBY Melbourne's groundbreaking *Melbourne's Missing Middle* report[10], is still being developed by our volunteer team and broadening the application of parking reform across the city features heavily.

Brisbane's focus on "spot upzoning" post-industrial land has left the vast majority of our inner city's most well-located neighbourhoods the domain of only those who can afford a detached "character home". Islands of exclusivity emerge if you map permissible building heights between the patchwork of neighbourhood plans, priority development areas, zones and other instruments like we have here near the Gabba[11].

[10] Jonathan O'Brien et al, *Melbourne's Missing Middle* (9 October 2023)

[11] Greater Brisbane, *Submission to Economic Development Queensland on the Woolloongabba Plan* (17 July 2024)

This patchwork serves no one but planning consultants. It restricts development in our inner city for little reason or social benefit while making understanding our city's planning intractable and incomprehensible to the vast majority of its residents.

To fix this problem with arbitrary lines on a map determining the shape of our city and who gets to live in our most well-located neighbourhoods, Greater Brisbane will work over the coming years to abolish Low-Density, low-to-medium-density, and Medium-Density zones in the next City Plan review.

We will also advocate for reviewing all existing character overlays to ensure only private residences with genuine historical, architectural, and social heritage values are protected, setting a new flexible foundation for zoning in our city.

To replace these overly restrictive character restrictions and residential zones, Greater Brisbane has sketched out three new baseline zones, all allowing some form of mixed-use by right.

Our ***Urban Centre Zone*** would effectively apply the existing City Centre Zone to all residential, centre, and mixed-use zoned land within the City Core and any residential, centre, and mixed-use zoned land where heights greater than seven storeys are currently permitted within five kilometres of the Central Business District or 800 metres of a train, ferry, or Busway station.

This zone recognises that street-level activation is extremely important to high-growth areas. It also attempts to integrate three disconnected but overlapping concepts in our City Plan—the City Centre Zone, the City Core, and the Brisbane Central Traffic Area—into a coherent set of boundaries.

Our ***Urban Residential Zone*** would apply to all residential, district centre, and mixed use zoned land within 800 metres of a train or Busway station or a major bus interchange and 400 metres of BUZ and CityGlider stops across Brisbane. It would also apply to specialist centres and industrial land identified as underutilised or needing housing growth within the same catchment, for example future renewal neighbourhoods in Geebung and Coopers Plains. This would not replace neighbourhood centres or any community, open space, conservation or sport and recreation zoned land.

This new zone would allow any predominantly residential development up to seven storeys, regardless of the lot size. Any other low-impact use — ranging across retail and hospitality, offices, education, health, temporary accommodation or even some light industry — would be permitted. Precinct-scale projects would have to reserve at least 50% of the floor space for residential uses. Car parking minimums would be removed within this zone.

Our ***Suburban Residential Zone*** would apply to all other residential land outside the Urban Residential Zone catchment, as well as underutilised industrial and district centre land. However, it would not apply to neighbourhood centres or any community, open space, conservation, or sport and recreation zoned land.

This new zone would allow any residential developments up to four storeys — including detached homes, townhouses and low-rise apartments. Current car parking minimums would be retained in these areas as we would like to see a move away from on-street parking to free up suburban streets for play, planting and active transport.

This zone would also include a *corner store* rule, allowing neighbourhood hospitality, health and retail businesses to operate on any appropriately large or corner lot[12].

While liberalising small-scale commercial uses in residential areas will have building, noise, and traffic implications, Greater Brisbane believes these should be assessed under a more streamlined business permitting scheme than the existing planning regime.

Any home within these zones that should be protected on character grounds should be required to reach the higher threshold for local heritage listing rather than receive special protection merely for being built in a particular place.

Under our plan, Brisbane City Council would undertake an audit over three years to translate these blanket overlays into stronger, targeted protections.

Phased removal of on-street parking

These modest changes are, in our view, an important first step in a more fundamental shift that needs to happen to our city before the Brisbane Olympic and Paralympic Games in 2032 — removing on-street parking in our inner city entirely.

In the lead-up to this year's Games, Paris removed 70,000 on-street parking spaces within their city boundaries. That's nearly 80% of all parking in the city.

The Paris municipal government had an ambitious agenda to boost public transport ridership by 10% and proactively encourage "hyperproximity" — the majority of residents being able to access their daily needs within a short walk of their home — through zoning and regulatory changes and substantial direct investment.

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[12] For a discussion in an American context, see: Linda Baker, "The Corner Store Comeback" in *Bloomberg* (3 October 2024) and Ashley Salvador, "Want more local businesses in your neighborhood? Then legalize Accessory Commercial Units." in *Strong Towns* (17 August 2020)

One key mechanism they used to achieve this was the removal of on-street parking and significant increases to parking rates in the remaining spaces—particularly for large sports utility vehicles, which have special differential rates related to their size and weight.

Their changes paid off, with 1,000 kilometres of new bike lanes in place of car spaces leading to a 1,000% increase in cycling, 200,000 new street trees dramatically cooling the city and the long-standing "car free Sundays" that closed major roads in Paris now permanently converting those roads into parks[13].

Even the surrounding departments of Greater Paris were inspired by Paris' changes and undertook similar revitalisation projects in their jurisdictions.

These changes took a long time. While many of the most dramatic changes like the parking spaces removal and the restoration of the riverbank only implemented since 2020, the administration has been laying the groundwork with trials, experiments and pilot precincts for over a decade.

If we are to have even a fraction of Paris' ambition, we need to start making changes now.

Greater Brisbane is calling on Brisbane City to commit to the total removal of on-street parking for non-commercial vehicles within the City Core, along key active transport corridors and around Games precincts by 2032 — and a phased draw-down of 2,000 parking spaces each year between now and then.

An early component of this is a mapping exercise to calculate the number of at-grade car parking spaces within Brisbane City Council. This exercise can break down the number of on-street parking spaces and the area of off-street at-grade parking including access and navigation lanes, broken down by suburb.

Without knowing how much of our city is handed over to cars and where, it's impossible to determine the opportunity cost.

Yours sincerely

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[13] Rowan Moore, "How the Paris 2024 Summer Olympics are driving the city's green revolution" in *The Observer* (31 December 2023)

Wednesday, 7 August 2024

Danielle Wood
Chair, Productivity Commission
by email to communications@pc.gov.au

Dear Ms Wood and Commissioners

Inquiry into barriers to homebuilding

We are writing to you today regarding your forthcoming inquiry on constraints on homebuilding in Australia.

As Australia's largest grassroots urbanism network, the Abundant Housing Network Australia is invested in the success of this Government's ambitions to deliver more housing supply in desirable, high amenity areas.

We wanted to congratulate the Commission on undertaking this bold and much needed inquiry.

Barriers to innovation — especially in forming the kind of viable mid-sized firms capable of delivering our missing middle at scale — has been a key concern of the Network since we started.

While there's an abundance of evidence in favour of our motivating goal — broadly upzoning our cities and liberalising urban planning — our work has identified a few topics that have been under-researched in an Australian context.

Many of the necessary solutions to Australia's housing crisis require significantly more government investment and intervention. We recognise however that the Commission's unique strength is in thoroughly and critically dissecting regulatory barriers that distort functional markets.

With that in mind, we have three priority areas we believe would benefit from a Productivity Commission deep dive: zoning and planning rules as a barrier to housing construction, heritage and character restrictions as a barrier to building in well-located areas, and barriers to the recruitment of skilled migrants in construction trades.

Australia's incoherent urban planning regulations

We understand that the Productivity Commission has previously interrogated the impact that built environment regulation — in particular, overly restrictive and often incoherent zoning imposed by local governments — has on the delivery of housing, particularly in delivering housing cheaply and quickly.

Most Australian cities face multiple layers of zoning and neighbourhood plans alongside highly convoluted, expensive, slow and often politicised planning approval processes split between both local and state governments. These systems are intractable and incoherent for anyone aiming to build homes or even residents aiming to understand how their neighbourhoods are set to change over time.

The cumulative impact of the planning system on housing costs, emissions, labour markets, commute times and the urban fabric of our cities is still not well understood, including by the various professions responsible for operating different aspects of the system.

Politicians of all stripes seek to take advantage of this incoherence, while a preponderance of discretionary rules and tribunals overly receptive to clearly vexatious cases to further delay, redesign or block developments, at great expense to the end purchaser.

Despite the clear evidence both locally and abroad, influential figures in our media continue to peddle supply skepticism and treat the role of urban planning in housing affordability and delivery as a kind of intellectual lacuna.

A Commission deep-dive that analyses the breadth of urban planning restrictions across Australia's capitals, the scope for political discretion in those regulations and the local and international experiences of reducing those regulatory burdens would be extremely useful — especially in rebutting the clearly bad-faith supply skeptics in Australia's media and politics.

We would especially like to point out the Auckland experience and the work that Matthew Maltman and Stu Donovan have both done in translating that experience to an Australian context.

We also believe that it's important to situate those regulations in their historical context and acknowledge that the reasons they were introduced may no longer be relevant or the trade-offs involved have tipped the scales in another direction. Regulatory lag and how quickly market conditions change relative to how quickly democratic or bureaucratic institutions are capable of responding to those conditions is well canvassed.

But additionally, we need to acknowledge that many of those restrictions were hard fought for and many for ostensibly good reasons — to protect vulnerable people, historic buildings or support community welfare and health.

Whether community expectations have changed, the trade-offs have shifted or still well-intentioned regulations have been co-opted by bad faith anti-housing actors is at the heart of any interrogation of our urban planning systems.

These regulations are not *prima facie* our enemy nor does good urban planning necessarily act as a handbrake on housing growth.

But Australia's highly discretionary, highly politicised and highly localised urban planning regulations are in no one's interests but a handful of consultants and politicians vested in make-work and delaying housing growth.

Australia’s outdated urban heritage regulations

Australia’s national framework for urban heritage regulation last had a root-and-branch review in 1998 while the last Productivity Commission inquiry into the topic concluded in 2006 with many of its recommendations on privately-owned heritage places still unaddressed by state and local governments.

This inquiry focused on the role that individual listings have on the conservation of heritage places and impacts on broader economic activity, but the preponderance of heritage restrictions 30 years later are weaker but much more broadly applied heritage and character regulation over whole neighbourhoods, often arbitrarily.

Heritage restrictions have a huge impact on housing renewal. Local heritage listings, heritage overlays and housing character restrictions are overwhelmingly located in high-demand inner city areas and are applied by bad faith anti-housing actors, whether local councillors or community reference groups, in an often arbitrary manner to block intensification and renewal.

These restrictions and the arcane processes that lead to listings and overlays being applied have spawned a small cottage industry of heritage consultants whose interest is primarily in their own proliferation and the creation of more work for themselves.

This mercenary attitude to our shared heritage by councils, consultants and conservative residents undermines the values on which heritage regulation is ostensibly built.

These systems are arbitrary, highly corruptible and impose a high cost on people seeking to develop homes in our inner cities — and the trade-off is more inner city neighbourhoods become run-down, poorly insulated rentals that look nice from the street but have a huge health toll on the residents, or expensive renovations for owner-occupiers that destroy any of the heritage values of the home anyway.

Facing both a housing and climate crisis, with our inner city neighbourhoods having an imperative to intensify and build modern, energy efficient homes resilient in the face of heatwaves and floods, we cannot afford to have our inner cities locked down for the exclusive use of a handful of increasingly wealthy homeowners buying heritage protected properties explicitly to minimise the risk they will have to live near poorer neighbours.

A Commission deep-dive on the role that heritage and character restrictions on private residential properties, particularly blanket restrictions like overlays, have on housing affordability, approvals and construction delays and climate adaptation will start to unwind the extremely one-sided public discourse about urban heritage.

Skilled migration in the construction trades

Construction trades and adjacent professions have been granted special carve-outs from our liberalised migration system. This has created an unbalanced immigration program which has created unnecessary pressure on housing and infrastructure.

To ensure strong growth in housing supply, we should be recruiting skilled construction industry workers and professionals from overseas in the same targeted way we recruit doctors and teachers.

Master Builders Australia estimate we need half a million more construction industry workers in the next three years to meet our housing and infrastructure ambitions. The Planning Institute of Australia has recently highlighted the planning skills shortage, identifying more than 500 short-staffed local councils across Australia. A significant proportion of these jobs are highly skilled and high income.

Meanwhile, migration skills assessment processes remain slow, expensive and inconsistently applied even in the construction trades — and a huge proportion of Australia's construction workforce being independent contractors rather than employees throws a further spanner in the works of someone trying to emigrate here to build homes.

A Commission deep-dive into migration pathways and the impact that special carve-outs for building and construction trades have from skilled migration would help build a body of evidence to reform our migration systems.

Other questions

We also wanted to share some questions we have identified over the last year as useful routes of research into housing and urban policy.

We want to underline just how many outstanding questions there are about Australia's housing market that go under-researched – or even where excellent work at a state level does not get replicated nationally.

Australia's think-tank ecosystem is finally turning its head towards the housing crisis and the Commonwealth is recognising the policy deficit itself has cultivated but there is still a decade of work to catch up on.

We understand many of these questions are out of scope or out of expertise for the Commission but we wanted to share regardless with hope that if this research strays into these areas, these could be integrated.

- What are the regulatory and financial barriers to mid-sized firms in building, construction and property development such as those critical to the delivery of innovative, medium density homes elsewhere in the world?

- What government interventions could facilitate more mid-sized firm creation and derisk innovative housing projects?
- How can infrastructure funding models be changed to improve the speed, efficiency and risk of housing construction?
- What public financing vehicles could be put in place to facilitate a much greater market share for not-for-profit building, construction and property development firms like Nightingale?
- How do we better make explicit to homebuyers the implicit subsidies on greenfield development and build those costs into the buyers' purchase price rather than be borne by the broader population?
- What regulatory changes could better make renters feel secure and safe in their home with longer tenure and more predictability around rents? How do we make long term renting more appealing to the broader population?
- What are the cultural barriers to long-term renting and what government interventions could overcome those barriers?
- How do we address information asymmetry in the housing market — especially for renters seeking to understand a home's condition, accessibility, energy ratings, history of disputes or poor behaviour by providers and agents, and expected tenure and rent rises?
- What are the gaps in policy-making and research expertise in the Australian public service and what governance models would support greater Commonwealth coordination in homebuilding?
- What are the impacts on the building, construction and property development sector of sudden changes in machinery of government — for example, an incoming government abolishing urban development agencies or departmental urban policy clusters? Does deregulation or governments vacating from a policy space cause less certainty in the market?

We look forward to working with the Commission to formulate workable policy solutions to our housing supply crisis and get on with the job of delivering the fastest housing growth possible in places where people want to live.

Yours sincerely

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Article

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Character contradiction: The exclusionary nature of preservationist planning restrictions

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Abstract
Preservationist planning broadly describes planning instruments that purport to preserve physical qualities of neighbourhoods by preventing demolition of historic dwellings. Here, we analyse land use conversion of almost 6000 lots in Brisbane, Australia, to understand if, and how, preservationist planning impacts the built environment. Results demonstrate that preservationist planning suppresses multi-family housing construction, even where increased density is encouraged by the planning scheme. We suggest that preservationist planning is exclusionary in nature and not solely focused on built heritage, particularly as substantial modifications to existing dwellings are allowed. These findings run counter to the purported aim of built heritage protection and suggest that the preservationist planning framework should be revised.

Keywords
Brisbane, built heritage, character zone, densification, exclusionary zoning

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摘要
保护主义规划泛指旨在通过防止拆毁历史性住宅来保护街区物理特性的规划手段。本文分析了澳大利亚布里斯班近 6000 块土地的用途转换，以了解保护主义规划是否以及如何影响建成环境。结果表明，即使在规划方案鼓励增加密度的情况下，保护主义规划也会抑制多户住宅的建设。我们认为，保护主义规划具有排他性，并不只关注建成遗产，尤其是其允许对现有住宅进行重大改造。这些研究结果与所谓的保护建成遗产的目标是相左的，我们建议对保护主义规划框架进行修订。

关键词
布里斯班、建成遗产、特色区、密集化、排他性分区

Received January 2023; accepted July 2023

Introduction

The debate regarding how best to preserve the heritage of the built environment vis-à-vis the housing needs of an urban population remains central to many urban planning conversations (Glaeser, 2010). In most cases, an underlying tension exists between the priority of redevelopment, particularly at higher densities, and the rationale underpinning the conservation of historical building typologies. While the most ubiquitous tool for preservation is the designating of historic buildings, sites or neighbourhoods, a variety of planning tools also serve preservation aims (Avrami, 2016; Redaelli, 2021). Conservation overlays or zonings are widespread in the United States, Australia and New Zealand, and purport to '. . . protect "neighbourhood character"' (Lemar, 2015: 1525). This unique form of heritage protection, employed by planning authorities, differs from heritage listing by accommodating alteration to existing buildings, often subject to development approval by a local authority.

Preservation of older buildings tends to prevent redevelopment of existing low-density structures and ensures that new construction is of a similar scale (Avrami, 2016). This creates conflict between preserving historical low-density residential areas and allowing their redevelopment at higher density. Neighbourhoods targeted for increases to residential density are often in proximity to the central city, public transport infrastructure and high amenity areas such as waterfronts. These are often established neighbourhoods with older housing stock, making them targets for both high density and built heritage protections (Avrami, 2016). While architecture is prominent in decisions for or against built heritage protection, consideration of planning, socioeconomic factors, and the impact to property rights, are also highly influential in the decision-making process (Mualam and Alterman, 2020).

Many cities around the world currently face a 'housing crisis' (cf. Pawson, 2022 for Australia; Badger and Washington, 2022 for the United States) due at least in part to a failure to construct enough housing to keep pace with population growth and household formation. Cities with growth management or urban consolidation polices are often required to source most new dwellings from existing urban areas (e.g. greyfield and brownfield sites), known as infill development. These policies are implemented with intentions to prevent habitat destruction and loss of urban fabric tied to 'greenfield' development on the urban fringe. While historic preservation is extensively discussed in the planning and property economics literature, due to its ability to influence property prices, there is limited analysis on the built form implications of conservation overlays or zoning (Been et al., 2016; Glaeser, 2010; Tan and Ti, 2020). Most research focuses on the ability of conservation policies to prevent redevelopment (cf. Kovacs et al., 2008 in Canada; Tan and Ti, 2020 in Singapore; Neilsen and Pojani, 2020 in Australia). There is little analysis of the compatibility of historic preservation and densification goals, and whether preservation zoning regimes can respond to changing urban dynamics and housing preferences.

The conflict between densification of existing urban areas and the preservation of historic housing typologies is further compounded by the exclusionary nature of zoning more generally (cf. Grey, 2022), which preserves low-density residential areas (Longstreth, 2011), at times without a 'character' or 'heritage' designation in place. The term exclusionary zoning features largely in American literature (Taylor, 2013) and refers to any form of land use zoning that prevents low to middle income households from finding housing in a neighbourhood (Whittemore, 2021). While land use zoning cannot explicitly dictate who can live in a certain area, it can be an effective means of social segregation by increasing the cost of building or maintaining housing. There is a large body of literature on the intersection between historic preservation and gentrification (Allison, 2005; Bures, 2001; Jones and Varley, 1999). For example, while historic preservation in New York City contributed to the economic revitalisation of designated neighbourhoods, it did displace lower income residents (McCabe and Ellen, 2016). There is, however, a significant research gap in understanding whether preservation policies can simultaneously facilitate infill development.

This research aims to understand whether the practical outcome of preservationist planning results in built heritage preservation, and whether redevelopment can both conserve historic housing and increase residential density. We make a unique contribution to the literature by analysing land use transitions of almost 6000 houses from 1951 to 2021. We question whether preservationist planning is necessary to preserve built heritage. To answer this question, we focus on the city of Brisbane, a state capital city at the centre of one of Australia's fastest growing metropolitan areas. In addition to a legacy of low-rise housing and extensive preservationist planning that prevents the removal of historic houses (but allows modifications), Brisbane has significant pressure on housing supply, and state-sanctioned growth management policies that require almost all new dwellings to be sourced through infill development. This provides a unique opportunity to analyse how both preservation and infill policies influence redevelopment patterns.

Background

Built heritage is defined as any building or group of buildings that 'offer significant values and benefits such as the conservation of the history and narration of a city's existence' (Aigwi et al., 2021: 45). The protection of built heritage is a social process where buildings, monuments, structures, and areas are deemed to be of heritage value (Negussie, 2007). While some argue that conservation of built heritage effectively places public interest above private interest by seeking to protect the built environment for the common good (Phelps et al., 2002) and that heritage protection is an important tool to 'slow the pace of change' (Ashworth, 1997: 99), others claim that conservation policies artificially inflate dwelling costs, and prevent the construction of affordable housing, to the benefit of owners (Been et al., 2016). Defining what constitutes built heritage involves a complex group of stakeholders who compete to determine the future of a city (Short, 2007). Advocates for conservation argue that market-driven development is unable to protect built heritage, whereas critics argue that those advocating for conservation policies are another lobby group opposing change (Been et al., 2016).

Built heritage is generally protected through regulatory mechanisms, either legislative or policy, which seek to prevent inappropriate development or demolition (Short, 2007). Built heritage can broadly be conserved in two ways, through heritage listing, and through conservation or preservation strategies employed by planning authorities (Negussie, 2007). While both can be defined by legislation, and arguably contribute to local culture by linking current residents with the past (Tan and Ti, 2020), conservation strategies related to heritage listings of individual monuments or buildings do not generally support alterations to the original building (Tweed and Sutherland, 2007). In contrast, conservation strategies employed by planning authorities 'often epitomise a unique population density, historic nature, street pattern or other urban morphological or cultural feature' (Tweed and Sutherland, 2007: 63). These conservation strategies are described with varying terminology, ranging from historic, preservation or conservation districts or zoning, design overlay, demolition control precincts and many more (Avrami, 2016). For the purpose of this article, we describe any land use planning instrument that seeks to preserve a historic built form as 'preservationist planning'. Preservationist planning can stipulate allowable building uses, heights and profiles, and requirements for the building façade, roof, colour, and interior finishes (Kovacs et al., 2008; Tan and Ti, 2020). In most contexts, properties are graded on a point-scale, with the highest value being assigned to those of significant cultural value that cannot be altered without detailed plans, while the lowest value requires only the preservation of façades and other cosmetic elements.

Using zoning to influence new housing typology. Zoning has also long regulated the bulk and scale of buildings through maximum heights, setback requirements, lot coverage and floor to area ratios (Lemar, 2015). However, the suburban development that characterised the post-war period saw cities following a general trend of reducing flexibility in housing construction, with secondary dwellings ('granny flats'), duplexes and corner stores gradually prohibited in suburban estates (Grey, 2022). Preservationist planning instruments go beyond regulating land use and size by dictating aesthetic standards such as building materials, siting, and roof lines (Lemar, 2015). In jurisdictions with growth management, infill development is the primary source of new dwelling construction, often by local governments upzoning specific properties to allow developers to construct more dwellings on the same site than was previously allowed. It is viewed as a policy tool to increase housing supply and decrease dwelling prices (Rodríguez-Pose and Storper, 2020). Upzoning is, however, contentious as it has the potential to alter existing housing typologies in a neighbourhood. To this end, proposals to increase residential density are often met with community resistance, despite urban planning trends from the 1980s attempting to re-think car-orientated design in favour of mixed land uses, transit-oriented development and higher density living (Raynor et al., 2017). As a result, while upzoning is used in some neighbourhoods to allow change to existing housing stock, low-density zones, including those aimed at built heritage conservation, are also used to prevent change or exclude housing typologies such as apartments.

Contemporary zoning cannot be uncoupled from its discriminatory history (Raitt, 2022), with social segregation being a major motivator for their introduction and subsistence (Whittemore, 2021). It has long been argued that land use regulations are a mechanism of preserving affluent areas, as 'minimum lot sizes and setback requirements ensure that only members of acceptable social classes could settle' (Jackson, 1985: 242). Exclusionary zoning tools are not the same in every jurisdiction (Whittemore, 2021) and examples include planning regulations that restrict the construction of multi-family dwellings such as apartments and townhouses by preventing their development altogether or imposing requirements around minimum lot sizes, car parking, setbacks and street frontages that make such developments unfeasible (Ihlanfeldt, 2004). By preventing the emergence of different housing typologies, low density residential zonings exclude residents that cannot afford the price of a house in the suburb. These regulations reduce the presence of rental properties (Pendall, 2000), with higher income neighbourhoods most likely to adopt restrictive land use zoning (Ihlanfeldt, 2004).

There is a large body of research that demonstrates how low-density residential zones have been used to ensure racial and economic homogeneity by restricting dwelling supply and elevating housing costs (Grey, 2022). Preservation of low-density residential areas through restrictive zoning practices bars many people from living in high opportunity and high amenity locations and ensures that opportunity is not evenly distributed across a metropolitan area, disproportionately impacting minority and low-income families (Manville et al., 2020). Research from Los Angeles shows that properties that were rezoned for higher density development were generally in areas with less political resistance (or influence) and areas with high political resistance were more likely to retain a low-density residential zone (Gabbe, 2017). Similarly, wealthier areas in Melbourne have higher levels of planning disputes and a greater number of objections to new development (Taylor, 2013). The conflict between densification goals and the preservation of historic housing typology makes planning decisions highly political. There is little investigation in the literature of the exclusionary nature of planning schemes with the purported aim of preserving historic housing typology (cf. Lemar, 2015; Taylor, 2013).

Preserving urban character in an Australian context. How neighbourhood character is defined and conserved varies depending on the jurisdiction. In Australia, character homes are generally those constructed prior to World War Two when the national population was less than one-third of what it is today. Often located within 5–10 kilometres of the centre of Australia's major cities, the former streetcar and railway suburbs were previously targeted for urban renewal, and pre-war housing considered slum-like and demolished. However, in the 1980s and 1990s these areas became highly sought after and property prices rose exponentially (Badcock, 2001; Pegler et al., 2020).

Queensland has a hybrid planning system where development compliant with the requirements of the relevant planning scheme must be approved. Discretion is also given to decision-makers to approve development that is not compliant with the relevant planning scheme zone code, but these applications must be publicly advertised, with properly made submissions providing the ability for community members to appeal the granting of a development approval, and decision-makers can consider any 'relevant matter' when assessing the application (Planning Act 2016 [Qld], s 45). Zoning remains a primary tool to guide development patterns and is used to both prevent removal of character housing and to facilitate infill development. The purpose of the 'Character Residential' zone is to 'ensure the character of a residential area is protected or enhanced' (Planning Regulation 2017 [Qld], schedule 2). It is largely left to the discretion of local governments to determine what constitutes neighbourhood character. In the capital city of Brisbane, ‘character’ homes are those constructed prior to 1947 and identified in the Character Residential Zone in Brisbane’s planning scheme (Brisbane City Council [BCC], 2021). The styles of character homes vary but they are generally detached single-family houses, colloquially referred to as ‘tin and timber’ or ‘Queenslanders’ (Neilsen and Pojani, 2020).

Brisbane homeowners use zoning to prevent densification of their neighbourhoods (Nielson and Pojani, 2020). A study of residents living in character houses in Brisbane shows conservation planning can be understood as protecting the local identity of a neighbourhood, but also as a ‘manifestation of political and economic power’ (Neilsen and Pojani, 2020: 1058). In addition to purchase price, the maintenance cost of character houses can be large, with some residents associating maintenance costs with economic status and extensive renovation signifying greater financial power (Nielson and Pojani, 2020). There are some differences in how planning systems work in practice, and the discretion given to decision makers, but this study is applicable to any city that employs preservation through its planning framework.

Study area, data and methods

Brisbane is a sprawling metropolis at the centre of Southeast Queensland, one of the fastest growing regions in Australia, with a population of over 3.6 million in 2021 (Australian Bureau of Statistics [ABS], 2022). Like many Anglo-American cities, urban growth in Brisbane has been characterised by low density and car-centric peripheral expansion. In the 1970s and 1980s Brisbane became known as the ‘demolition capital of Australia’, when numerous historic public buildings were demolished (cf. Herde, 2022). As a result, Brisbane’s architectural character exists largely within private housing stock (Lockwood, 1994). While Brisbane’s post-war planning instruments have allowed multi-family dwellings, the area of the city where they are allowed has generally decreased over time (Lockwood, 1994).

The introduction of protections for character houses in Brisbane. By the early 1990s Brisbane’s population had trebled from 502,000 in 1954 to over 1.4 million in 1991 (ABS, 2022). Momentum was also growing for the protection of houses constructed prior to World War II. A 1993 Brisbane City Council plan stated that the ‘impact on our residential suburbs includes removal or demolition of “Queenslanders”, erosion of the character of neighbourhoods by inappropriate new buildings and intrusion of non-residential uses into residential areas’ (BCC, 1993: 16). Amendments to the Brisbane Town Plan 1987 were introduced in 1995 where some neighbourhoods were declared demolition control precincts, requiring an advertised planning application to remove or demolish a character house (Sommerfield, 2003). Bipartisan changes were incrementally introduced between 2005 and 2008 to refine protections for houses built before 1947 from demolition or removal, which had previously only been protected if they were in groups of three, and to introduce a minimum lot size of 450 m^2 to prevent subdivision of lots containing character houses (Falvey, 2007; Griffith, 2005).

At the same time, new planning instruments shifted the balance to infill development as the major source of new dwelling supply. Infill development ranges from large-scale master-planned high-rise developments to ad hoc subdivision of backyards for additional house construction (Gallagher et al., 2020). A state planning instrument mandates that 94% of new dwellings in Brisbane are to be sourced from the existing urban area (Department of Infrastructure, Local Government and Planning, 2017). It is, however, the local government planning scheme that specifically outlines how and where new dwellings are to be constructed. Both the 2000 and 2014 iterations of the Brisbane City Council planning scheme focussed on higher density development and mixed uses around existing railway and busway stations, but also increased protections for character houses. The Brisbane City Plan 2014 simplified provisions to allow owners to shift character houses and subdivide the vacant side of the lot. However, pre-1947 houses could only be demolished if 'structurally unsound' (BCC, 2021, section 8.2.21).

In the current iteration of Brisbane's planning scheme, development in the Character Residential Zone 'provides for low density suburban and inner-city living though the development of predominately 1 or 2 storey dwelling houses comprising of existing houses built in 1946 or before and infill housing that incorporates any housing built in 1946 or before in the development' (BCC, 2021, section 6.2.1.5). These policies preserve buildings based on a threshold house age, rather than specific architectural traits or social histories. Planning requirements for modifications are generally limited to site density, building height, number of storeys, setback and the appearance of fences and garages (BCC, 2021, section 8.2.22). This was an intended policy outcome, with Brisbane City Council's then Deputy Mayor making clear that regulations on renovating character houses should be eased, but demolition controls tightened (Falvey, 2007). Under Brisbane's planning scheme, character houses can be lifted and built under, extensions can be added, and the house can be moved so that the lot can be subdivided. However, any additional dwellings must be located between or behind character houses and of a similar scale (BCC, 2021, section 6.2.1.5). This effectively limits new development to detached houses or, where the planning scheme allows, low-set townhouses and apartments (BCC, 2019). Multi-family dwellings, referred to as 'multiple dwellings' in Brisbane's planning scheme, must be no more than two storeys, with a maximum dwelling yield of one dwelling per 300 m^2 in the Character Residential (Infill) zone (BCC, 2021, section 6.2.1.5). Character Residential zones began in suburbs within four kilometres of the city centre (Lockwood, 1994) but now account for 12.3% of Brisbane's residential zoned land area. In comparison, the low-density residential zone contains most residential zoned land (73.2%), with the remaining 14.5% distributed into higher density zones.

Data selection and analysis. To analyse the implications of preservation policies on redevelopment, we selected five study areas containing houses built before 1947, in both Character Residential and other zones. Each study area is located within 10 kilometres of Brisbane's city centre. Three (South Brisbane, Woolloongabba and Newstead) are adjacent to the city centre and two (Nundah and Indooroopilly) were identified as major centres in the Brisbane Town Plan 1987 (Figure 1).

We first collected the 1951 land use survey maps covering the five selected study areas from the Brisbane City Council's Library Services (BCC, 1951). These maps were compiled around 1950–1951 to determine the land use zones in the Brisbane Town Plan. The original key to the colour codes used in these survey maps was lost but the codes can be deduced by historical knowledge and verified using 1946 aerial photos. These aerial photos were also used by Brisbane City Council to determine which houses should be retained as part of

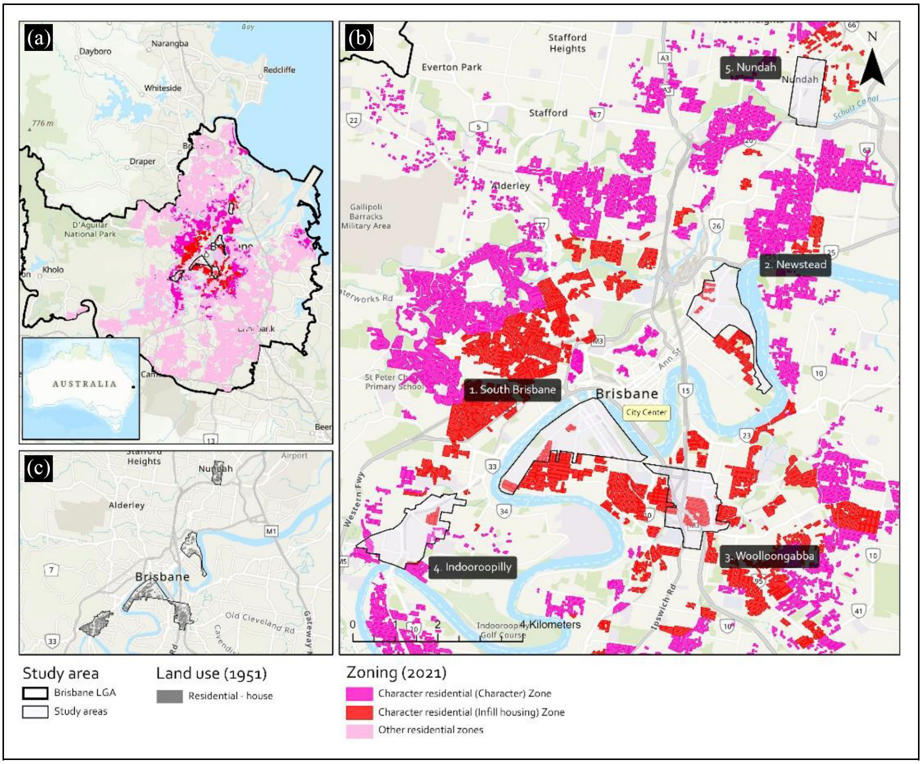

Figure 1. (a) Extent of the Character Residential zones compared to other residential zones in Brisbane in 2021. (b) Character Residential zones in the study areas in 2021. (3) Lots containing houses in 1951.

their planning scheme. Using the 2021 digital cadastral database (DCDB) obtained from the Queensland Government Spatial Data Portal (Queensland Government, 2021) as the base map, we georeferenced the 1951 survey maps for the selected areas to the DCDB and added the land use information to each land parcel. We then scanned, georeferenced and digitised Brisbane's 1952 proposed zones, which guided council development decisions prior to a formal planning scheme being gazetted in 1965, and the Brisbane Town Plan 1987, to obtain the land use and zoning data for these times and assigned these data to each lot using the 2021 DCDB as the base map (Figure 2).

The 1987 planning scheme had three residential zones, with the Residential B applying to much of the inner city and the only zone where apartment buildings were allowed. Height limits varied depending on location and minimum lot sizes. In contrast, the Residential A zone – the predominant residential zone across the city at the time – expressly prohibited apartment buildings.

We collected contemporary zoning data in Shapefile format from Brisbane City Council's planning scheme (2021). Residential zones include the Character Residential, Low Density (houses only), Low-Medium density (building of up two to three storeys in height, depending on location), Medium Density (up to five stories) or High Density Residential (up to eight or 15 stories, depending on location). Contemporary land use data was

Figure 2. Transformation of character houses in Study Area 3.

derived from the Queensland Land Use Mapping Program (2019). Land use types were standardised across the 1951 and 2021 datasets to use the same terminology to classify land uses. Across all time periods housing typologies were categorised as either a house, defined as a single-family, detached dwelling on a single lot, or multiple dwelling (apartment, townhouse and the like). Industry included manufacturing and warehousing, commercial services included offices and retail, and public services included schools and hospitals.

Using ArcGIS, we spatially joined the land use data in 1951 with zoning in 1952 and 1987 and land use and zoning in 2021. Through a series of queries in GIS based on the attribute features of each land parcel, we identified 5984 lots in the five selected study areas that contained a detached house (as per the property boundaries defined in the 2021 DCDB); their land use in 2021 and zoning in 1952, 1987 and 2021 were also recorded in the attribute table. This integrated dataset enables us to track the change (if any) of land use and zoning on each lot from 1951 to 2021. For example, a lot in South Brisbane was used as a residential dwelling (detached house) in 1951 but was zoned for industrial use in 1952. By 1987 this same lot was zoned for warehousing and, in 2021, the lot was zoned for high density residential use and contained an apartment building. Through this data we can track land use and zoning transitions for almost 6000 lots containing a house in 1951 and analyse how planning instruments influence redevelopment patterns.

Results

Our results provide insight into the implication of fluctuating urban policy trends, such as inner city, low density housing being earmarked for redevelopment in 1987 through the Residential B zone, and the introduction of character zoning in the 1990s, which protected remaining pre-1947 houses from removal (see Figure 1). Figure 3 provides a summary of the results, outlining changes to zoning (1952, 1987 and 2021) and land use (1951 and 2021) over time for the 5978 lots containing houses in 1951.

More flexible zoning prior to the 1980s facilitated the construction of apartments and other multiple dwellings. This was a policy change from the 1950s, where there was a clear intention of relocating residential dwellings away from inner city and riverfront areas and rezoning these houses to warehousing or industrial use. A focus on the redevelopment of inner-city areas occurred in the late 1980s and these properties were again rezoned but, in this instance, to mixed use or high density residential. By 2021, a large number of lots were used for commercial services (20.2%) or multiple dwellings (46.7%), with 28.6% of total lots containing a detached house. Using the Character Residential zones as an indication of where pre-1947 houses were retained, 1221 lots (20.4%) contained a character house protected from removal (Figure 3). While it cannot be assumed that all pre-1947 houses will be in Character Residential zones, this figure indicates that approximately four out of five pre-1947 houses were removed over the 70-year period. The introduction of character zoning in the early 1990s not only encouraged the retention of remaining character houses but also facilitated the construction of additional detached houses, as only a small number of multiple dwellings were constructed on these lots despite the zone allowing infill development.

Apartment zonings facilitate multiple dwelling construction

Our results show that in 1987, 3479 out of 5978 (58.2%) of the total lots were zoned as Residential B in 1987, which allowed for

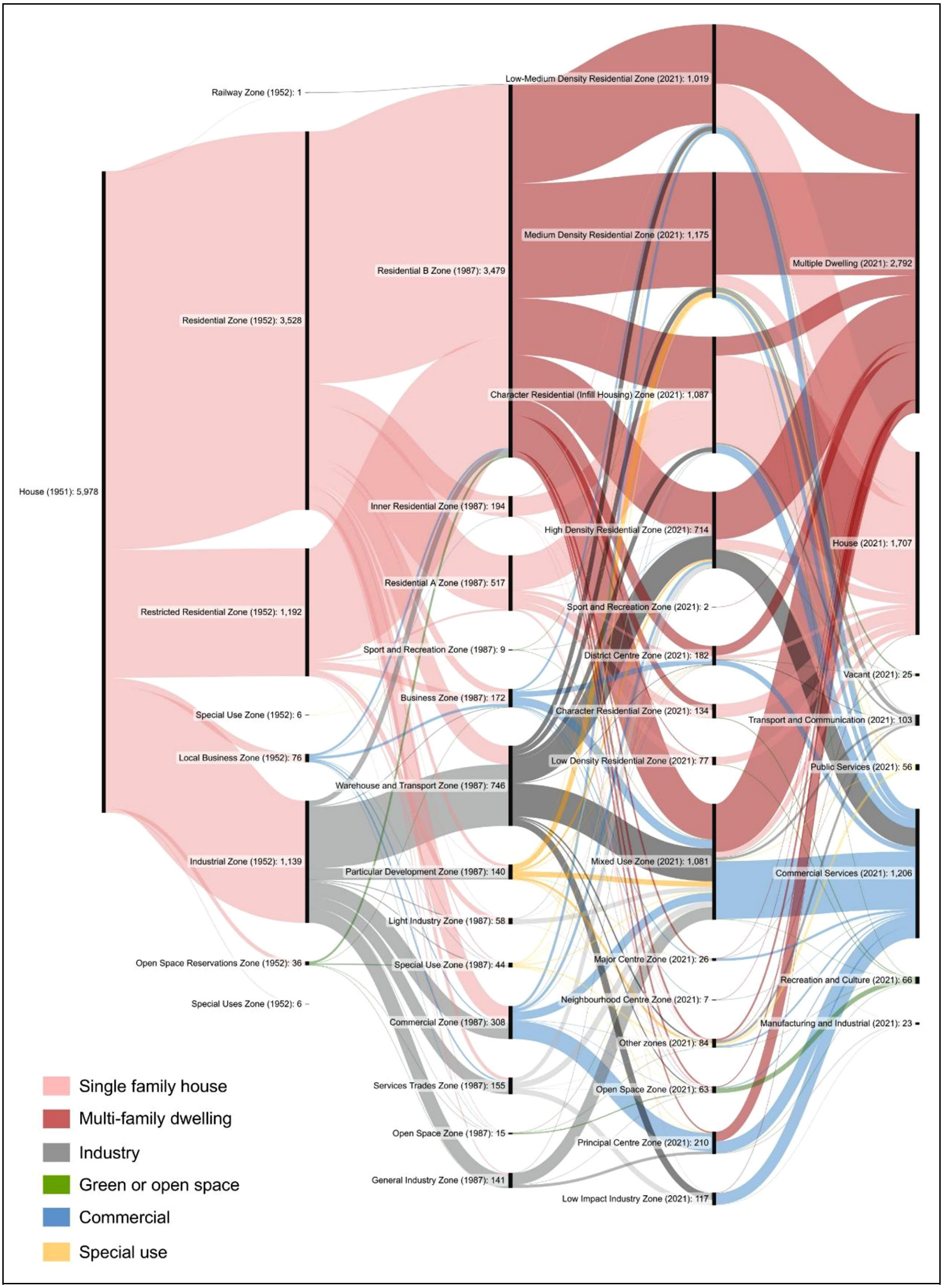

Figure 3. The process of land use and zoning changes of 5978 lots containing detached houses in 1951, showing the rezoning of 3479 lots for apartment building construction (Residential B) in 1987, and 2792 lots containing apartments, townhouses, or other multi-family dwellings in 2021, and 1707 lots containing houses in 2021. Attributes for each lot includes (1) land use in 1951, (2) land use zoning in 1952, (3) land use zoning in 1987, (4) land use in 2021 and (5) land use zoning in 2021.

higher density residential development such as apartment buildings (Figure 3). This zone did not contain requirements for retention of pre-1947 housing. The majority of lots containing a multiple dwelling in 2021 were in the Residential B zone in 1987 (73.9% of the 2792 lots containing a multiple dwelling in 2021). A number of lots (584 or 16.8% of lots zoned as Residential B in 1987) were dezoned between 1987 and 2021, by having their allowable densities reduced through the requirement to retain a pre-1947 house. This indicates that a number of character houses remained in the study areas despite being zoned for apartment building construction until the early 1990s. There were 695 lots that contained houses in 2021 despite being in a zone that allowed multi-family housing. Allowable densities on these lots ranged from rowhouses to 15-story apartment buildings (Figure 3). This figure means that 40.7% of existing detached houses are not subject to retention requirements and could, in theory, be replaced with higher density housing. In fact, 302 lots containing houses could be redeveloped into apartment building of four stories or more, accounting for 12.9% of all lots in these higher density zones.

Small lot sizes prevent upzoning and redevelopment

The mean lot size in 1951 for the 5978 lots studied was 714.7 m^2. For lots that were upzoned to Residential B (apartments allowed) in 1987, the mean lot size was 759.9 m^2, compared to lots zoned as Residential A (houses only) which had a mean lot size of 568.5 m^2. The mean size of lots in a zone allowing for apartments of five storeys or more in 2021 was 945.8 m^2, compared to a mean of 690.7 m^2 for lots in a Character Residential zone. Across all zones, the mean lot size (in 1951) of a house that was preserved between 1951 and 2021 was 575.1 m^2, whereas the mean lot size (in 1951) of a house that was converted into a multiple dwelling by 2021 was 880.9 m^2.

Limited infill development in character residential zones. Of the 1707 lots that contained a detached house in 2021, following changes to heritage protection in the 1990s and 2000s, the majority (1221 lots or 55.0% of all lots containing houses in 2021) were in a zone that required retention of any house constructed before 1947 (Figure 3). Put simply, a two-bedroom, character house can be renovated and extended to become a house with five bedrooms, a two-car garage and two living rooms, but cannot be demolished. See Figure 3 for renovations in practice. The majority of these houses (1804 lots or 63.5% of all lots containing houses in 2021) had previously been zoned as Residential B in 1987 (allowing for apartment construction), indicating that a large number were dezoned between 1987 and 2021. We found that 177 out of 1087 lots (14.5%) in a Character Residential zone, allowing for additional dwelling construction, contained a multiple dwelling.

Discussion

Our results demonstrate that changes to urban policy have a definitive impact on the built environment by facilitating both redevelopment at higher densities and preservation of houses. Just 1.0% of lots that allow for medium to high-rise development still contain houses, whereas lots in a Character Residential zone had limited uptake in the opportunity to add extra dwellings, despite infill development being allowed. Given that the degree of modification to character houses allowed under the existing planning scheme (cf. BCC 2021, sections 6.2.1.5 and 8.2.22), that the default position is protection from demolition or removal based on the age of the structure rather than specific architectural traits (cf. BCC 2021 section 8.2.21) and that the policy does not apply to all character houses in the city but to select areas based on neighbourhood zoning (see Figure 1), there are clearly exclusionary implications to this policy (Lemar, 2015).

Preservationist planning prevents housing diversity

Our results demonstrate that preservationist planning, in this instance, is synonymous with maintaining low residential density. One of the guiding principles for Brisbane City Council's planning strategy is to 'protect the Brisbane backyard and our unique character', which includes using planning instruments to prevent townhouse and apartment construction 'in areas for single homes', ensure minimum setbacks on property boundaries, and to seek 'greater enforcement powers. . . to protect Brisbane's character and values' (BCC, 2022). These principles were created following a survey of Brisbane residents. Where infill development in the form of multi-family housing is allowed, the planning scheme requires a maximum of one dwelling per 300 m^2 of site area (BCC, 2021, section 6.2.1.5). Our results show that even areas targeted for densification through infill development, character house retention requirements, combined with minimum lot sizes and maximum dwelling yields, preclude housing diversity. Where additional dwelling construction occurs, it is generally in the form of backyards being subdivided for additional house construction (cf. Gallagher et al., 2020).

Low levels of redevelopment imply that the existing use value of the character house is higher than the development value of adding new dwellings. The construction of new dwellings will not occur if the densities allowed are too low to make development economically feasible (Phillips, 2020). Research consistently finds that minimum lot sizes compel developers to build houses on lots larger than what the market would otherwise support (Gottlieb et al., 2012; Grey and Further, 2019), thereby increasing the cost of housing (Zabel and Dalton, 2011), exacerbating social segregation by adversely impacting would-be new residents and contributing to urban sprawl (Boudreaux, 2016). As the outcome of Brisbane's planning requirements to retain character houses suppress multi-family housing, we posit that the unstated aim of these planning instruments is exclusion (cf. Nally, 2022).

Small lot sizes protect character houses

Despite the assumed impacts of zoning, owners ultimately have agency in how land use changes (or does not change) (Acolin and Vitiello, 2018). Zoning does not decide whether construction will occur. Fundamentally, in a market-based economy, zone-based regulations determine what is allowed to be constructed and private actors, policy decisions (e.g. interest rates, subsidies to homeowners), and exogenous forces (e.g. migration, foreign investment) will determine if new structures are built. Due to preservation policies as well as minimum lot sizes, minimum car parking and setback requirements, new development in existing residential areas is largely limited to the construction of an additional detached house, which is often far below market-determined levels (Chakraborty et al., 2010). Our results indicate that character houses on larger lots were historically more likely to be rezoned for higher density, and, conversely, that lot size is a crucial factor in the conversion of pre-1947 housing.

Many of the lots containing multi-family housing in 2021 were in the Residential B zone in 1987. This zone allowed for walk-up apartment building construction, including the 'six-pack' apartment (see Figure 2). This housing typology has been historically highly stigmatised but is often of a similar size and bulk to contemporary Australian houses (CommSec, 2020). Where they still exist, these apartments provide affordable housing in some of Australia's most expensive suburbs (McGreevy, 2018). Previous research of one Brisbane inner city suburb in 1994 found that take-up of the Residential B zone was as low as 9.5%, meaning that most property owners chose to retain the original house despite the absence of character house retention requirements (Lockwood, 1994). This is supported by our research which shows that 695 landholders opted to retain a house on the lot, despite Character Residential zones not applying and zoning allowing a higher density use. Our results indicate that in the absence of Character Residential zones, many pre-1947 houses are likely to be retained by their owners. As such, widespread preservation requirements may not be required to conserve built heritage and could potentially be limited to areas of historical significance. The question therefore becomes whether the perceived benefits of conserving character areas, where the built environment is unable to transform, denser development is prohibited and the 'leafy green suburbs' are maintained (Fernandez and Martin, 2020: 3241), justify exclusionary zoning practices (Andersson et al., 2019; Koster and Rouwendal, 2017).

Preservationist planning is a form of exclusionary zoning. The imposition of zoning can be viewed as a contract between a landholder and the state, with landholders restricted in their ability to develop a property but benefitting from constraints imposed on neighbours (Sheehan and Kelly, 2015). The allocation of specific uses, such as low density residential, occurs at a point in time and informs current and future landholders of whether a proposed use is permissible (Sheehan and Kelly, 2015). Issues arise when knowledge of future needs changes, requiring changes to applicable zoning such as increases to density. Nelson (1979) argues that zoning represents the evolution of a collective property right, with the practical effect being the transfer of key rights from the individual to the municipality. Zoning provides residents with the right to collectively decide what new uses are permitted and that 'in the absence of zoning, more desirable neighbourhoods would lack protection from and would be occupied by less affluent individuals living in higher density facilities' (Nelson, 1979: 719). In fact, zoning in the post-war period has evolved to create a framework where owners have significant power to restrict growth and change (Glaeser, 2011), reflecting the inherent conservatism of existing residents (Glaeser, 2011). Glaeser (2011) states that there are two powerful psychological biases behind this perceived need to protect neighbourhoods from redevelopment or change, the first referred to as 'status quo bias' where a person has a 'strong attachment to the current state of affairs' and the second, where people 'significantly over-estimate the impact that a negative shock will have on their happiness' (p. 262).

There is a balance to be struck between redevelopment and preservation, particularly as more flexible zoning leads to greater housing diversity. In Brisbane, residents have called to extend Character Residential zoning to suburbs where Brisbane City Council proposed increases to residential density (cf. Nally, 2022), but residents in the same neighbourhood oppose heritage listing of their houses due to the restrictions on modifications (cf. Formica, 2023). Most residential land in Brisbane is zoned for single family houses (but not character housing) and these neighbourhoods are car-centric and lack mass transit. In comparison, inner city neighbourhoods with character housing are well-serviced by railway and busway stations, as well as significant commercial precincts. A study of Adelaide, Australia saw that wealthy inner suburbs that did not have exclusionary zoning until the 1980s had a greater diversity of housing typologies (and therefore more affordable housing) when compared to less expensive suburbs with homogenous, low-density housing due to the path dependant legacy of restricting multiple dwelling construction (McGreevy, 2018). This is evidenced in our study areas, which, due to the legacy of the Residential B zone, contain walk-up apartments and townhouses constructed in this period. Despite infill development provisions allowing for the construction of townhouses and walk-up apartments in some character areas, previous research shows that subdivision of lots for the construction of additional detached houses was the most common form of densification in Brisbane's inner-city suburbs (Gallagher et al., 2020). This is supported by our research which shows a limited uptake of opportunity to increase the diversity of housing typologies in these neighbourhoods.

Decisions to terminate preservation requirements can be taken to increase housing density and improve affordability (Fernandez and Martin, 2020). In adopting a new planning scheme in 2016, Auckland (New Zealand) terminated the preservation requirements of 30% of previously protected areas. Properties in New Zealand's character protection zones have controls on the demolition or alteration of existing buildings, and the design and appearance of new buildings, with most dwellings limited to use as a detached house. The main impetus of this decision was to improve housing affordability through greater housing diversity (Fernandez and Martin, 2020). While the removal of character protections zones did increase price premiums for upzoned lots, Fernandez and Martin (2020) concluded that this was due to land eventually being directed to its most valuable state, which includes redevelopment at higher densities. Nevertheless, reform of existing zoning, especially in cities with high housing demand, can also drive gentrification and fail to produce housing for low- and moderate-income earners if efforts to ensure affordable housing provisions are not supported (Chakraborty, 2020).

Conclusion

Preservationist planning imposed through planning instruments aims to conserve the historical value of individual dwellings, and neighbourhoods. In the case of Brisbane, Character Residential zones restrict the development of multi-family housing and, without these preservationist policies, many character houses are nonetheless preserved on smaller lots. We argue that policymakers should be cautious of extending preservationist policies across a local government area, without due diligence paid to the expected versus intended outcomes and impacts. There is an argument that preservation should be a targeted policy affecting properties with specific architectural or social history traits, especially if the underlying impetus of conservation is not to limit housing diversity.

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The preservation of historic districts—is it worth it?

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Abstract

I investigate the welfare effect of conservation areas that preserve historic districts by regulating development. Such regulation may improve the quality of life but does so by reducing housing productivity—that is, the efficiency with which inputs (land and non-land) are converted into housing services. Using a unique panel dataset for English cities and an instrumental variable approach, I find that conservation areas lead to higher house prices for given land values and building costs (lower housing productivity) and higher house prices for given wages (higher quality of life). The overall welfare impact is found to be negative.

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1. Introduction

Conservation areas (CAs) protect historic neighbourhoods by placing restrictions on the aesthetic quality of new development.[1] CAs are particularly widespread in England with more than 9600 designations since the legislation came into effect in 1967. Inside a CA, any new development is required to preserve or enhance the existing character of the neighbourhood. Similar policies exist in different forms internationally, for example, as local historic districts in the USA or as *Ensembleschutz* in Germany. By regulating the subjective quality of new buildings, CAs may reduce the productivity of the housing sector. Historic neighbourhoods are no doubt an important urban amenity; however, their preservation may hinder cities in affordably housing their current and future populations.

I estimate the welfare effect of CAs by assembling a unique panel dataset for English cities. The dataset comprises 11 years of CA designations over 1997–2007, as well as house prices, land values, construction costs and other city characteristics. I construct my dataset at the city-level to capture the full costs and benefits of the policy at the level of the housing market. Specifically, I use the Housing Market Area (HMA) definition of urban areas.[2]

1 CAs protect groups of buildings within certain boundaries. Single buildings are usually protected by different legislation, e.g. 'listed buildings' status in England.

2 HMAs are defined to capture individual housing markets, based on evidence from patterns of commuting, migration and house prices (DCLG, 2010). As such, they are characterised by a high level of self-containment—77.5% of working residents of an HMA have their workplace inside the HMA—and typically approximate recognisable city regions.

I estimate a net welfare effect composed of quality of life effects (benefits) and housing productivity effects (costs). The quality of life effect is derived from the amenity value that households place on the historic built environment in their city and its conservation. A city-level analysis captures benefits at the neighbourhood level—since residents are more likely to live inside or near a CA if they are widespread in a city—and at the city-level i.e. the value that residents place on the amount of preservation in their urban area as a whole.

The costs of conservation are modelled as a housing productivity effect i.e. the effectiveness with which land and non-land inputs are converted into housing services. Underlying this is the assumption that productivity, and not quantity, is the major channel for the supply-side effects of designation.[3] Indeed, the purpose of CAs is not to prevent development but to ensure that new buildings preserve the character of a neighbourhood. Such aesthetic restrictions may lower housing productivity in several ways. First, developers wishing to build inside CAs must navigate an extra layer of regulation. Secondly, the planned buildings must meet certain standards, which may not be the most cost-effective way of providing housing services. Thirdly, the extra costs of developing inside CAs may push development out to less favourable sites in a city. For these reasons, cities with lots of CAs will be less productive in the housing sector than other cities. Developers will be able to produce fewer units of housing services for given amounts of land and non-land inputs resulting in higher housing costs. A city-level analysis is required to capture productivity effects that determine prices at the level of the housing market.

There is a growing body of literature on the economic effects of CAs. The majority of this literature has focussed on estimating the quality of life effects of CAs by examining property prices. A distinction commonly made in the literature (e.g. by Coulson and Leichenko, 2001) is between (negative) internal effects related to restrictions to property rights and (positive) external effects related to the conservation of neighbourhood character. Quasi-experimental evidence has shown that the overall effect of designating CAs is to increase property prices, which suggests that the positive effects dominate (Koster et al., 2014; Ahlfeldt et al., 2017).[4] Furthermore, Koster et al. (2014) find that households with higher incomes have a higher willingness to pay for living inside CAs in the Netherlands. Ahlfeldt et al. (2017) find that the pattern of house price effects in England is consistent with a situation where local planners designate CAs according to the interests of local owners. If local owners who benefit from designation are indeed able to game the planning system to their advantage then it important to know what the effects of designation on housing costs are at the wider market level.

There is a current lack of evidence on the supply-side effects of CAs. The only evidence to date is presented by Been et al. (2016), who show that construction is slightly lower inside historic districts in New York City. However, they do not examine quantity effects at the city level or supply-related effects on housing costs. The evidence from other forms of regulation suggests that the costs of development restrictions are significant.[5] For example, Hilber and Vermeulen (2016) find that house prices in

3 I provide some empirical support for this assumption by showing that CA designations do not impact negatively on dwelling stock in England over 2001–2010.

4 Other studies that examine the impact of CAs on property prices include Asabere et al. (1989); Asabere and Huffman (1994); Asabere et al. (1994); Coulson and Lahr (2005); Leichenko et al. (2001); Noonan (2007); Noonan and Krupka (2011); Schaeffer and Millerick (1991).

5 See Gyourko and Molloy (2015) for a good overview of the evidence.

England would be 35% lower if planning constraints were removed. The available evidence finds that the quality of life benefits associated with planning are smaller than the costs. Glaeser et al. (2005) examine building height restrictions in Manhattan, a policy that is intended to prevent towering developments that block the light and view available to existing structures. They find that the development restrictions led to large increases in house prices that left residents worse off, even after accounting for the policy benefits. This 'regulatory tax' finding is repeated in other studies such as Albouy and Ehrlich (2012) and Turner et al. (2014), both for regulatory constraints in the USA, and Cheshire and Sheppard (2002) for land use planning in Reading, England.[6]

In this article, I investigate the extent to which CAs explain differences in housing productivity across cities and whether there are associated quality of life improvements that compensate. As such, I provide an estimate of the net welfare effect of CAs for the average (owner occupier) household. Evaluation of the welfare effects of CAs in cities is challenging since both quality of life (via demand) and housing productivity (via supply) result in increased house prices. To disentangle these effects, I make use of Albouy and Ehrlich's (2012) two-step approach. In the first step, I estimate a cost function regressing house prices on input prices (land and non-land) and city characteristics that may shift productivity. Housing productivity is defined as the amount of physical housing that can be produced for given quantities of inputs. The key assumption behind this step is perfect competition. If designation makes building more costly then house prices will be higher for given input prices to maintain zero profits. I find that the average increase in CA designation share at the HMA level over 1997–2007 decreases housing productivity by 4.3%, implying a cost-driven increase in house prices of the same magnitude. In the second step, I construct an expenditure-equivalent quality of life index based on house prices and wages and regress it on the same productivity shifters, including designation. The key assumption here is of household mobility. Spatial equilibrium implies that if designation improves quality of life in a city then house prices must be higher for given wage levels. I find that designation increases quality of life, but not by enough to compensate for the greater expenditure on housing resulting from lower productivity. The results imply that designations in England over 1997–2007 were welfare-decreasing for an average owner-occupier household in these cities.

While I make use of the Albouy and Ehrlich (2012) approach, my key contribution is different. I focus on estimating the welfare effect of a particular form of regulation, CAs, rather than of housing regulation in general. CAs are a particularly fitting application for the approach since they are expected to impact on housing productivity less than quantity, specifically. Moreover, focussing on a particular form of regulation allows me to identify a causal impact by employing an instrumental variables approach. Finally, my article distinguishes itself by focussing on England rather than the USA, and by constructing a panel dataset that allows me to control for fixed unobservables.

My identification strategy involves an instrumental variables approach. The instrument for designation is a shift-share of the Bartik type (Bartik, 1991). The closest previous approach is Koster and Rouwendal (2017) who use national-level changes in spending on cultural heritage weighted by the local share of listed dwellings as an instrument for local investment in historic amenities. My instrument uses changes in the national-level

6 Further studies find that planning policies have damaging effects on the retail sector (Cheshire and Hilber, 2008; Cheshire et al., 2011).

designation shares for the dwelling stock of particular build periods weighted by the HMA shares of dwellings in those build periods. The national level changes in designation are assumed to reflect changes in the subjective evaluation of the dwelling stock of particular build periods. As such, the instrument is a fairly novel application of the shift-share approach. The identifying assumption is that the instrument is unrelated to unobserved shocks to housing productivity or quality of life, conditional on pre-trends in house prices, trends related to the initial value of the instrument (capturing the initial stock) and trends related to other city characteristics. I support the validity of this assumption by showing that the instrument is not related to gentrification.

The key contribution of this article is to estimate both the supply-side costs and demand-side benefits of CAs; evidence that is currently missing from the growing body of literature on the policy. This article also contributes to a literature that investigates the costs and benefits of regulation and planning more generally. I present some of the first causal estimates of the welfare effects of a form of housing regulation. To my knowledge, the only previous paper to examine both the costs and benefits of housing regulation using exogenous policy variation is Turner et al. (2014). I also contribute to a literature on the value of locational amenities, by estimating the quality of life effect of a regulation policy instrumented at the city level.[7]

Furthermore, my results contribute to the literature on housing production functions by estimating what is, to my knowledge, one of the first housing production functions for the UK. I follow Albouy and Ehrlich (2012) who take the traditional approach of regressing house prices on input prices (e.g. McDonald, 1981; Thorsnes, 1997). A more recent literature attempts to estimate the production function, treating housing as a latent variable (Epple et al., 2010; Ahlfeldt and McMillen, 2014; Combes et al., 2016). According to Combes et al. (2016), the two major challenges with estimating any type of housing production function are data availability and disentangling housing quantity from its price. Data availability is a challenge since the approach usually requires data on both house prices and land values. As discussed, I construct a unique panel dataset of cities that includes house prices and some previously unused data for land values and constructions costs for England. The land value data, depicted in Figure 1 for 2007 play a key role in the production function step and in estimating the productivity impact of designation.

The second challenge is disentangling housing quantity from its price, which is difficult due to unobservable property characteristics that impact on price. Having collected a panel dataset, I am able to estimate the cost function using fixed effects, which helps to overcome the problem of unobserved property characteristics. My preferred estimates of the land cost share (0.29) and the elasticity of substitution between land and non-land inputs (0.53) fall within the range in the literature.[8]

The outline of the rest of the article is as follows. In Section 2, I lay out the theoretical model which demonstrates the potential effects of CAs on quality of life and housing productivity. In Section 3, I go over the data used in empirical analysis. In Section 4, I outline the two-step empirical approach and the identification strategy. In Section 5 I present the results. Section 6 concludes.

7 The amenities literature is large, but a few examples are Albouy (2016); Bayer et al. (2007); Brueckner et al. (1999); Chay and Greenstone (2005); Cheshire and Sheppard (1995); Gibbons et al. (2011); Glaeser et al. (2001); Moeller (2018).

8 For example, Albouy and Ehrlich (2012) find a land cost share of about one third and an elasticity of substitution of 0.5 for the USA.

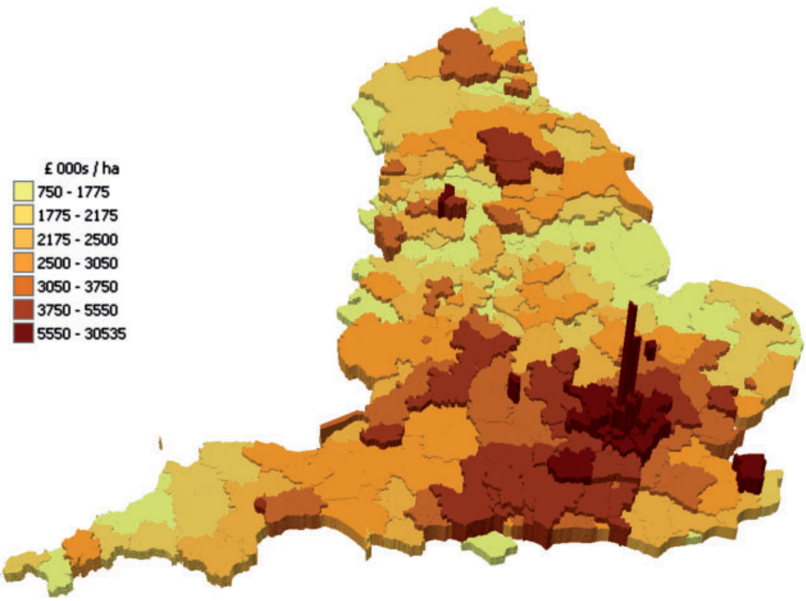

Figure 1. Residential land values by local authority, 2007.
Notes: Valuation Office Agency data. Assessed residential land value for small sites with outline planning permission. Areas are extruded proportionally with land value.

2. Model

In this section, I describe how CA designation impacts on housing productivity and quality of life in a general equilibrium context. I use the model of Albouy and Ehrlich (2012), which is an intercity spatial equilibrium framework based on work by Roback (1982) and Albouy (2016). Each city j is small relative to the national economy and produces a traded good X and housing Y that is non-traded. The city-specific price of a standard housing unit is p_j and the uniform price of the traded good is equal to the numeraire. Households with homogeneous preferences work in either the Y-sector or the X-sector and consume both housing and the traded good. The model involves two important assumptions; that of perfect competition, which gives the zero profit conditions, and that of labour mobility, which gives the spatial equilibrium conditions.

2.1. Housing production under zero profits

Since the focus of this article is on the housing sector the derivations for the traded good are relegated to footnotes. The housing good Y represents physical housing services. By 'physical', it is meant that the housing services are derived from the characteristics of the physical unit itself. Benefits derived from neighbourhood quality will come in to the individual utility function via a quality of life measure defined later on. Firms produce housing services in each city according to:[9]

9 The traded good is produced from land, labour and capital according to $X_j = A_j^X F^X(L, N^X, K)$ where A_j^X is traded good productivity, N^X is traded good labour (paid wages w_j^X) and K is mobile capital paid a price i everywhere.

$$Y_j = A_j^Y F^Y(L, M), \tag{1}$$

where A_j^Y is a city-specific housing productivity shifter, F^Y is a constant returns to scale (CRS) production function, L is land (price r_j in each city) and M is the materials (non-land) input to housing (paid price v_j). Materials are conceptualised as all non-land factors to housing production including labour and machinery. The housing productivity shifter represents the efficiency with which developers can convert land and non-land factors into housing services and is a function of city-specific attributes which may include the level of CA designation. Specifically, designation will impact negatively on A_j^Y if the policy makes it more difficult to produce housing services. As discussed in the introduction, I assume that the major supply-side effects of designation come through the productivity rather than the quantity channel. The validity of this assumption has important empirical implications that are discussed in subsection 2.4 below. Changes in A_j^Y are assumed to be factor-neutral productivity shifts i.e. the relative factor productivity remains unchanged. However, I demonstrate robustness to this the factor-neutrality assumption in the empirics.

Firms choose between factors to minimise the unit cost at given factor prices $c_j(r_j, v_j; A_j) = \min_{L,M}\{r_j L + v_j M : F^Y(L, M; A_j) = 1\}$. Zero profits imply the unit price of housing is equal to this unit cost, i.e. $p_j = c_j(r_j, v_j; A_j)$. Log-linearisation and taking deviations around the national average gives the zero profit condition:[10]

$$\tilde{p}_j = \phi_L \tilde{r}_j + \phi_M \tilde{v}_j - \tilde{A}_j^Y, \tag{2}$$

where for any variable z the tilde notation represents log differences around the national average, i.e. $\tilde{z}_j = \ln z_j - \ln \bar{z}$, where $\bar{z}$ is the national average, ϕ_L is the land cost share for housing and ϕ_M is the non-land cost share. This condition tells us that for each city the house price is given by the sum of the factors' prices (weighted by their cost shares) minus productivity. Cities with lower housing productivity must have higher house prices for given factor prices to maintain zero profits.

Figure 2 illustrates this point by plotting house prices against land values (holding materials costs constant) in an illustrative diagram. The average productivity curve shows how house prices relate to input prices (land values) for cities of average productivity, such as York and Cambridge. As the input price increases, house prices must also increase to maintain zero profits. The curve is concave since developers can substitute away from land as it becomes more expensive. Cities above the curve, such as Brighton, are considered to have low housing productivity because they have higher house prices for the same input price. Brighton has the same land value as Cambridge but ends up with more expensive housing because it is less effective at converting the inputs into outputs. The productivity difference between two cities such as Brighton and Cambridge can be inferred from the vertical difference between them.[11]

10 Zero profits in the traded good sector is given by $\tilde{A}_j^X = \theta_L \tilde{r}_j + \theta_N w^X$ where θ_L and θ_N are the land and labour cost shares, respectively, for the traded good.

11 To complete the firm-side of the model, the non-land input is produced using labour and capital $M_j = F^M(N^Y, K)$ and the equivalent zero profit condition gives $\tilde{v}_j = \alpha \tilde{w}^Y$, where α is the labour cost share of the non-land input.

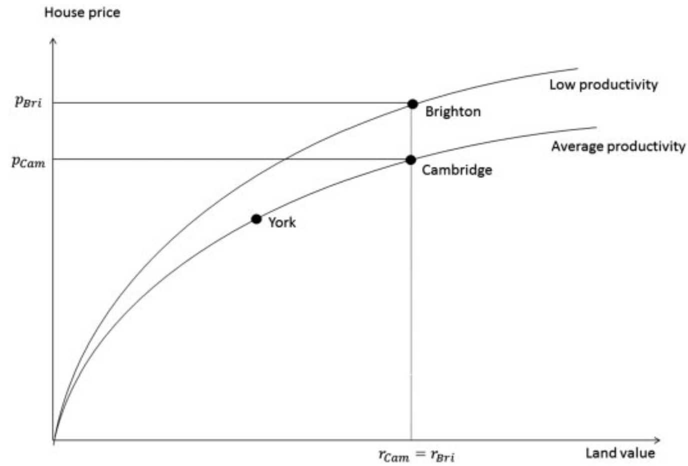

Figure 2. Housing productivity example.
Notes: This figure is an adaptation of Figure 1A from Albouy and Ehrlich (2012).

2.2. Location choice under spatial equilibrium

Households with homogeneous preferences have a utility function $U_j(x, y; Q_j)$ that is quasi-concave in the traded good x and housing y and increases in city-specific quality of life Q_j.[12] Quality of life is determined by non-market amenities that are available in each city, such as air quality or employment access. These may also include CA designation. An increase in designation impacts positively on Q_j if preservation has amenity value. As the designation share in a city increases it becomes more likely that a representative household lives inside or close to a CA. Furthermore, the general level of preservation in a city may be of amenity value to all residents. Households supply one unit of labour to receive a wage w_j, to which a non-wage income I is added to make total household income m_j. Households optimally allocate their budget according to the expenditure function $e(p_j, u; Q_j) = \min_{x,y}\{x + p_j y : U_j(x, y; Q_j) \geq u\}$. Households are assumed to be perfectly mobile, therefore, spatial equilibrium occurs when all locations offer the same utility level $\overline{u}$. Perfect mobility is consistent with an extensive empirical literature that shows migration flows follow economic incentives (e.g. Linneman and Graves, 1983; Graves and Waldman, 1991; Gyourko and Tracy, 1991). A more direct test of spatial equilibrium is provided by Greenwood et al. (1991) who find little evidence of disequilibrium pricing in income across cities. Indeed, Notowidigdo (2011) estimates mobility costs finding they are 'at most modest and are comparable for both high-skill and low-skill workers' (p. 4).

Locations with higher house prices or lower levels of quality of life amenities must therefore be compensated with higher income after tax τ, i.e. $e(p_j, \overline{u}; Q_j) = (1 - \tau)(w_j + I)$. Log-linearised around national average this spatial equilibrium condition is:

$$\tilde{Q}_j = s_y \tilde{p}_j - (1 - \tau) s_w \tilde{w}_j, \tag{3}$$

12 There are two types of worker: housing sector and traded good sector. They may each receive a different wage and may be attracted to different amenities. The condition for only one type of worker is presented here for simplicity.

where s_y is the average share of expenditure on housing, τ is the average marginal income tax rate and s_w is the average share of income that comes from wages. The spatial equilibrium condition tells us that in each city the (expenditure-equivalent) quality of life must be equal to the unit house price minus the wage (weighted by expenditure shares). Cities with a higher quality of life must have higher house prices for given wages to compensate.

2.3. The impacts of designation on house prices

The two conditions, zero profit and spatial equilibrium, both suggest that CAs may increase house prices but the two channels are entirely separate. It is worth underlining here exactly how these two channels operate since this is the mechanism on which the subsequent empirical approach is based. First, if designation impacts on housing productivity only then house prices must be higher *for given input prices* to maintain zero profits (Equation (2)). This point is illustrated by the example of Brighton over Cambridge in Figure 2. Since quality of life is left unaffected, higher house prices in cities with designation must be compensated for by higher wages to maintain spatial equilibrium (Equation (3)). In this way, the quality of life index remains unaffected by housing productivity shocks from designation. Secondly, if designation impacts on quality of life only then house prices must be higher *for given wage levels* to maintain zero spatial equilibrium (Equation (3)). Since housing productivity is unaffected, higher house prices must be associated with higher input prices to maintain zero profits (Equation (2)). Figure 2 does not include wages so quality of life differences cannot be illustrated. However, if wages were held constant then an increase in quality of life could look like a movement from Cambridge to York. Thus, the quality of life effect cannot be confused with the housing productivity effect, and the housing productivity effect cannot be confused with the quality of life effect.

2.4. Quantity effects, preference heterogeneity and sorting

So far the costs of designation have been treated as a productivity effect, rather than a quantity effect. This assumption has been motivated by the fact that CAs do not ban development (as in zoning) or specifically restrict the amount of housing (as in height restrictions), but instead impose aesthetic standards that may make building more costly. While there is no specific provision for height restrictions in CA policy, the local planning authority is fairly free to decide which buildings they feel preserve the character of the neighbourhood and which do not. Therefore, it cannot be ruled out that they favour lower-rise buildings, effectively imposing a height restriction. Furthermore, even if CAs do not restrict the amount of housing directly, there may be quantity adjustments resulting from housing productivity reductions.

The Albouy and Ehrlich (2012) model neatly sidesteps quantity effects by the assumption of homogeneous individuals. Even if there are quantity effects, this has no impact on city prices because the new marginal resident has the same willingness to pay as the old marginal resident (holding quality of life constant). In a similar model, Albouy and Farahani (2017) introduce a degree of preference heterogeneity which delivers a downward sloping demand curve at the city level. Taking an assumed value for the elasticity of population to housing costs, the model predicts that housing productivity reductions lead to larger increases in prices and smaller decreases in land values, compared with the homogeneous preferences case. The reason for the difference is that the quantity reduction pushes the marginal resident up the demand curve where they have a higher willingness to pay resulting in both higher prices and higher land values, compared with a flat demand curve.

The empirical implication of this is that the quality of life step will now capture both (i) quality of life increases due to amenity changes and (ii) quality of life increases of the marginal resident due to quantity rationing. The empirical implication is not an identification problem as such—since the quality of life for the marginal resident continues to be correctly identified—but rather a problem to do with interpreting the quality of life parameter in the welfare calculations. Clearly, using (ii) as a welfare increase misses whatever happens to the residents who would have been living in the city had it not been quantity-rationed.

A related problem is that of household sorting. Sorting occurs if CA designation leads to a migration of residents into a city who have a higher willingness to pay for that type of quality of life amenity compared with existing residents. As before, the quality of life effect for the marginal resident will continue to be correctly identified in that empirical step. However, it leaves open the possibility that the quality of life effect has an additional component (iii) a quality of life increase of the marginal resident due to changes in the willingness to pay as a result of sorting.

If effects (ii) or (iii) represent a relatively large proportion of the overall quality of life estimate than the model would likely be overestimating the welfare benefits of conservation. The welfare conclusions are justified to the extent that the actual sorting and quantity effects of designation are relatively small over the time period considered. Such effects would be small if price adjustment to the quality of life effects is immediate (since residents value security over the future character of their neighbourhood) but if adjustment through quantities and sorting between cities is limited and occurring over a longer time frame. To somewhat alleviate the concerns related to quantity, I conduct a regression of CAs on the number of dwelling units at both the local and city level. In Table 3, I show that CA designations did not impact on the number of dwelling units in England over 1997–2007, either at the city-level (HMA) or at the very local level (output area).[13] However, there remains the possibility that CAs impact on some other measure of housing quantity such as floorspace. Overall then, while the assumption that sorting and quantity effects are limited may be reasonable, the existence of large effects cannot be empirically ruled out and the welfare results are therefore caveated accordingly.

3. Data

3.1. Housing market areas

The empirical analysis is conducted at the HMA level. These areas are defined by DCLG (2010) using a grouping algorithm applied to ward-level census data on commuting patterns, house prices and migration flows. The use of commuting patterns makes them similar to the better-known travel-to-work area (TTWA) definition. However, HMAs have a higher commuting self-containment rate of 77.5%, compared

13 Output areas (OAs) are the smallest geographical units available for most UK data. They cover 0.78 km^2 on average, which is only three times the size of the average CA (0.26 km^2). In comparison, HMAs cover 1762 km^2, on average.

with just 66.7% for the TTWAs (DCLG, 2010). For this reason in particular, they are considered a better empirical counterpart to the theoretical *j*-locations. In addition, HMAs are defined such that similar houses have a similar within-area price (after adjusting for observed characteristics). Furthermore, HMAs have a 50% closure rate for migration flows, implying a good deal of both within- and between-market integration.

For much of the data described below, I aggregate from local authorities (LAs) based on the relationship mapped in Figure 3. I use weighted aggregation to address potential spatial mismatch. To improve the precision of the house price index, I drop eight (of 74) HMAs—those with fewer than 100 housing transactions per year.[14] Since the greatest period of overlap of the different data is 1997–2007, the final panel dataset has $T = 11$ and $N = 66$. While this is a fairly small N, any loss of precision is worth it to ensure self-contained areas prescribed by the theory. The wider costs and benefits of designation may only be fully captured at the market level. As described in the introduction, part of the benefits of conservation may be from living in a city with lots of well-preserved heritage neighbourhoods. On the cost side, designation that lowers productivity in one part of the city will impact on prices elsewhere in the city, since the units offer access to the same labour market and are therefore substitutable. However, in Appendix B in the Online Appendix I demonstrate that the approach is robust to using LAs as the unit of observation.

All variables used in the analysis are expressed as log deviations from the national average in each year, denoted by tilde (e.g. $\tilde{p}$). For each variable, I first log-transform it and then subtract the mean of the log-transformed values across HMAs in each year. For the productivity shifters, I additionally normalise the standard deviation to one. Descriptive statistics for the panel dataset are given in Table 1.

3.2. House prices

The production function relies on the theoretical concept of ‘housing services’, which represents the flow of value derived from physical housing for the occupant. Housing quality and housing quantity are assumed to be entirely substitutable in that each simply delivers a flow of ‘services’ to the occupant. This assumption is a useful simplification since it implies that the unit price of housing services can be estimated from house prices in a hedonic approach that controls for housing quality and quantity.

House prices for 1,087,896 transactions in England over the period 1995–2010 come from Nationwide, the largest building society in the UK. All transactions in the Nationwide data are for owner-occupied units.[15] In addition to the price paid, the data have property characteristics including postcode location, which is used to identify which HMA the transacted unit belongs to. The house price index is computed by regressing the log of the transaction price p for unit-i in HMA-j and year-t on a vector of property characteristics X_{ijt} and a set of HMA-year indicator variables:

14 This is an arbitrary cut-off point. Results for the full dataset are presented in robustness checks in Appendix B in the Online Appendix.

15 This implies that the quality of life index will reflect homeowner spatial equilibrium only. However, during the time period considered, private renters represented only around 10% of households, whereas homeowners represented nearly 70%. The small share of private renters and the fact that rents are likely to be closely related to house prices means that a homeowner spatial equilibrium is likely to be broadly representative.

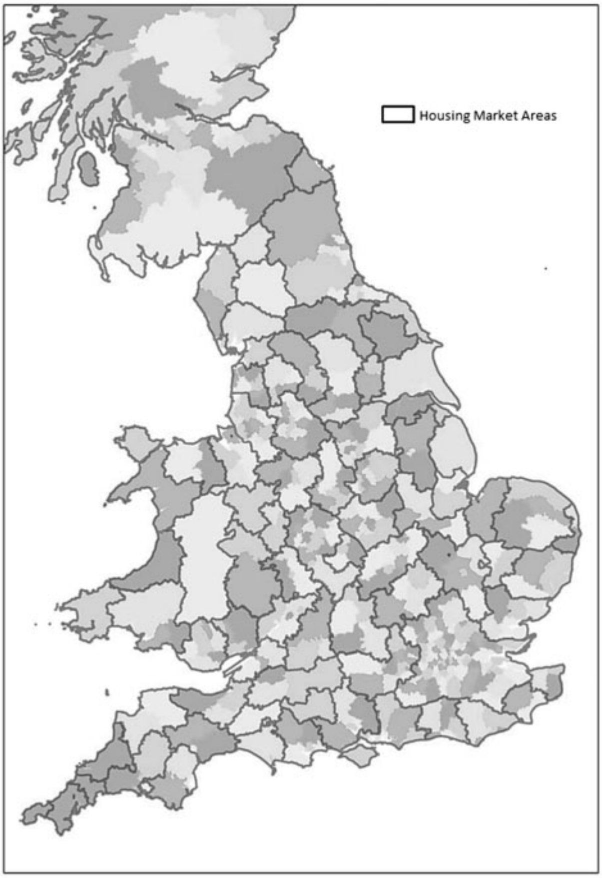

Figure 3. Housing markets areas over LAs.
Notes: Map P11.4 from *Geography of housing market areas* by DCLG (2010).

$$p_{ijt} = X_{ijt}\beta + \varphi_{jt}(\text{HMA}_j \times \text{YEAR}_t) + \epsilon_{ijt}. \tag{4}$$

The house price index is then constructed by taking the predicted HMA-year effects $\hat{\varphi}_{jt}$ and subtracting the national average in each year, i.e. $\tilde{p}_{jt} = \hat{\varphi}_{jt} - \bar{\hat{\varphi}}_t$. The result represents log deviations from the national average since house prices are log transformed for the hedonic regression. The results of the hedonic regression and a brief discussion of the coefficients are presented in Appendix A in the Online Appendix. Since the distribution of observed transactions within each HMA-year may differ from the actual distribution of housing stock in the HMA, each observation is weighted by the LA dwellings count in 2003 divided by the LA-year transaction count.[16]

16 Further detail on the weighting procedure and regressions without weights are reported in Appendix B in the Online Appendix. The main results without weights are similar.

Table 1. Descriptive statistics for panel dataset

	Overall statistics				Between-group			Within-group		
	Mean	SD	Min	Max	SD	Min	Max	SD	Min	Max
Variables (standard)										
House price (£000s)	118.2	52.90	41.6	345.9	27.30	76.6	220.2	45.43	7.077	243.8
Land value (£000s/ha)	1486.5	1046.2	183.4	7964.4	740.1	600.1	5197.3	744.5	−1420.7	4253.7
Const. cost index	136.7	26.31	93.1	207.0	7.025	123.2	160.4	25.37	93.20	193.7
Designation share	0.0176	0.0136	0.000004	0.0712	0.0136	0.000004	0.0711	0.00126	0.0103	0.0363
Refusal rate	0.230	0.112	0	0.625	0.0601	0.1	0.389	0.0952	−0.0893	0.588
Variables (normalised)										
Price differential	−0.000	0.231	−0.573	0.775	0.225	−0.422	0.662	0.055	−0.176	0.164
Land value diff.	−0.000	0.483	−1.450	1.458	0.455	−1.012	1.216	0.169	−0.569	0.639
Const. cost diff	−0.000	0.054	−0.160	0.192	0.050	−0.101	0.160	0.021	−0.063	0.102
Desig. share (z-value)	−0.000	0.993	−4.824	1.765	0.997	−4.798	1.725	0.072	−0.603	1.040
Pred. refusal (z-value)	0.000	0.993	−4.514	2.352	0.910	−2.850	1.942	0.411	−1.879	1.335

Notes: Descriptive statistics for panel dataset with 66 cities × 11 years = 726 observations overall. Standard variables are: the price of a house with average characteristics in each HMA (based on predictions from hedonic regression), the residential land value (mean of bulk, small and flats), the construction cost index (100 = UK average in 1996), the share of HMA land that is designated and the planning application refusal rate. The normalised versions of the variables are those used in the empirical analysis after being processed as described in the data section. The 'diff.' variables are log differentials (in each year) and hence have a mean of zero. The 'z-value' variables are additionally divided by the standard deviation in each year and hence have a between-group standard deviation of approximately one.

3.3. Land values

Residential land values are obtained from the Valuation Office Agency (VOA). The land values are produced for the *Property Market Report* which has been released biannually since 1982. Land values for the full set of LAs were, however, not made available until recently (2014). As such, this research is one of the first empirical applications of the full dataset. The assessments are based on a combination of expert opinion and observed values for transactions of land. The values are assessed for small sites (<2 ha), bulk land (>2 ha) and flat sites (for building flats) for vacant land with outline planning permission. To produce an overall land value index I adjust for the price differences by site category using a regression discussed in Appendix A in the Online Appendix. Notably, the regression results show that bulk land is considerably cheaper (by 4.9% to 11.2%) than small plots in every year. It is reassuring that the valuations conform to the well-documented 'plattage effect' (by e.g. Colwell and Sirmans, 1993). To validate the valuations, I make use of transaction data in the form of land auctions between 2001 and 2012.[17] There is a very high correlation with the

17 It is not possible to use these transactions as the main source of data for land values since in many of the smaller cities there are not enough observations.

valuation data as discussed in Appendix A in the Online Appendix. Land valuations for 1995–1998 are reported using a slightly different LA definition due to a local government reorganisation that occurred over this period. I converted the earlier LA definition to the new definition using the relevant lookup table.[18] I then took the mean of the biannually reported land values and aggregated them to the HMA level, again using the distribution of housing stock in 2003 as weights. As a final step, I computed log differentials.

3.4. Construction costs

To capture the costs of non-land inputs to construction an index of rebuilding costs was obtained from the *Regional Supplement to the Guide to House Rebuilding Cost* published by the Royal Institute of Chartered Surveyors (RICS). Rebuilding cost is an approximation of how much it would cost to completely rebuild a standard unit of residential housing had it been entirely destroyed. The index takes into account the cost of construction labour (wages), materials costs, machine hire, etc., and is considered to be an appropriate measure of the price of non-land inputs to housing. The index is also reflective of local build quality.[19] The data are based on hedonic regression using observed tender prices for construction projects and the sample size of tenders is given with each factor. I make use of location adjustment factors that are available annually from 1997 to 2008 at the LA-level and take into account the local variations in costs. To my knowledge these data have not been used before in empirical analysis at this level of detail. The location factors were scanned from hard copies and digitised using optical character recognition software. The separate years were then matched to form a panel dataset. Some LAs were missing from the data, especially in the earlier years. However, a higher tier geography (corresponding in most cases with counties) was recorded completely, enabling a simple filling procedure described in Appendix A in the Online Appendix. Finally, the LA level data were aggregated to HMAs weighted by dwelling stock, and then log differenced.

3.5. CA designation

A spatial dataset of CAs was obtained from English Heritage. The dataset contains polygons that map the borders of all CAs in England on the British National Grid coordinate system. The full dataset has only been used once before in empirical analysis by Ahlfeldt et al. (2017). The data include the date of designation, which lies between 1966 and 2011. Using this information, I calculated in a geographical information systems (GIS) environment the share of land in each HMA that was covered by CAs in each year over 1997–2007. Figure 4 plots the initial designation share in 1997 against the change in share over the study period. The chart shows variation in both the initial share and the change over the period. Although the changes are small as a proportion of all land, they may still have large productivity or quality of life effects as outlined

18 Most LAs were unaffected. Of the original 36,621 were merged into nine new areas, making the new total 354 LAs.

19 This is beneficial since otherwise unobserved build quality would lead to designation being associated with higher house prices for given construction costs. Note that time-invariant build quality differences are captured by fixed effects in the cost function.

below. The CA designation share is first computed at the LA level to be aggregated to HMAs weighted by dwelling stock, ensuring all the data are produced comparably. The log land shares are then normalised to have a mean of zero and a standard deviation of one which is achieved by taking log-differences around the national average and then dividing by the standard deviation in each year. Such '*z*-values' are created for each of the housing productivity factors to ensure the effects on log costs are comparable.

The designated share of all HMA land is a proxy for the extent to which designation might impact on housing productivity or quality of life. So while the increase in designated land area over the period for the average HMA is relatively small, at 0.13%, the actual effects may be much larger.[20] A specific reason for this is that housing productivity effects will depend on the impact of designation on *marginal* developments which may disproportionately occur in existing residential areas where designations are more common. Moreover, designations might occur specifically to ensure that potential new developments maintain the neighbourhood character. On the benefits side, designations may also have quality of effects outside of the designated areas themselves via spillovers as documented, for example, by Ahlfeldt et al. (2017).

3.6. Planning restrictions and other housing productivity factors

To control for the underlying regularity restrictiveness in each city, the share of planning applications that are refused in each year from 1997 to 2007 was obtained. These data were first used by Hilber and Vermeulen (2016) to analyse the effect of planning restrictiveness on housing costs in England. The LA data were aggregated to HMAs weighted by dwelling stock. The variation in refusal rates is volatile over time such that it is unlikely that every fluctuation represents actual changes in planning restrictiveness. The data were, therefore, smoothed to eliminate the short-term noise while keeping the longer-run trends in planning restrictiveness. This smoothing was done by regressing the refusal share on a binomial time trend and using the predicted values.

To estimate whether designation effects vary with geographic constraints, I compute the undevelopable share of land within 25 km of each HMA centroid, following Saiz (2010).[21] Developable land is defined as land that is flat (<15 degree slope) and dry (solid land covers). To calculate the slopes, I use the OS Terrain 50 topography dataset which is a 50 m grid of the UK with land surface altitudes recorded for the centroid of each grid square. I calculate the slope in the steepest direction for each grid square and if this is greater than 15 degrees then the 50 m grid square is defined as undevelopable. To identify dry land I use the Land Cover Map 2000, which is a 25 m grid for the whole of Great Britain where each square is assigned to one of 26 broad categories of land cover. The grid square is defined as undevelopable if it is water, bog, marsh, etc., following Hilber and Vermeulen (2016). The final undevelopable land share is

20 In fact, the average increase of 0.13% in designated land share already looks much larger when looking at the proportion of designated buildings, according to the Nationwide transaction dataset—this is three and a half times larger at 0.45%.

21 Saiz (2010) uses 50 km circles around US MSA centroids—whereas I define 25 km circles to adjust for the smaller size of English HMAs. The average area of a US MSA is about 7000 km^2, which corresponds to the area of a circle with a radius of around 50 km and is perhaps the reasoning behind Saiz's choice of radius. Since the average HMA in England is about 1800 km^2, an appropriately sized circle would have a radius of about 25 km.

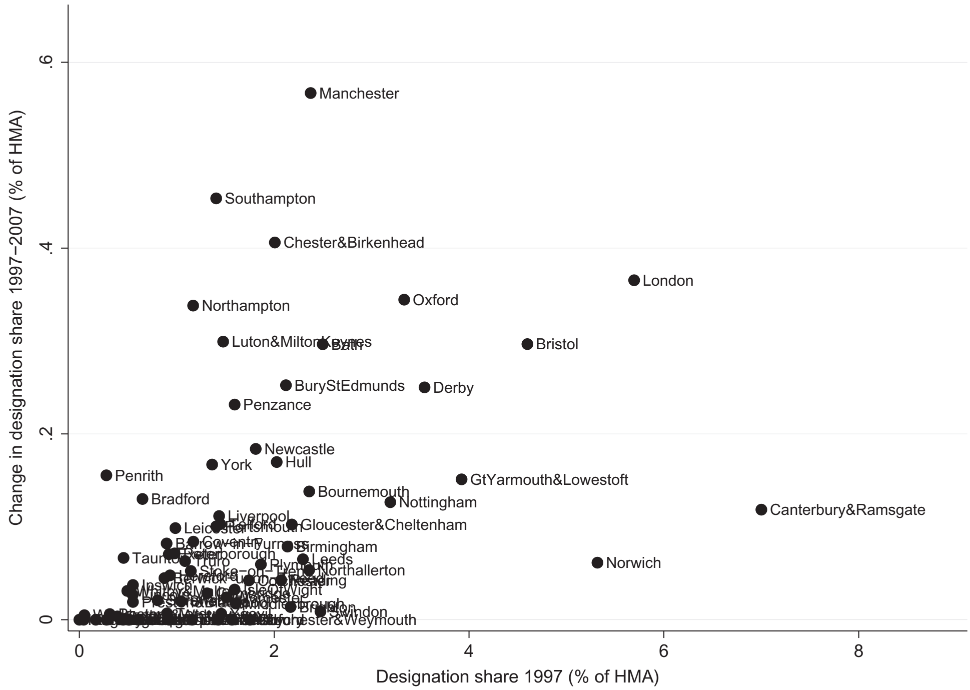

Figure 4. Initial designation share against change for HMAs.
Notes: Blackburn & Burnley HMA is not depicted since the change in designation share over the period is off the chart at 2.6% of the land area.

computed for each HMA as the total land area that is not developable divided by the total area in the 25 km circle.

3.7. Quality of life index

I construct a quality of life index according to Equation (3) as follows:

$$QoL^{1}_{jt} = 0.31 \times \tilde{p}_{jt} - (1 - 0.225) \times 0.64 \times \tilde{w}_{jt}, \qquad (5)$$

where 0.31 is the average share of expenditure on housing, which comes from the *Expenditure and Food Surveys 2001–2007*. In different empirical specifications, I demonstrate robustness to using different values for the housing expenditure share, as well as using shares that vary by average city income. The price differential $\tilde{p}_{jt}$ is the same as that used in the cost function step, computed via hedonic regression. The annual wages $\tilde{w}_{jt}$ come from the *Annual Survey of Hours and Earnings* at the local authority level and are aggregated (weighted by the number of jobs) to HMAs before taking log differentials. The average marginal income tax rate of 0.225 was computed using data from the HM Revenue and Customs for 2005–2006 and the average share of income from wages of 0.64 is from the Department for Work and Pensions for 2005–2006. I estimate additional specifications where the marginal income tax rate depends on the average income specific to each HMA-year observation and where the share of income from wages varies across regions. The results are robust to such changes as presented in Appendix B in the Online Appendix suggesting the use of average figures is suitable. A ranking of HMAs according to this quality of life index is presented in Appendix A in the Online Appendix.

4. Empirical strategy and identification

My empirical strategy is based on the two-step approach of Albouy and Ehrlich (2012). In the first step I estimate a cost function for housing production. The unit value of housing is regressed on land values, construction prices and productivity shifters, including designation. In the second step, the quality of life index is regressed on housing productivity factors to reveal the overall welfare impact of designation. My identification strategy is based on implementing a panel fixed effects approach and instrumenting for designation with a shift-share.

4.1. First step: cost function

Following Albouy and Ehrlich (2012) and Christensen et al. (1973) I first estimate an unrestricted translog cost function:

$$\tilde{p}_{jt} = \beta_1 \tilde{r}_{jt} + \beta_2 \tilde{v}_{jt} + \beta_3 (\tilde{r}_{jt})^2 + \beta_4 (\tilde{v}_{jt})^2 + \beta_5 (\tilde{r}_{jt} \tilde{v}_{jt}) + \pi \tilde{R}_{jt} + \delta \tilde{D}_{jt} + f_j + u_{jt}, \qquad (6)$$

where $\tilde{R}_{jt}$ is the predicted refusal rate and $\tilde{D}_{jt}$ is the CA designation share. The fixed effects f_j capture all time-invariant productivity shifters, such as geographic constraints. The parameter δ is an inconsistent estimate of the housing productivity impact of CAs if designation is correlated with the error term. According to the model, quality of life factors are absent from u_{jt} as they are capitalised in land values $\tilde{r}_{jt}$. However, unobserved housing productivity shocks may be correlated with designation as discussed in the identification strategy below.

In this panel format, the log-differentials are taken around the national average in each year t. These differentials are equivalent to using year effects in the regression; however, I prefer to stick to the format suggested by the theory.[22] Imposing the restrictions of CRS: $\beta_1 = 1 - \beta_2$; $\beta_3 = \beta_4 = -\beta_5/2$ makes this equivalent to a second-order approximation of Equation (2) and imposing the further restrictions of $\beta_3 = \beta_4 = \beta_5 = 0$ makes this a first-order estimation i.e. a Cobb–Douglas cost function (Fuss and McFadden, 1978). Comparing Equation (6) with Equation (2) reveals that housing productivity is given by:

$$\tilde{A}_j^Y = -\pi \tilde{R}_{jt} - \delta \tilde{D}_{jt} - f_j - u_{jt}. \qquad (7)$$

Housing productivity is the (negative of) observed and unobserved city attributes that impact on unit house prices after taking into account input prices. If designation impacts negatively on housing productivity then its coefficient δ is expected to be positive i.e. it will raise house prices above what is predicted by factor prices alone.

22 Taking differentials is necessary in certain parts of the model, e.g. to eliminate the interest rate i or reservation utility u.

4.2. Second step: quality of life

Increasing the cost of housing is not the intended effect of designation. Rather, CAs reduce housing productivity to preserve or improve the attractiveness of neighbourhoods. The second step investigates the demand-side effect of CAs by relating the same productivity shifters, including designation, to a measure of quality of life. The regression takes the form:

$$\tilde{Q}_{jt} = \mu_1 \tilde{R}_{jt} + \mu_2 \tilde{D}_{jt} + \mu_3 u_{jt} + g_j + \epsilon_{jt}, \tag{8}$$

where g_j are fixed effects that capture time-invariant quality of life factors. The parameter μ_3 gives the relationship between designation and quality of life. According to the model, productivity factors are absent from ϵ_{jt}, despite the fact that house prices go into the quality of life index. They are absent because higher wages will compensate for higher prices from productivity factors to maintain spatial equilibrium. However, unobserved quality of life factors may lead to a bias of μ_2, as discussed in the identification strategy below.

If CAs increase quality of life then μ_2 will be positive. The coefficient gives the quality of life impact expressed as a share of expenditure. Combining this with the estimate from the first step gives the total welfare as $\mu_2 - (0.31 \times \delta)$, since 0.31 is the housing expenditure share.

4.3. Identification

There are two features to the identification strategy. First, I make use of the panel nature of the data by estimating a fixed effects model. Secondly, I combine fixed effects with a time-varying instrument for designation based on the Bartik (1991) shift-share. It is worth noting that identification here focusses only on the impacts of designation. Consistent estimates of the land cost share are obtained by instrumenting land values in an alternative specification outlined in subsection 4.5, but this step is neither necessary nor desirable for consistent estimation of the impacts of designation, as explained in that subsection.

Fixed effects estimation alone provides a major improvement over pooled OLS estimation by controlling for time-invariant housing productivity factors or quality of life factors. For example, on the cost function side, a time-invariant factor such as soil type may both affect housing productivity and be correlated with today's CAs (if it drove the location of historical settlements). Likewise on the quality of life side, many urban amenities such as job accessibility, natural factors and cultural amenities are relatively fixed over the period of one decade. Furthermore, the fixed effects models remove any effect from unobservable housing characteristics that biased the house price index in the hedonic regression stage. Thus, they help to deal with a common problem with estimating housing production functions (Combes et al., 2016). I additionally include individual HMA trends to capture the effect of unobservable trends in housing productivity and quality of life factors that may be related to designation. A relationship in trends could come about if, for example, trends in unobservable housing productivity or quality of life factors and trends in designation are both related to the initial heritage endowment of a city. In terms of the theoretical model, estimation of a fixed effects model assumes spatial equilibrium in each year.[23]

The fixed effects strategy does not help when unobservables are time-variant. To illustrate, consider the example of a city with ongoing transport improvements that increase housing productivity and/or quality of life. Such improvements may also be the result of (or may result in) gentrification, which itself has been empirically demonstrated to lead to designation (Ahlfeldt et al., 2017). In general, changes in city attributes that impact on housing productivity or quality of life will likely be interlinked with gentrification and, therefore, designation. To address this I employ an instrumental variable approach similar in spirit to a Bartik instrument (Bartik, 1991). The instrument provides HMA-level 'shocks' that are a weighted average of the national level designation share of buildings in different build date categories. The weights used for a given HMA are the share of its dwelling stock in each build date band. Specifically, the instrument is computed as:

$$Z_{jt} = \sum_{b=1}^{14} D_{j-1,bt} H_{jb0}, \tag{9}$$

where Z_{jt} is the counterfactual designation share in HMA-j and year t, $D_{j-1,bt}$ is the designation share in each age band b for all HMAs other than HMA-j and H_{jb0} is the initial share of dwelling stock in HMA-j in age band. The national level designation share in each of the age bands are based on the Nationwide transactions data and are described in Appendix A in the Online Appendix.

The counterfactual designation share is expected to be a relevant predictor of HMA designation even conditional on fixed effects and trend controls. National changes in the designation share for buildings of certain build periods capture shifts in preferences for heritage. If an HMA has a high proportion of buildings in those build periods then the chances of designation are increased. Relevance is confirmed by the F-stats in Table 4 and Table 6 for the cost function and quality of life regressions, respectively. Furthermore, the instruments are significant and (mostly) have the expected signs in the first-stage regressions in tables presented in Appendix A in the Online Appendix. The charts in Figure 5 illustrate the counterfactual designation share and the actual designation share conditional on HMA fixed effects and trend interactions for a selection of cities.[24]

To be a valid instrument, the counterfactual designation share must be orthogonal to the error terms u_{jt} and ϵ_{jt}. The argument for exogeneity is that changes in the national level designation share are unrelated to anything going on at the individual city level, like gentrification. To capture general trends in unobservables that might be correlated with the initial stock, I include a trend variable interacted with the initial value (in 1997)

23 This will be the case if prices adjust quickly to quality of life changes. This assumption seems reasonable since consumers will immediately be willing to pay more for locations with improved amenity value. Theoretically, all prices (house prices, land values and construction costs) will immediately reflect changes to housing productivity and quality of life due to market competition. For example, developers buying land will pay a price that takes into account the latest information on what their buildings will sell for. The available evidence shows that house prices do respond quickly to amenity changes. For example, Gibbons and Machin (2005) show house prices in 2000 and 2001 adjusting to rail improvements from 1999.

24 The designation share in these figures may appear to have a slight tendency towards a downward trend; however, this is just due to the selection of cities. The average trend is in fact zero after conditioning on trend interactions.

for the instrument. To capture further possible trends I include interactions of a trend variable with city characteristics: the initial designation share, the initial refusal rate, the city population, protected land share and undevelopable land share.[25] Therefore, the identifying assumption is that the instrument is unrelated to unobserved shocks to housing productivity or quality of life, conditional on controlling for trends related to the initial stock (as captured in the initial value of the instrument) and trends related to other city characteristics.

The exclusionary restriction requires that the instrument not lead directly to changes in the outcome variable. The exclusionary restriction could be violated if national-level changes in preferences for buildings of an HMA lead to the gentrification of that HMA, which in turns impacts on housing productivity or quality of life. I argue, however, that such a correlation is unlikely to continue conditional on HMA fixed effects and trend controls. Gentrification is a complex process that depends on many more factors than the build date of the dwelling stock. In Table 2 I present evidence to support this argument. Here, the designation share and the counterfactual designation share are regressed on a measure of the share of residents who hold a degree certificate. This dependent variable comes from the UK census and proxies gentrification of a city. The positive and significant relationship with designation in the pooled OLS model implies that gentrification and designation are indeed interlinked. The size of this coefficient decreases as fixed effects and trends are introduced. However, for the instrument there is no relationship at all in either of the models. Given that gentrification is the most likely source of unobserved shocks, it is reassuring that it is not related to the instrument.

Another potential violation of the exclusionary restriction is if the instrument captures increased valuations placed on specific property characteristics. As it stands, these are not controlled for in the hedonic regression. To deal with this, for the IV models only, I re-estimate the hedonic regression with interactions between year effects and the build date categories. In a robustness check in Appendix B in the Online Appendix, I demonstrate that the results are not sensitive to this change.

4.4. Alternative specifications

I estimate three alternative specifications. First, I investigate whether the effects of designation depend on the quantity of available land around a city. If there is an abundance of land, designation may have less effect on productivity as developers can easily build outside the city. To test this idea I create two dummy variables, one for HMAs that are above-average on the Saiz index and one for those below average. I interact the designation variable with each of these dummies and include the interactions in the two regression steps in place of the uninteracted version of the designation variable. These separate dummy interactions give the effect on housing productivity or quality of life in HMAs that have a scarcity of land or an abundance of land. Secondly, I investigate whether the benefits/costs of designation take time to materialise. I create a cumulative version of the designation share that is the sum of the designation share across periods, i.e. $C_{jt} = \sum_{t=1}^{T} D_{jt}$. If this is significant in either step it may indicate that the productivity or quality of life effects build up over time. Thirdly,

25 Note that individual HMA trends are not used to ensure the instrument is relevant in the first stages.

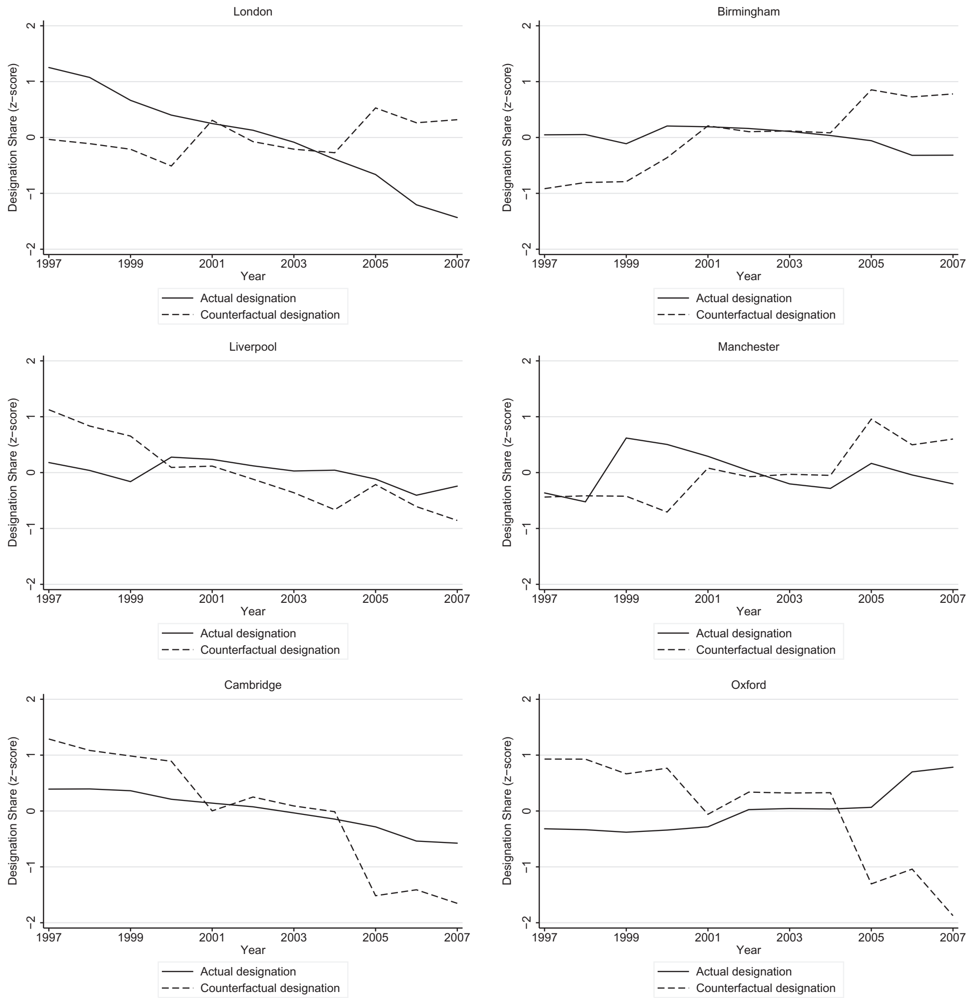

Figure 5. Actual designation against counterfactual designation for selected HMAs.
Notes: Designation (z-scores) have been adjusted for HMA fixed effects giving them a zero mean across years for each HMA. The shares are also conditional on trend interactions.

I investigate whether designation is associated with factor non-neutral productivity shifts. I follow Albouy and Ehrlich (2012) by interacting the designation share with the factor price difference. This interaction captures whether designation impacts on the productivity of land more than it does on the productivity of non-land.

4.5. Consistent estimation of the land cost share

Since the land cost share is of independent interest it should be estimated consistently. The land cost share will be inconsistent if there are unobserved housing productivity factors in the error term of Equation (6) since according to the model these capitalise in land values. The theory provides guidance as to a potential instrument since both quality of life and non-housing productivity factors will also capitalise into land values.

Table 2. Degree share regression

	(1) OLS	(2) OLS	(3) FE & Trends	(4) FE & Trends
Designation share	0.010*		−0.002	
	(0.005)		(0.002)	
Counterfactual designation		0.001		−0.062
		(0.005)		(0.043)
F-stat	3.619	0.029	0.965	2.069
R^2	0.068	0.000	0.002	0.023
AIC	−543.0	−532.7	−1239.3	−1242.4
Numbers of HMAs	74	74	74	74
Observations	148	148	148	148

Notes: The dependent variable is degree share (differential) in 2001 and 2011. Fixed effects and trends are implemented by demeaning and detrending the variables beforehand. This pre-step was carried out using two separate samples: (i) annual data over 1997–2007 for the designation shares and (ii) Census data for 1991, 2001 and 2011 for the degree share. The data were then merged for 2 years, 2001 and 2011. The designation shares for 2007 were used for 2011 as this is the closest possible match. Standard errors in parentheses are clustered on HMAs.
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 3. Housing quantity regression

	Output Area		HMA		
Dep. Var.: Log Dwelling count	OLS (1)	FE (2)	OLS (3)	FE (4)	IV (5)
CA land share	0.022***	0.001	0.003*	−0.000	−0.001
	(0.001)	(0.002)	(0.002)	(0.000)	(0.001)
R^2	0.010	0.872	0.085	1.000	1.000
Number of areas	165665	165663	74	74	74
Observations	1655727	1655725	740	740	740

Notes: Regressions of logged dwelling count on CA land share at the city (HMA) and very local (Output Area, OA) levels. CA land share has been scaled to give the effect of an average-sized designation for each geography. The fixed effects specification includes HMA trends, and the IV specification includes a trend variable interacted with the initial value of the instrument and designation share. The regressions demonstrate that designation does not significantly decrease housing quantity. The pooled OLS specifications in columns (1) and (3) demonstrate a significant *positive* relationship most likely due to unobservables. However, there is no effect once fixed effects have been included in columns (2) and (4) and when instrumenting in column (5) for HMAs with the counterfactual designation share used for the main specifications in this paper. Standard errors in parentheses are clustered on the geographical units.
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

If any of these factors are unrelated to housing productivity then they could serve as suitable instruments.

I create such an instrument based on the original Bartik (1991) shift-share where initial local employment shares across industries act as weights on national level changes in gross value added in those industries. This instrument predicts local changes

Table 4. Cost function

	Panel fixed effects				Instrumental variable			
	Cobb–Douglas		Translog		Cobb–Douglas		Translog	
	Unrestr. (1)	Restrict. (2)	Unrestr. (3)	Restrict. (4)	Unrestr. (5)	Restrict. (6)	Unrestr. (7)	Restrict. (8)
Land value differential	0.178***	0.172***	0.180***	0.175***	0.176***	0.173***	0.185***	0.181***
	(0.022)	(0.022)	(0.021)	(0.021)	(0.013)	(0.014)	(0.012)	(0.012)
Constr. cost differential	0.553***	0.828***	0.527***	0.825***	0.635***	0.827***	0.544***	0.819***
	(0.138)	(0.022)	(0.123)	(0.021)	(0.119)	(0.014)	(0.110)	(0.012)
CA land	0.159***	0.158***	0.169***	0.165***	0.480***	0.600***	0.496***	0.433***
share (z-value)	(0.036)	(0.036)	(0.038)	(0.037)	(0.131)	(0.117)	(0.123)	(0.087)
Predicted refusal rate	0.099***	0.092***	0.101***	0.087***	0.027***	0.030***	0.034***	0.026***
(z-value)	(0.021)	(0.019)	(0.022)	(0.019)	(0.008)	(0.009)	(0.008)	(0.007)
Land value differential			0.021	0.018			0.074***	0.058***
squared			(0.026)	(0.020)			(0.013)	(0.011)
Constr. cost differential			−1.409	0.018			−0.261	0.058***
squared			(1.249)	(0.020)			(1.257)	(0.011)
Land value differential			−0.101	−0.035			−0.717***	−0.117***
× Constr. cost diff.			(0.262)	(0.041)			(0.234)	(0.022)
R^2	0.975	0.975	0.976	0.975	0.950	0.940	0.951	0.954
AIC	−2488.9	−2480.9	−2491.1	−2482.2	−2348.7	−2381.4	−2363.0	−2363.0
Number of HMAs	66	66	66	66	66	66	66	66
Observations	726	726	726	726	726	726	726	726
p-value for CRS		0.048		0.095		0.105		0.001
p-value for CD	0.595	0.098			0.000	0.000		
p-value for all restrictions		0.169				0.000		
Elasticity of substitution	1.000	1.000		0.755	1.000	1.000		0.213
F-stat of instruments					33.73	33.73	38.08	38.08

Notes: Fixed effects and IV regressions of Equation (7). The dependent variable is the house price differential. All columns include HMA fixed effects. Fixed effects models include individual HMA trends. IV models include a trend variable interacted with the initial value (in 1997) for the instrument, and with other city characteristics. The instrument is the counterfactual designation share given by Equation (9) and first stages for the restricted translog model are reported in Appendix B in the Online Appendix. The elasticity of substitution is computed as $\sigma^Y = 1 - 2\beta_3/[\beta_1(1-\beta_1)]$. Standard errors in parentheses are clustered on HMAs.
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 5. Alternative specifications for cost function

	Panel fixed effects				Instrumental variable			
	(1) Baseline model	(2) Undev. interact	(3) Factor non-neut.	(4) Cumulat. desigat.	(5) Baseline model	(6) Undev. interact	(7) Factor non-neut.	(8) Cumulat. designat.
CA land share (z-value)	0.165***		0.164***		0.433***		0.947***	
	(0.037)		(0.038)		(0.087)		(0.235)	
CA land share × above-average undev. share		0.189***				0.327***		
		(0.034)				(0.119)		
CA land share × below-average undev. share		0.052				−3.437***		
		(0.117)				(0.995)		
CA land share × (land value diff. − construction cost diff.)			−0.008				0.238***	
			(0.027)				(0.088)	
Cumulative CA designation (z-value)				0.767				1.368***
				(0.510)				(0.270)
R^2	0.975	0.975	0.975	0.975	0.954	0.886	0.893	0.946
AIC	−2482.2	−2745.5	−2743.3	−2481.9	−2363.0	−2385.7	−2381.4	−2370.3
Numbers of HMAs	66	66	66	66	66	66	66	66
Observations	726	726	726	726	726	726	726	726
p-value for CRS	0.095	0.093	0.075	0.108	0.001	0.521	0.401	0.013
Elasticity of substitution	0.755	0.740	0.724	0.740	0.213	−0.022	2.535	0.350
F-stat of instruments					38.08	6.45	3.60	48.98

Notes: Alternative regressions of the restricted translog cost function. Columns (1)–(4) are variants of fixed effects model from Table 4, column (4) and columns (5)–(8) of the IV model from Table 4, column (8). The dependent variable is the house price differential. Only CA variables differ from baseline specification and to save space the other variables are not presented in this table. The instrument is the counterfactual designation share given by Equation (9) and first stages are reported in Appendix B in the Online Appendix. The reported F-stat of instruments is the Cragg-Donald statistic in columns (6) and (7) where there is more than one instrument. Standard errors in parentheses are clustered on HMAs.

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

Table 6. Quality of life regressions

	Panel fixed effects				Instrumental variable			
	(1) Baseline model	(2) Undev. interact	(3) Factor non-neut.	(4) Cumulat. desigat.	(5) Baseline model	(6) Undev. interact	(7) Factor non-neut.	(8) Cumulat. designat.
CA land share (z-value)	0.077***		0.074***		0.071**		0.163***	
	(0.019)		(0.020)		(0.033)		(0.045)	
CA land share × Above-average undev. share		0.088***				0.046*		
		(0.025)				(0.028)		
CA land share × Below-average undev. share		0.024				-0.845***		
		(0.032)				(0.234)		
CA land share × (land value diff. – construction cost diff.)			−0.008				0.029***	
			(0.009)				(0.008)	
Cumulative CA designation (*z*-value)				0.294***				0.388***
				(0.074)				(0.087)
Predicted refusal rate (z-value)	0.040***	0.040***	0.042***	0.041***	0.002	0.005*	0.006**	−0.000
	(0.010)	(0.010)	(0.009)	(0.010)	(0.002)	(0.003)	(0.003)	(0.002)
Residuals	0.266***	0.266***	0.266***	0.266***	0.245***	0.256***	0.190***	0.291***
	(0.026)	(0.026)	(0.024)	(0.026)	(0.024)	(0.046)	(0.031)	(0.026)
1st step specification	Table 4, Col. (4)	Table 5, Col. (2)	Table 5, Col. (3)	Table 5, Col. (4)	Table 4, Col. (8)	Table 5, Col. (6)	Table 5, Col. (7)	Table 5, Col. (8)
R^2	0.955	0.955	0.955	0.954	0.934	0.934	0.928	0.937
AIC	−4121.2	−4120.1	−4259.9	−4247.5	−3836.5	−3829.3	−3769.5	−3864.8
Observations	726	726	726	726	726	726	726	726
F-stat of instruments					63.62	18.51	32.21	70.04

Notes: Fixed effects and IV regressions of Equation (8). Dependent variable is a quality of life index computed according to Equation (5). All columns include HMA fixed effects. Fixed effects models include individual HMA trends. IV models include a trend variable interacted with the initial value (in 1997) for the instrument, and with other city characteristics. The instrument in columns (5)–(8) is the counterfactual designation share given by Equation (9) and first stages are reported in Appendix B in the Online Appendix. The reported F-stat of instruments is the Cragg-Donald statistic in columns (6) and (7) where there is more than one instrument. The welfare impact can be computed as the coefficients here minus the share of expenditure on housing times the coefficients from the first step specification. For example, for column (5) a one-point increase in designation results in a 0.071 − (0.31*0.433) = −0.063 decrease in welfare expressed as a share of expenditure. Standard errors in parentheses are clustered on HMAs.

$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

in productivity (which capitalise into land values) that arise from national-level shocks that are unrelated to local-level housing productivity factors (conditional on city-level fixed effects and trends). The initial local employment shares come from the 1991 UK Census (Office of Population Censuses and Surveys, 1991). This Census is a number of years before the panel begins to remain as exogenous as possible. The annual national level GVA over 1997–2007 comes from Cambridge Econometrics (2013). Both are available for some 30 different industries.

Instrumentation of land values is kept to a separate specification because such instrumentation prevents the cost function of Equation (6) from properly disentangling the housing productivity from quality of life effects. If land values are predicted by an exogenous factor then they do not include variation as a result of capitalised quality of life effects from CA designation. These effects will therefore instead be captured in δ, making it a mixture of quality of life and housing productivity effects, and difficult to interpret. In effect, for the cost function to work as desired, land values are required to be endogenous.

5. Results

5.1. Housing cost function

Figure 6 plots mean house price differentials ($\bar{\tilde{p}}_j$) against mean land value differentials ($\bar{\tilde{r}}_j$) and serves as an introduction to the regression results. The slope of the linear trend suggests a land cost share of $\phi_L = \beta_1 = 0.436$ and the binomial slope suggests convexity ($\beta_3 = 0.076$) and an elasticity of substitution less than one. Holding all else constant the HMAs above (below) these lines have lower (higher) than average housing productivity. However, some of the price differences will be explained by construction costs. Furthermore, construction costs are correlated with land values, therefore, the land cost share itself is biased.

Table 4 presents the results from the panel fixed effects and IV estimation of Equation (7). I estimate the Cobb–Douglas and translog production functions with and without CRS restrictions. The key parameter is CA designation, and this is positive and significant across all specifications, implying that CAs lead to higher house prices by reducing housing productivity. A standard deviation increase (an increase of 0.013) in designation is associated with a 0.159–0.169 house price effect in the fixed effects models and a 0.433–0.600 effect in the instrumented models. Since the fixed effects results are inconsistent under the existence of time-variant unobservables and since the first stage F-stats indicate the instrument is not weak, the IV estimates are the preferred results. The estimates imply that designation over 1997–2007 would have increased house prices (via reduced productivity) by 4.3–6.0% for the average HMA.[26] The instrumented estimates are significantly larger than their uninstrumented versions, implying that unobservables that are positively related to designation (such as gentrification) are positively related to housing productivity (i.e. reduce house prices for given input

26 The average HMA increased its designation share by about one tenth of the (between-group) standard deviation over the period 1997–2007. One tenth is multiplied by the coefficients to arrive at the average effect on prices. As argued in the data section, the increase in designation of 0.13% of all HMA land may produce large productivity effects if it disproportionately affects marginal developments. Therefore, the estimated effect sizes are plausible.

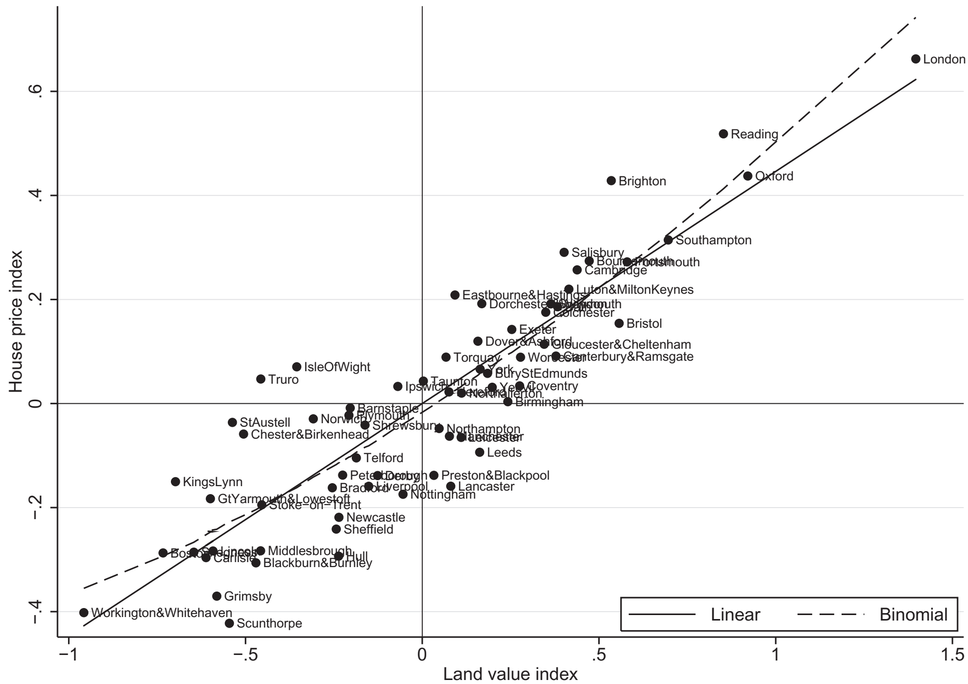

Figure 6. House prices vs land values for English Housing Market Areas.
Notes: These trend lines depict predicted values from simplified versions of Equation (7). The linear version of the simple regression is: $\bar{\bar{p}}_j = \beta_1 \bar{\bar{v}}_j + \beta_3 (\bar{\bar{r}}_j)^2$ where the bar accent signifies the average across years for each HMA.

prices). As discussed in the empirical strategy this could be the case if gentrification is associated with, for example, transport improvements at the city level that increase productivity in the housing sector.[27]

The refusal rate control is also positive and significant in all models, implying planning restrictiveness decreases housing productivity. Here, the magnitude of the coefficient in the instrumented models suggests an increase in house prices of 6.0–7.8% over the period.[28] However, the refusals data has been smoothed making the coefficients unreliable. Furthermore, only the designation variable has been instrumented.

The land cost share is around 0.17-0.18 in all columns, which compares with a land cost share of 0.35–0.37 when estimating a housing cost function for the US (Albouy and Ehrlich, 2012). However, as outlined in Appendix B in the Online Appendix my preferred estimate of the land cost share is 0.29 after instrumenting for land values. The elasticity of substitution is 0.755 in the (restricted translog) panel fixed effects model and 0.213 in the instrumented model (compared with 0.367 for the US in Albouy and Ehrlich (2012)). The parameter from the instrumented model falls at the lower end of

27 Transport is also a likely quality of life amenity that would *increase* house prices via the quality of life route. However, it would also increase land values and therefore be captured in the land cost share of the cost function step.

28 The effect implied by the coefficients of 2.6–3.4% multiplied by the average increase in refusals of 2.3 (between-group) standard deviations.

the range of estimates in the literature, however, a robustness check in Appendix B in the Online Appendix using only new properties finds it increases to 0.402 which is the preferred estimate of the elasticity of substitution since new properties will not be subject to a depreciation of the capital component of the cost of housing, as argued by Ahlfeldt and McMillen (2014).

In terms of model selection, I focus on the tests of the restrictions in the instrumented models. The Cobb–Douglas restrictions are easily rejected in columns (5) and (6). The CRS restrictions are not rejected in column (6) but are rejected in column (8). Although CRS is rejected in column (8) I choose to proceed with the restricted translog model assumed in the theory. This decision is also justifiable given the results of interest do not differ greatly between restricted and unrestricted models.

5.2. Alternative specifications

Table 5 presents the alternative specifications of the restricted translog cost function. The baseline fixed effects and instrumented models are repeated in columns (1) and (5) for comparison. The first stages in Appendix B in the Online Appendix indicate that the instrumental variable approach encounters varying degrees of success across these alternative specifications. Therefore, in cases where the instrument appears to fail, evidence from the 'second-best' fixed effects model will be drawn upon to form tentative findings.

Columns (2) and (6) report the results for designation interacted with dummy variables for the Saiz undevelopable land index. In the instrumented model, there is a surprising negative effect for the land-abundant HMAs. However, the instrument has an unexpected sign for the subsample of land-abundant HMAs, suggesting this result may be disregarded. Instead, I focus on the fixed effects results where the productivity effect of designation in land constrained HMAs is larger than the baseline effect. For HMAs with plenty of land, however, the effect is far smaller and is statistically insignificant. Therefore, the results from the fixed effects model imply there is a greater effect of designation on housing productivity where there is a lack of land availability. This result conforms to expectations, since regulating development in CAs should have a smaller impact on productivity if there is an abundance of land elsewhere in the city.

Columns (3) and (7) report the factor non-neutral specification. Again, the first-stage coefficient of the instrument has the wrong sign for the non-neutral variable, suggesting that instrumentation is not successful in this model. In the fixed effects model, however, the designation parameter is unaffected by the inclusion of the interaction with the factor price difference. The interacted variable itself is insignificant, implying factor neutrality is a reasonable assumption. This result is in line with that found by Albouy and Ehrlich (2012) for regulation across US MSAs.

Finally, columns (4) and (8) report the effect of the cumulative version of the designation variable. The variable is insignificant in the fixed effects specification but significant in the instrumented model. Since the instrument is strong, the instrumented version is preferred, suggesting that the housing productivity effects of designation may increase over time.

The alternative specifications support the main result of the cost function step that designation increases housing costs by reducing housing productivity. The additional specification suggest that the effect may decrease with land availability and may be cumulative with time. The results also support the assumption of a factor neutral housing productivity impact.

5.3. Quality of life and CAs

Table 6 presents the estimates from the quality of life regression of Equation (8). The same productivity shifters are used as in the respective first step cost functions. Columns (1)–(4) use the fixed effects model in both the cost function and quality of life steps and columns (5)–(8) use the instrumented model in both steps. In general, the parameters for the designation variables are positive and significant, implying designation increases quality of life. In the baseline fixed effects model of column (1), a one-point decrease in designation is associated with a 0.077 point increase in quality of life expressed as a share of expenditure. Instrumenting designation in column (5) reveals a similar quality of life effect of 0.071. A similar estimate makes sense if designation was associated with trends in both positive and negative quality of life factors.

As stated, the overall welfare effect is computed as the quality of life effect minus the housing expenditure share times the housing productivity effect. Using the baseline fixed effects specification results in a welfare effect of $0.077 - (0.31 \times 0.159) = 0.028$ and using the baseline instrumental variables specification results in a welfare effect of $0.071 - (0.31 \times 0.433) = -0.063$. The fixed effects model suggests that designations are welfare-improving, whereas the instrumented model suggests designation worsens welfare. Since the fixed effects results are inconsistent under the presence of time-variant unobservables, and since the F-stats indicate the instrument is strong, the instrumented model is preferred. The average HMA increased its designation share by $1/10$ points over the period, suggesting an effect on welfare of -0.63% of expenditure.[29] Given the mean income of £22,800 in 2004–2005 this is equivalent to an income reduction of about £1500 over the study period. As discussed in the theory, the validity of the welfare effect relies on there being relatively little quantity adjustments or sorting. In the case where such effects are large, the welfare benefits of designation are overestimated, implying that the welfare loss from designation is an underestimate.

Further, it should be noted that I have computed the overall welfare effect using point estimates. To obtain confidence intervals in another specification I estimate both steps together using seemingly unrelated regressions (SUR). This approach allows for computation of the welfare effect as a linear combination of coefficients across models. Following this approach implies a 90% confidence interval with a lower bound of -0.005 and an upper bound -0.126. Essentially, the welfare loss could range from almost zero to around double the point estimate.

For planning refusals, the quality of life effects are very small in the instrumented specification. Given that the housing productivity effects were negative, this suggests that planning refusals are welfare-decreasing. However, since the planning variable is volatile and is not instrumented, this should not be taken at face value.

Columns (2) and (6) examine the quality of life effects when interacting the designation variable with the Saiz index dummies. As in the cost function step, the first

29 This effect refers to an average homeowner in a city, and there may be a distribution of effects depending on whether the household lives inside or nearby a CA.

stage for land abundant cities has an unexpected sign, suggesting that instrumentation was unsuccessful and that the fixed effects results are preferred. The fixed effects model shows a significant positive impact on quality of life for areas with land scarcity but an insignificant effect in areas with a land abundance. The coefficient for land scarce areas implies slightly larger quality of life effects than in the baseline specification. Together with the first step, these results imply designations will have both larger housing productivity and larger quality of life effects in cities with a scarcity of developable land. This result makes sense since it is unlikely that designation will have quality of life effects without impacting on housing productivity.

Columns (3) and (7) investigate the quality of life effects allowing for non-factor-neutral productivity shifts from designation. As with the first step, the instrumentation appears to fail when predicting the non-neutral designation variable. I therefore concentrate on the fixed effect results where the substantive conclusions are unchanged from the baseline specification. This result supports the evidence from the cost function step that indicated that factor neutrality was a reasonable assumption.

Finally, columns (4) and (8) investigate the quality of life effects for the cumulative version of the designation variable. The cumulative designation effects in the instrumented specification are larger than the baseline effects, but the overall welfare effect remains negative (although smaller in magnitude).

5.4. Robustness checks

To check the sensitivity of these results, I estimate a number of robustness checks in Appendix B in the Online Appendix. These checks are (i) unweighted aggregation of the data to the HMA-level, (ii) using only new properties (<5 years old),[30] (iii) using the full sample of 74 HMAs (not excluding the eight with few transactions), (iv) using a quality of life measure that uses regional variation in the marginal tax rate and the share of wages in income, (v) using a quality of life measure with a high expenditure share on housing, (vi) using a quality of life measure with a low expenditure share on housing, (vii) using a quality of life measure where the expenditure share varies according to city income and (viii) repeating the IV specification using prices from the hedonic model without date bands interacted with year effects. As discussed in Appendix B, the broad results are robust to these changes. In Appendix B, I also demonstrate that the approach is robust to using LAs as the unit of observation.

6. Conclusion

This article provides evidence of the effects of CA designation on economic welfare. I constructed a unique panel dataset for English housing market areas (HMAs) that resemble city regions. In the first step of the empirical strategy, I estimated the housing productivity effect of designation using a cost function approach. Here, I regressed house prices on factor prices (land and construction costs) and productivity shifters

30 Using only new properties follows Ahlfeldt and McMillen (2014) who argue that accurate estimates of the land cost share and elasticity of substitution will be biased by a depreciation of the capital component for older housing stock.

(including designation). In the second step, I estimated the quality of life benefits and the overall welfare impact of designation. I regressed a quality of life index on housing productivity factors used in the first step. I implemented both stages using panel fixed effects and IV approaches.

The main results imply that CA designations (in England, 1997–2007) are associated with both negative housing productivity effects and positive quality of life effects. In the cost function step, increases in designation share lead to higher house prices (compared with land values) indicating a negative shift in housing productivity. The second step reveals that designation leads to increases in quality of life. However, the overall welfare effect is negative in the instrumented and preferred specification. This result is in line with previous evidence that suggests housing regulation is welfare-decreasing.

The negative welfare impact of designation over 1997–2007 makes sense if there are concave returns to designation. The areas most worthy of protection may have been designated in the policy's first 30 years of operation (1966–1996). More recent designations then would be of a less distinctive heritage character, and perhaps only of local significance. Designation has continued despite large costs incurred at the housing market level, since, as argued by Ahlfeldt et al. (2017), designation status is largely determined by local homeowners who stand to gain from the localised benefits of the policy.

Nevertheless, though, there may be significant heterogeneity in the quality of CAs over the studied period and the results of this article do not suggest that all of these CAs reduced welfare. Furthermore, there may be significant heterogeneity across individuals, for example, the designation would be more welfare-improving for individuals with a greater than average preference for heritage or with a less than average expenditure share on housing. Overall, though, the results suggest that the average household would have been better off without the average CA being designated in the period between 1997 and 2007 in England. This overall welfare improvement of these designation not being made would have been equivalent to about £1500 per household.

Supplementary material

Supplementary data for this article are available at *Journal of Economic Geography* online.

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Dispelling myths: Reviewing the evidence on zoning reforms in Auckland☆

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ABSTRACT

In 2016, the city of Auckland adopted zoning reforms that enabled more housing on approximately three-quarters of its urban land. Three subsequent studies have found that these reforms increased housing supply and reduced rents. Two economists have, however, criticised these studies on blogs and social media, describing their findings as a "myth". Despite their informal nature, these critiques have been cited in formal planning and policy processes. Here, we review these critiques and find them to have little to no merit. Specifically, the critiques misunderstand the papers' methods and rely on inappropriate analyses. In our view, there is remarkably robust evidence that zoning reforms increased housing supply and reduced rents in Auckland.

Myths which are believed in tend to become true.
Accredited to George Orwell

1. Introduction

Economists have long been interested in the effects of planning policies on housing outcomes (for reviews, see Gyourko and Molloy, 2015; Molloy, 2020). Where planning policies act to constrain the development of housing, then conventional economic models predict they will lead to reduced housing supply (a "quantity" effect) and higher housing prices (a "price" effect), and vice versa where planning policies enable housing. The theoretical economic framework that produces these predictions is, however, hotly contested, especially by so-called "supply sceptics" who argue either that planning reforms do not increase housing supply or that increased housing supply does not lead to lower housing prices (for rebuttals of these arguments, see Manville et al. 2022 and Been et al. 2024). In this context, there is heightened need for empirical research to confirm whether the effects predicted by conventional economic models do indeed occur in practice and are large enough to make a meaningful contribution to housing affordability.

Previous efforts to undertake empirical research into the effects of planning policies on housing outcomes have, however, run into a simple problem: Large changes in planning policies are quite rare. For this reason, most empirical research has had to analyse the effects of small and/or gradual changes in planning policies on housing outcomes between locations and over time (see, e.g. Wallace, 1988; Mayer and Somerville, 2000; Glaeser and Gyourko, 2018). In these studies, the gradual and/or small size of the changes in planning policies vis-à-vis other factors make it more difficult to draw causal inferences about the effects of reforms on quantities and prices. Additionally, the empirical effects of small and/or gradual changes may be substantively different from major reforms. By significantly expanding the supply of developable parcels, for example, major reforms could increase competition between landowners and have larger effects than small (or, "spot") upzonings. Until recently, empirical analyses of housing outcomes before and after the adoption of *major* planning reforms have been a notable gap in the literature.

Nonetheless, growing concerns with housing affordability have

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prompted some jurisdictions to progress policy reforms to enable more housing, which is often described as "upzoning". The case for upzoning is often premised on the predictions of conventional economic models as noted above, where planning policies are seen as constraints on development that reduce housing supply and increase housing prices.[1] Perhaps the most notable example of upzoning comes from the city of Auckland, New Zealand, where the amalgamation of seven councils necessitated the development of a new set of planning rules known as the Auckland Unitary Plan, or "AUP" (for a background to the AUP, see Greenaway-McGrevy and Jones, 2023). By upzoning approximately three-quarters of Auckland's urban land, the AUP presented researchers with a rare opportunity to study the empirical effects of major zoning reforms on housing outcomes. As a result, Auckland is now home to the most well-studied case study of major zoning reforms globally. The findings from three quasi-experimental studies that seek to quantify the empirical effects of the AUP are central to this paper and are worth introducing briefly from the outset.[2]

First, Greenaway-McGrevy and Phillips (2023) analyse the impact of the AUP on building consents ("permits") for dwellings by comparing upzoned and non-upzoned residential areas within Auckland from 2010–2021. The authors estimate that the AUP led to an additional 21, 808 consents after five years, which is around 4 % of Auckland's housing stock. Second, Greenaway-McGrevy (2023a) also analyses the impact of the AUP on consents but uses a different method that compares outcomes in Auckland to similar cities in New Zealand that did not upzone. This study finds even larger effects: The AUP led to an additional 43,500 consents within six years, or approximately 9 % of the housing stock. Third, Greenaway-McGrevy and So (2024) analyse the effects of the AUP on rents. Compared to similar cities in New Zealand that did not upzone, the authors find rents for comparable properties in Auckland six years after the AUP are 28 % lower than they would have been otherwise. Taken together, these studies provide evidence that, before the AUP, planning policies in Auckland were acting to constrain housing supply and increase housing prices — exactly as predicted by conventional economic models.[3]

At a time of growing concern with housing affordability, the three quasi-experimental studies of upzoning in Auckland have been received with interest by researchers, policy makers, and elected representatives alike — not just in New Zealand but also globally.[4]

Nevertheless, two economists — namely, Cameron Murray and Tim Helm (hereafter, "Murray and Helm") — have strongly criticised these three studies of the effects of upzoning in Auckland and somewhat controversially concluded that their findings are a "myth". Murray and Helm argue that *none* of the aforementioned evidence is credible. In contrast, our assessment finds that Murray and Helm's critiques have little to no merit: There is strong evidence that Auckland's upzoning has had large effects on housing outcomes. Indeed, even a cursory look at the data reveals that housing supply in Auckland has grown rapidly. As shown in Figure 1, dwelling consents in Auckland surged after the AUP to levels that were one-third higher than their previous peak, at the same time as consents in other parts of New Zealand remained fairly stable.

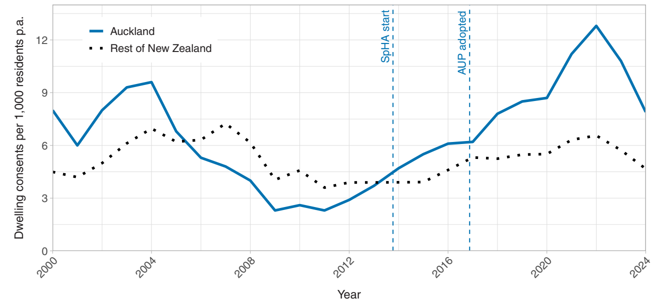

Fig. 1. Dwelling consents per 1000 residents in Auckland and rest of New Zealand 2000-2024. *Notes:* The "Rest of New Zealand" includes all other parts of New Zealand but exclude the Canterbury and Wellington regions, which were affected by an earthquake and zoning reforms in this period, respectively. The vertical line labelled "SpHA start" denotes when upzoning under the AUP was selectively applied to some areas of Auckland. The dwelling consent data for recent years is provisional and subject to revisions.

This discussion hints at a key question that is central to this paper: What housing outcomes would have been observed in Auckland in the *absence* of the AUP? Answers to this hypothetical question define the "counterfactuals" to which we can compare actual outcomes, such as consents and rents, in the wake of the AUP. In the three quasi-experimental studies discussed above, the counterfactuals are defined by non-upzoned areas of Auckland (cf. Greenaway-McGrevy and Phillips 2023) or non-upzoned cities in New Zealand (cf. Greenaway-McGrevy 2023a; Greenaway-McGrevy and So 2024).[5] More formally, these three quasi-experimental studies seek to infer the causal impacts of the AUP by comparing outcomes for locations that are subject to upzoning (the "treated" group) to outcomes for locations that are not (the "control" group). The underlying assumption is — in the absence of the AUP — outcomes for locations in the control group would be identical to those in the treated group. In turn, this implies the studies must carefully select the locations in the control group that define the counterfactual.

While there is room for debate on the most appropriate approach to defining the counterfactual for housing outcomes in Auckland, we find *all* reasonable methods imply the AUP had economically and statistically significant effects. The consistency of this finding suggests the impacts of upzoning are relatively robust to methodological choices. Although there is value in critiques of economic papers, including but not limited to these three studies from Auckland, we suggest Murray and Helm's arguments do not help to inform the debate. In Section 2, we provide a brief background to Murray and Helm's critiques and elaborate on our motivations for writing this paper.

2. Background

The first quasi-experimental study of the AUP was Greenaway-McGrevy and Phillips (2023), which was published online in the Journal of Urban Economics on 31 May 2023.[6] Five days later on 4 June 2023, Murray and Helm published a blog post titled "The Auckland Myth: There is no evidence that upzoning increased housing construction" (Murray and Helm, 2023a). As Greenaway-McGrevy and Phillips

[1] For an example of these arguments, see NZ Productivity Commission (2024), cf. p. 9).

[2] Two of these three studies are currently working papers. A fourth (published) quasi-experimental study analyses the impacts of the AUP on redevelopment premiums (Greenaway-McGrevy et al., 2021).

[3] The recent paper by Greenaway-McGrevy (2025) finds similar effects using a structural economic model that analyses the impact of upzoning in Auckland on residential floorspace and house prices.

[4] These three papers have, for example, been cited by the Australian Productivity Commission (2022); the NSW Productivity Commission (2023); the Grattan Institute (Coates and Moloney, 2023); the New South Wales Premier (NSW Parliament, 2024) and Housing Minister (ABC, 2024); the Chief Economist for Auckland Council (Jones et al., 2024); the Centre for Independent Studies (Tulip, 2024); Australian Treasury (2024); and the current Australian Government Housing Minister (O'Neil, 2024). In the US, Auckland's zoning reforms are discussed in, for example, West and Garlick (2023) and Politano (2024).

[5] Greenaway-McGrevy (2023a) also presents the results of a sensitivity test where outcomes in Auckland are compared to capital cities and states in Australia. The results of this test imply even larger effects.

[6] Versions of the working paper have been available to the public since 2021.

(2023) was at the time the only published quasi-experimental study of upzoning, Murray and Helm (2023a) claimed they had rebutted the evidence for upzoning.[7] Before publishing their blog post, Murray and Helm emailed some of their concerns to the lead author of Greenaway-McGrevy and Phillips (2023), who subsequently sought to address them in an extension paper, hereafter "Extension Paper" (Greenaway-McGrevy, 2023b). As the Extension Paper was also published on 31 May 2023 — *before* the publication of Murray and Helm (2023a) — we are unsure why the blog post did not address the Extension Paper in detail given that, as we shall argue below, it thoroughly addresses many of their concerns.

Soon after Murray and Helm's first blog post, one of the authors of this paper published a blog post titled "A response to Murray and Helm on Auckland's upzoning" (Maltman, 2023). This post considered Murray and Helm's critiques, noted the existence of the Extension Paper, and concluded Greenaway-McGrevy and Phillips (2023)'s methods and results appeared to be robust. On 27 August 2023, Murray and Helm released a second blog post that claimed to tackle Maltman's response, but instead mostly repackaged their initial concerns (Murray and Helm, 2023b).[8] In the wake of their two blog posts, Murray and Helm have posted on social media that the impacts of upzoning in Auckland are a "myth" (see, e.g., Helm, 2024a). Although these critiques initially did not engage with the two more recent papers noted above — that is, Greenaway-McGrevy (2023a) and Greenaway-McGrevy and So (2024) — this changed on 22 August 2024, when Helm claimed the results of these papers were also "utterly implausible" (Helm, 2024a).

Given that Murray and Helm have published their comments via informal channels *and* subsequent sections of this paper find them to have little to no merit, readers may wonder why these critiques would warrant our attention. We have three main reasons for wanting to formally document and assess Murray and Helm's critiques in this paper.

First, Murray and Helm have cited their blog posts in their submissions to formal policy and planning processes. Helm (2024b), for example, cited Murray and Helm (2023a) in evidence submitted to a planning process in Wellington, New Zealand. This evidence appears to have swayed Commissioners in this process, who determined that planning policies did not play a "dominant role in housing affordability" in Wellington (cf. p. 45 Independent Hearings Panel, 2024). Similarly, a parliamentary inquiry in Australia concluded that the evidence on Auckland's upzoning was contested, citing evidence submitted by Murray (see NSW Parliament, 2024a, paras 3.47–3.50). Given their apparent influence on policy and planning processes, we consider there is a public interest in formally documenting and assessing Murray and Helm's critiques in this paper.

Second, many of Murray and Helm's critiques diverge from the wider economic evidence. Not only is there robust quasi-experimental evidence that upzoning increased housing supply and reduced rents in Auckland, but this evidence dovetails with a large number of other economic studies that also find planning policies can affect both the supply and price of housing.[9] The combined weight of this evidence, moreover, appears to have persuaded a majority of economists. In a survey of notable economists conducted by the Economic Society of Australia, 65 % of respondents believed 'easing planning restrictions' is one of the top 3 measures that governments can take to improve housing affordability (Martin, 2023). Similarly, a survey undertaken by the New Zealand Association of Economists found around 95 % of respondents believed that land use restrictions reduced housing supply and affordability (Wesselbaum, 2023). In this context, we see value in contrasting Murray and Helm's critiques with the wider economic evidence.[10]

Third, this episode raises questions about how planning processes engage with economic evidence. In our view, the adverse influence of Murray and Helm's critiques provides a timely reminder of the value of more formal literature, such as working papers and peer-reviewed articles, compared to informal channels, such as blog posts and online comments. While formal literature is not immune to mistakes and misrepresentations, such problems are more likely to be identified and addressed — whether by the original researchers, peer reviewers, journal editors, or subsequent researchers. Interestingly, the Commissioners in Wellington admitted under questioning their decisions were informed more by Helm's *oral testimony* than his *written evidence* (cf. 48 mins, Wellington City Council, 2024). If the Commissioners had instead put more weight on Helm's written evidence, then they might have noticed that it relied heavily on a blog post that he had co-authored, rather than more formal sources. By documenting some of the most egregious errors that affect Murray and Helm's informal critiques, we hope to stimulate debate on how planning and policy processes can best engage with economic evidence.

The adverse influence of Murray and Helm's critiques on policy, their divergence from mainstream economic evidence and opinion, and the implications of this episode for planning and policy processes have motivated us to write this paper. In doing so, we hope to support more informed conversations, guide further research, and contribute to the adoption of evidence-based policies. We structure the following sections of this paper as follows: Section 3 considers Murray and Helm's critiques of Greenaway-McGrevy and Phillips (2023); Section 4 considers the reasonableness of various possible counterfactuals; Section 5 considers corroborating evidence; and Section 6 concludes.

3. Critiques of Greenaway-McGrevy and Phillips (2023)

In this section, we consider Murray and Helm's critiques of Greenaway-McGrevy and Phillips (2023). We decompose these critiques into three sub-sections: First, the selection of the treated and control groups; second, the distinction between consents and completions; and third, the econometric methods that underpin the analysis.

[7] As we shall discuss below, this claim contradicts a considerable body of evidence from other jurisdictions and contexts that also finds planning policies, like zoning, can constrain housing supply.

[8] Whereas the first blog post in Murray and Helm (2023a) mostly focused on the merits of the methods used in Greenaway-McGrevy and Phillips (2023), the second blog post in Murray and Helm (2023b) implied that others had ulterior motives, for example observing "… the story that upzoning produced a huge building boom is becoming an urban myth. Cherry-picking figures, uncritically citing a paper with known methodological issues, and writing fairy tales about a small and plucky city far away is well and good when pushing a policy agenda …But if that's your game with Auckland and upzoning, please be honest enough to admit you're playing politics, not doing economic science". The rhetoric was taken even further in a recent comment on social media, where Helm stated: "Do the people pushing it believe a data fudge or two is okay in service of a good cause? Because I don't. We need honesty. Good housing policy needs smart people to stop pretending to be stupid. Suspending your critical faculties because you like the policy story is not okay … right now, the public is being deceived. Presumably, no-one is orchestrating a conspiracy to enrich landowners at the expense of taxpayers, by misleading the public to ram through unpopular changes, but if they were, they couldn't do a better job" (Helm, 2024a).

[9] See, e.g. Hilber and Vermeulen (2016); Jackson (2016); Eriksen and Orlando (2022); Molloy et al. (2022); Ahlfeldt et al. (2023); Asquith et al. (2023); Maltman and Greenaway-McGrevy (2025); Greenaway-McGrevy (2025). For evidence of the microeconomic channels, or behavioural mechanisms, through which new housing can support housing affordability more widely see Mast (2023); Bratu et al. (2023). The latter use detailed data to track individual households over time and find that new housing creates vacancies that extend into the wider area via a series of household moves ("moving chains"), quickly alleviating housing pressures in middle- and low-income suburbs.

[10] Appendix A examines several additional related critiques advanced by Murray and Helm, such as landbanking, which are, in our view, unsupported by the economic evidence.

3.1. Selection of the treated and control groups

This aspect of Murray and Helm's critique focuses on the sample used in Greenaway-McGrevy and Phillips (2023), which excludes data for some areas of Auckland that — if they are included — appears to reduce the impacts of upzoning. Murray and Helm include this data in the chart in the left panel of Figure 2, which they argue is a more reasonable representation of trends in dwelling consents in upzoned and non-upzoned areas of Auckland than the chart from Greenaway-McGrevy and Phillips (2023) that is shown in the right panel. Murray and Helm's critique implies the increase in dwelling consents in upzoned areas is a continuation of existing trends before the AUP came into effect (the "pre-treatment period"), rather than an effect of the AUP in 2016.[11]

This critique is flawed for three reasons. First, Murray and Helm misunderstand how researchers select the treated and control groups in quasi-experimental studies. Second, Murray and Helm do not inform their readers that Greenaway-McGrevy and Phillips (2023) transparently disclose why they choose to remove these data and, most importantly, demonstrate that their results are robust to the inclusion of this data. Third, Murray and Helm mistakenly include all these data in the treated group when many of these consents were, in fact, in areas that were not upzoned. When correctly assigned, trends between upzoned and non-upzoned regions in the pre-treatment period appear comparable.

3.1.1. Designing a 'quasi'-experiment

Murray and Helm's critique misunderstands how quasi-experimental research works in practice. Unlike randomised control trials ("RCTs"), quasi-experimental research must assess the effects of interventions in the absence of randomization.[12] This requires researchers to construct a "quasi" experiment by using statistical methods to approximate randomization or by selecting a control group that closely matches the treated group in all respects except for exposure to the intervention. In quasi-experimental designs, researchers thus carefully select the data that goes into the control and treated groups to avoid bias; simply including all the available data is rarely appropriate.

In this spirit, Greenaway-McGrevy and Phillips (2023) deliberately select non-upzoned areas that they expect will provide an appropriate counterfactual to upzoned areas in Auckland. Accordingly, the authors intentionally contrast urban residential areas that were impacted by the AUP in 2016 with similar but unaffected urban residential areas. This approach *strengthens* the validity and reliability of the results by ensuring a meaningful "like-for-like" comparison. There is, however, one downside of allowing researchers to curate their sample to improve comparability: It could increase the risk that data is selectively used to support specific findings.[13] To mitigate this risk, quasi-experimental studies should ideally a) disclose any excluded data along with the rationale for exclusion and b) investigate the robustness of their results to the excluded data. As the following sub-section shows, Greenaway-McGrevy and Phillips (2023) does both.

3.1.2. Disclosure and robustness

As well as misunderstanding quasi-experimental methods, Murray and Helm's critique suffers from a second flaw: Greenaway-McGrevy and Phillips (2023) disclose their reasons for excluding some data and show their results are robust to their inclusion.

Specifically, to support the "like-for-like" comparisons that underpin the use of quasi-experimental methods, Greenaway-McGrevy and Phillips (2023)'s sample deliberately and transparently excludes two types of data. First, they limit the sample only to 'residential' areas, omitting rural and business areas. Although the latter sometimes allow residential development, the nature of housing tends to be quite different. Business areas, for example, may permit housing over commercial or retail space, but this is unlikely to be a suitable counterfactual for areas where single-detached dwellings are upzoned to medium-density housing. Second, Greenaway-McGrevy and Phillips (2023) also exclude data associated with Special Housing Areas, or "SpHA", which ran from September 2013 until the adoption of the AUP in December 2016, noting the following reasons (p. 5):

> "On the supply side, prior to the AUP, 'Special Housing Areas' ("SpHA") incentivized developers to provide some housing units at below-market prices in exchange for accelerated processing of building permits. Developers could also use more relaxed planning rules from a preliminary version of the plan (the "Proposed AUP", notified in September 2013).
> SpHA were disestablished once the AUP became operational. We exclude permits issued in SpHA prior to 2017 as a disproportionate share of SpHA permits are in locations that were later upzoned. A robustness check reported in the Appendix demonstrates that our findings are not substantively affected when these permits are included in the analysis."

Here, Greenaway-McGrevy and Phillips (2023) observe that they chose to remove data in SpHA *because developments in these areas could make use of AUP rules in advance.* Given Greenaway-McGrevy and Phillips (2023)'s focus on the 2016 date at which the AUP applied to all of Auckland, it would not be appropriate to include SpHA in either the control group (that is, non-upzoned areas in Auckland) or in the treated group.

In our view, removing data for rural/business areas and SpHAs is both standard practice and ex ante reasonable. We expect most researchers who are familiar with quasi-experimental studies would be more concerned if these data were included.

Notwithstanding these transparent disclosures, Greenaway-McGrevy and Phillips (2023) and the Extension Paper also document the results of sensitivity tests that show *even if* these data are included, the AUP still has a substantial (in fact, larger) impact on dwelling consents. The Appendix to Greenaway-McGrevy and Phillips (2023), for example, presents a sensitivity test where SpHAs are included in the control group with the original 2016 timing. Although this test is conservative, it nonetheless still finds the AUP had a large and statistically significant impact on consents. The Extension Paper presents another sensitivity test that is, in our view, more appropriate: All data — including SpHAs, rural, and business areas — are included in the sample with an additional treatment date set to 2013 (Greenaway-McGrevy, 2023b). In this test, the structural break in 2016 disappears, but a new break emerges in 2013 when the SpHAs began to take effect. The Extension Paper describes the results of this sensitivity test as follows (p. 14):

> "Total permits no longer exhibit a substantial break in trend in 2016, when the AUP became operational. However, the decomposition into upzoned and remaining areas illustrates that much of this is due to permits in upzoned areas growing at a faster rate between 2013 and 2016. Thus, much of the increase in the interim period between 2013 and 2016 is occurring in areas targeted for upzoning under the AUP."

Crucially, the Extension Paper finds that including all the data serves

[11] Different trends in the 'treated' and 'control' groups also violates a key assumption of the difference-in-difference ("DiD") methods that are used in Greenaway-McGrevy and Phillips (2023).

[12] In RCTs, researchers can randomly assign subjects into treated and control (or, "placebo") groups. Comparing outcomes between the treated and control groups is then sufficient to identify the causal effect of the treatment. RCTs are standard practice in medical trials, although much less common in economics.

[13] Recently, Helm suggested the sample choices made by the authors of Greenaway-McGrevy and Phillips (2023) were *intended* to exaggerate the impacts of the AUP, arguing they "… omitted inconvenient data, creating a heavily biased sample with a structural break that did not exist in reality" (Helm, 2024a).

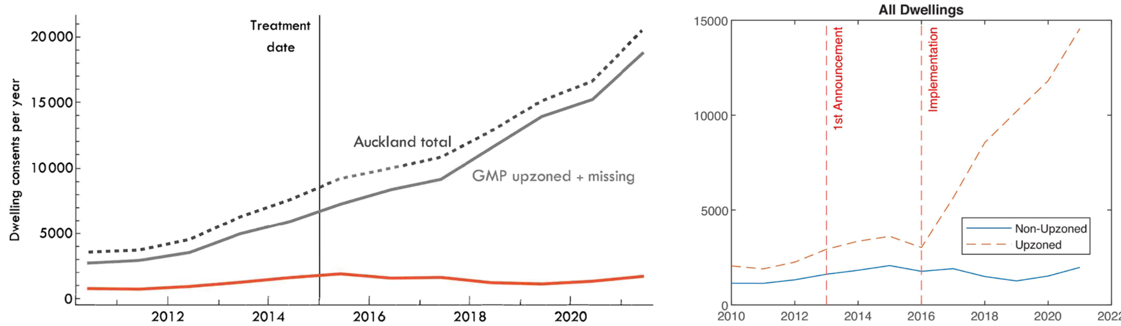

Fig. 2. Comparing trends in dwelling consents from Murray and Helm (2023a) to Greenaway-McGrevy and Phillips (cf Figure 3, (2023)).

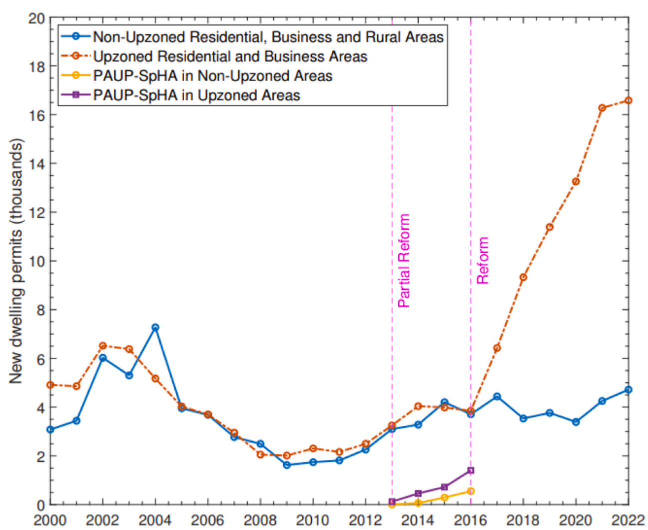

Fig. 3. Trends in total dwelling consents in Auckland 2000–2022 (Source: Greenaway-McGrevy and Phillips (cf Figure 3, 2023)).

to increase the estimated impacts of the AUP, because the latter now affects a larger area for a longer period (p. 19): "The incorporation of the SpHA generally lends support to the evidence that upzoning increased dwelling construction permits in Auckland. Set-identified treatment effects remain statistically significant under larger counterfactual sets, and point estimates of the increase in permits under linear trend counterfactuals are greater."

Together, these sensitivity tests show Greenaway-McGrevy and Phillips (2023)'s results are robust to the exclusion of these data. Indeed, including these data leads to larger impacts from upzoning. As Murray and Helm's blog posts and social media comments have not explicitly acknowledged nor engaged with the results of these sensitivity tests, we conclude that this aspect of their critiques has little to no merit.

3.1.3. *Clarifying the treatment*

The third flaw in Murray and Helm's critique is that it muddies the treatment of upzoning under the AUP in two crucial ways. First, Murray and Helm incorrectly assign data to the treated group and, second, they inaccurately represent the timing of the treatment.

As demonstrated in Figure 2, Murray and Helm lump all the missing data (that is, all business, rural, and SpHAs zones in Auckland) into the 'treated' or upzoned group. While *some* of these areas were affected by the AUP (notably SpHAs, as well as some rural/business areas being converted to residential or allowing for greater development), many were not. Placing all these missing data into the 'treated' or upzoned group is not accurate, and gives the false impression that a) non-upzoned areas were not a good counterfactual for upzoned areas, and b) that there was already strong growth in dwelling consents in upzoned areas prior to the adoption of the AUP.

In contrast, when undertaking the sensitivity test that was described in Section 3.1.2, the Extension Paper assigns these data to the correct group and with the correct timing (Greenaway-McGrevy, 2023b). Figure 3 illustrates the trends that result when the data is correctly assigned as upzoned under the AUP (or, "treated" in 2016), not upzoned under the AUP (or, "control"), and SpHAs ("treated" but with the timing of treatment occurring in 2013). We can see from Figure 3 that both the treated and control groups have comparable outcomes during the pre-treatment period. Additionally, we see growth in consents in SpHAs exceeded other areas in Auckland from 2013 to 2016, as upzoning began to impact dwelling consents in these areas. And, finally, outcomes in the treated group diverge rapidly following the adoption of the AUP in 2016.

The trends in Figure 3 differ from those in the left panel of Figure 2 because the latter incorrectly assigns data between the treated and control groups and inaccurately represents the timing of the treatment. Our assessment thus finds the data used in Greenaway-McGrevy and Phillips (2023) is ex ante reasonable and makes sense in practice. Moreover, the latter's results are robust to the choice of data; including all data tends to increase — rather than decrease — the estimated effect of upzoning in Auckland. For these reasons, we find this aspect of Murray and Helm's critiques has little to no merit.

3.2. *Consents are not completions, but both have hit record levels*

Another of Murray and Helm's methodological critiques considers the distinction between consents and completions. Specifically, this critique argues that because Greenaway-McGrevy and Phillips (2023) and Greenaway-McGrevy (2023a) use dwelling consents (comparable to a "permit" in other jurisdictions) rather than dwelling completions, the impacts on housing supply are over-estimated. Murray and Helm (2023a) argues:

> "A final note of caution concerns the interpretation of dwelling consents as extra dwellings. Historically, about 90 % of consents become completed dwellings after two years … Recently, however, net additional dwellings, as measured by the change in the number of residential electricity connections, have not grown as fast as completions would suggest. Net additional dwellings two years after approvals fell from 77 % prior to 2018, to 69% since 2020. This implies that more existing homes are being demolished for each new home."

There are two problems with this critique. First, although there are valid questions about what proportion of consents will result in completions and by when, Murray and Helm (2023a) ignore existing

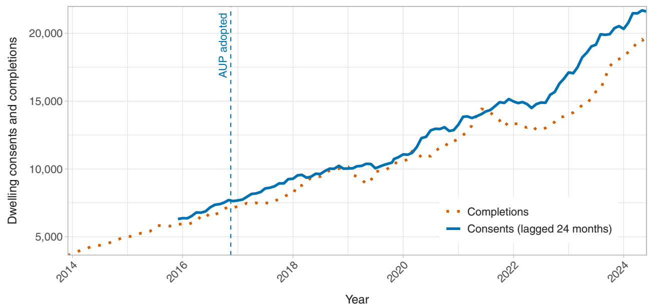

Fig. 4. Dwelling consents (lagged 24 months) and completions in Auckland 2014–2024. *Notes*: Dwelling consents are lagged 24 months from reported values. The consent data for recent years is provisional and can be subject to revisions.

evidence on these questions and misrepresent both the magnitude and timing of the gap that has emerged between consents and completions in Auckland.[14] Intuitively, consents for dwellings can take months if not years to be acted on, especially for larger and more complex developments, like major subdivisions and apartment buildings, with the duration of the lag fluctuating in response to prevailing macroeconomic conditions. In Figure 4, we plot annual rolling totals of both dwelling consents and completions but lag the former by 24 months. This reveals that completions have indeed closely tracked consents. Although the gap between completions and consents widens circa 2021–22, this timing appears unrelated to the AUP and more likely due to other economic factors, such as the COVID pandemic, higher costs for building materials, and/or higher interest rates. Most importantly, and despite the recent slowdown in the growth of consents in Auckland, completions remain at record levels.

Second, Murray and Helm (2023a) argue that new residential electricity connections imply net additions to the dwelling stock have fallen, possibly due to demolitions. Other researchers have, however, investigated this question and found it has no empirical support. Jones et al. (2024), for example, use Auckland Council valuation data to estimate changes to the dwelling stock over time and note (p. 13):

> "Between August 2018 and August 2023, the dwelling stock estimate increased by 61,209 units. This compares to 72,377 dwellings consented between September 2016 and August 2021. This implies that one dwelling was demolished for every nine constructed, on average, assuming a 95 % completion rate on consented dwellings. Estimated teardown ratios are higher if a lower completion rate is assumed."

At face value, this estimate implies that approximately 84 % of dwelling consents flow through into net additions to the dwelling stock, far higher than Murray and Helm's estimate of 69 %. A higher rate of net dwelling additions in the wake of the AUP is also supported by data from the 2023 Census: In the period from 2018 to 2023, Auckland added 64,836 dwellings, which would represent almost 90 % of consents. In our view, data from both valuation records and the Census are likely to provide a more reliable measure of net additions to Auckland's dwelling stock than electricity connections.

In short, data shows Auckland's dwelling stock has grown strongly in the wake of the AUP, with completions continuing to hit record levels. Thus, we find no evidence to support Murray and Helm's suggestion that falling completion rates or higher demolition rates serve to undermine the findings of Greenaway-McGrevy and Phillips (2023).

[14] The supplementary material of Greenaway-McGrevy and Jones (2023), for example, analyses data on housing completions in Auckland assuming a 24-month lag between consents and completions, like we do below. Although Greenaway-McGrevy and Jones (2023) acknowledges this lag is imprecise, we consider this analysis to be more reliable than Murray and Helm's calculations.

3.3. Econometric methods: a tale of many-not-one counterfactuals, linear models, and inappropriate transformations

We now consider a third aspect of Murray and Helm's critiques: That the econometric methods used by Greenaway-McGrevy and Phillips (2023) understate growth in consents in the pre-treatment period, which causes them to understate consents in the counterfactual and, in turn, overstate the impacts of the AUP. Specifically, Murray and Helm argue the counterfactual in Greenaway-McGrevy and Phillips (2023) assumes "(a) linear growth, and (b) identical trends in upzoned and non-upzoned areas prior to the AUP", which — in their view — introduces "… significant biases." We find this critique has no merit for two reasons. First, it misunderstands the methods adopted by Greenaway-McGrevy and Phillips (2023), which treats linear trends as a probabilistic outcome that, in turn, defines the bounds of a *set* of counterfactuals, rather than one counterfactual. Second, we argue the linear trend used in Greenaway-McGrevy and Phillips (2023) is ex ante appropriate, whereas Murray and Helm rely on inappropriate transformations of the data.

3.3.1. Many-not-one counterfactuals

The first problem with Murray and Helm's critique is it seems to misunderstand how linear trends are used in Greenaway-McGrevy and Phillips (2023). Helm, for instance has stated that 'the authors assumed that without upzoning, growth would have continued in a straight line' (Helm, 2024a). Although this is a common theme in Murray and Helm's critiques, it mistakenly implies that a) Greenaway-McGrevy and Phillips (2023) estimate only *one* counterfactual, and b) this counterfactual implies perpetual, linear growth.

Instead, most of Greenaway-McGrevy and Phillips (2023) focuses on the development and application of novel econometric methods that allow them to quantify uncertainty in the linear pre-treatment trend, which is then used to generate not just one but an *entire set of counterfactuals* (cf. Figure 9, Greenaway-McGrevy and Phillips, 2023). Naturally, this set encompasses many pre-treatment trends that imply much higher levels of consents in the post-treatment period as well as non-linear and non-parametric counterfactuals. Provided the "true" counterfactual for what would have happened in Auckland in the absence of the AUP exists somewhere within the bounds of this set, then we can be confident that upzoning had a statistically significant positive effect on consents.

This aspect of Greenaway-McGrevy and Phillips (2023)'s methodology is crucial to the robustness of their results and, as far as we can tell, it has never been acknowledged by Murray and Helm. It is crucial because it means Greenaway-McGrevy and Phillips (2023) allows for a wide range of outcomes, many of which differ markedly from the average linear pre-treatment trend. In this context, using a linear model to generate individual counterfactuals is less relevant than the range of possible outcomes that fall within the bounds of the resulting set. Greenaway-McGrevy and Phillips (2023)'s probabilistic treatment of pre-treatment trends is not a mere technical detail: Indeed, it is one of the paper's main econometric contributions and helps to greatly reduce the sensitivity of its results to the assumed functional form for the model of pre-treatment trends.

Greenaway-McGrevy and Phillips (2023)'s probabilistic approach to modelling pre-treatment trends also directly undermines Murray and Helm's critique. Greenaway-McGrevy and Phillips (2023) explains, for example, that the counterfactual set can even encompass a variety of *non-linear trends*, observing "… the counterfactual set can even accommodate limited forms of exponential growth … including a year-on-year growth rate of 13.68 %" (cf. p. 15, Greenaway-McGrevy and Phillips, 2023). Notably, this growth rate is higher than the rate of pre-treatment growth (cf. Section 3.3.2 for more details).

Murray and Helm's critique, therefore, appears to be largely limited to one sub-section of Greenaway-McGrevy and Phillips (2023), specifically Section 5.4 'How Many Additional Permits Did Upzoning Enable?' In this sub-section, Greenaway-McGrevy and Phillips (2023) uses the midpoint of the counterfactual set — that is, the average rate of pre-treatment growth — to estimate the number of new consents that followed from upzoning. This is the only part of Greenaway-McGrevy and Phillips (2023) that presents a single, linear counterfactual for consents in Auckland in the absence of upzoning.

Presenting a critique of this one sub-section — without engaging with the broader econometric methods of the paper — is, in our view, inappropriate for two reasons. First, Murray and Helm claim to rebut Greenaway-McGrevy and Phillips (2023), rather than just one sub-section of Greenaway-McGrevy and Phillips (2023).[15] Second, Greenaway-McGrevy and Phillips (2023) notes the results in this sub-section should taken with caution, as they do not capture underlying uncertainty.[16] Methodologically, this distinction is similar to reporting a point estimate compared with a confidence interval.

Notwithstanding these points, the following sections note that Greenaway-McGrevy and Phillips (2023)'s use of linear trends is reasonable (cf. Section 3.3.2) and the counterfactual that results is plausible (cf. Section 4).

3.3.2. Linear models and inappropriate transformations

Many economic models assume there exists a linear relationship between the dependent (Y) and independent variables (X), which simply implies that each unit change in X has a constant effect on Y. Linear models are common for three main reasons: First, they are simple to estimate; second, they are easy to interpret; and third, their behaviour is predictable. In economic contexts where the effect of a variable on an outcome is theoretically or statistically unclear, linear models often provide a useful starting point.

Murray and Helm, however, dispute the use of linear trends to generate the set of counterfactuals in Greenaway-McGrevy and Phillips (2023). In their first blog post, for example, Murray and Helm write, "… there is no reason the counterfactual trend should be linear. Not many economic trends are. Fitting a curve to the pre-treatment trend fits that data better …" (Murray and Helm, 2023a).[17] On the surface, Murray and Helm's critique is not entirely without merit, as linear trends may not be appropriate in many situations. A case could also be made that economists tend to rely too heavily on linearity and the field would benefit from greater use of non-linear methods.

However, even if a non-linear trend "fits" the data better in the pre-treatment period, as Murray and Helm claim, it does not follow — either statistically or economically — that it is suited to generating counterfactuals in the post-treatment period. Non-linear methods also come with risks, notably overfitting. The latter arises when a model specification has superior *internal validity* (i.e. ability to predict data in the pre-treatment period) but inferior *external validity* (i.e. ability to predict data in the post-treatment period). A myopic focus on internal validity, as Murray and Helm seem to espouse, risks producing overfitted models that perform better at predicting *observed data* but worse at predicting *new data*. As quasi-experimental studies like Greenaway-McGrevy and Phillips (2023) are interested in counterfactuals in the post-treatment period, external validity is crucial. This is why many econometric analyses, including but not limited to Greenaway-McGrevy and Phillips (2023), use linear models unless there is evidence to support the use of non-linear models. We return to the question of over-fitting in Section 4.

The benefits of linearity can be contrasted with a recurring problem in Murray and Helm's critiques: The use of inappropriate transformations of the data, such as growth rates and indices. In their second blog post, for example, Murray and Helm (2023b) write: "Greenaway-McGrevy and Phillips (2023) effectively assume that, without the AUP upzoning, growth in consents would suddenly have slowed down. Over the five years prior to the AUP, annual growth in consents in Greenaway-McGrevy and Phillips (2023)'s sample averaged 12.1 %. But Greenaway-McGrevy and Phillips (2023)'s counterfactual for the six years following involves an average annual growth of just 5.7 %". These sentiments are then repeated on social media, where Helm comments, "In the real world, property moves in cycles. In the paper, it does not. The authors assumed that without upzoning, growth would have continued in a straight line, inexplicably halving from 12 % per annum to 6 %" (Helm, 2024a).[18] The essence of Murray and Helm's critique is the linear models used in Greenaway-McGrevy and Phillips (2023) are unreasonable because they imply the percentage growth in consents in Auckland would fall over time.

To see why this argument is statistically absurd, consider a simple linear model: $Y = X + 1$, where Y measures consents and X measures time. For each one period increase in X, Y also increases by one unit. In turn, this model implies the *percentage growth rate* of Y will fall with time, X. For example, an increase from $X = 1$ to $X = 2$ causes Y to increase from 2 to 3, or 50 %, whereas an increase from $X = 2$ to $X = 3$ causes Y to increase from 3 to 4, or only 33 %. Put simply, the outcome in a linear model grows faster in percentage terms when the explanatory variables, for example time, are starting from low levels.

Economic factors are also at play. Starting from low levels of economic activity usually means there is spare capacity available. When considering housing in Auckland, Greenaway-McGrevy and Phillips (2023)'s pre-treatment period begins in 2010, *just* as Auckland emerges from the Global Financial Crisis. Indeed, 2009 was the worst year on record for consents in Auckland. Improving macroeconomic conditions after a recessionary period should, prima facie, give rise to fast growth. And, importantly for the counterfactuals in Greenaway-McGrevy and Phillips (2023), we would expect growth to slow once activity approached the long-run average and spare capacity was absorbed. In this context, the lower growth rate in the post-treatment period that is implied by the counterfactuals in Greenaway-McGrevy and Phillips (2023) is entirely plausible. This is not complicated: Economic variables often grow faster when they are starting from low levels. Most tellingly, growth in consents also abruptly slowed in other New Zealand cities in the years after the AUP, which is a key point that we return to in Section 4.[19]

[15] This is relevant for Murray and Helm's main argument that "there is no evidence that upzoning increased supply in Auckland." Consider a hypothetical situation where Murray and Helm definitively proved that the midpoint counterfactual in Greenaway-McGrevy and Phillips (2023) was unreasonable compared to one that allowed for a higher rate of supply. Nevertheless, provided the latter counterfactual still existed within the bounds of the set of counterfactuals estimated by Greenaway-McGrevy and Phillips (2023), the AUP would still be found to have a positive and statistically significant causal effect on consents.

[16] The paper notes: "A point of caution should be made in interpreting these findings. Mounting any counterfactual such as an extrapolated linear trend or any set of fixed points inevitably introduces potential misspecification due to the absence of an observable counterfactual scenario and the ambiguities in model selection. In this work a particular method for specifying a counterfactual has been used and point estimates will consequently be sensitive to changes in that specification. Importantly, set-identification mitigates such specification problems by constructing a set that covers a wide-range of possible unobservable counterfactuals" (Greenaway-McGrevy and Phillips, 2023).

[17] Cryptically, Murray and Helm (2023a) argue, "Extrapolating growth this far forward is unrealistic. And this is part of our point: whether using a linear or non-linear trend, extrapolating a short and highly-cyclical series a long way into the future is an inherently unreliable way of defining a counterfactual." We make two comments. First, we are unsure of how one can define a counterfactual without using either linear or non-linear trends. Second, Murray and Helm subsequently define a non-linear, non-cyclical counterfactual.

[18] We are especially confused by the latter comment because we would have expected that the main implication of a "property cycle" is that growth rates change over time, rather than remaining constant.

[19] In the three years before and after 2016, for example, consents in Hamilton City grew by 21 % and 6 %, respectively, whereas in Tauranga City consents grew by 23 % and then *fell* by 3 %.

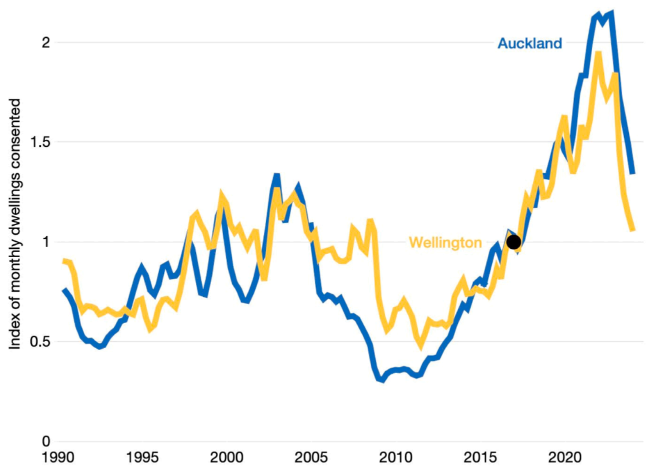

Fig. 5. Dwelling consents in Auckland and Wellington regions 1990–2024 indexed to 2016 levels (Source: Murray 2024).

To support their erroneous arguments about growth rates, Murray and Helm often adopt inappropriate and misleading transformations, such as indexation. Murray has, for example, regularly published charts such as Figure 5, which purport to show that consents in the Wellington region have tracked those in upzoned Auckland (Murray, 2024). This chart suffers from three problems. First, it uses an *index*. Although both regions approximately doubled consents after 2016, consents in Auckland increased from approximately 6 to 12 per 1000 residents whereas those in Wellington increased from less than 4–7 per 1000 residents. Indexation compresses the variance in the data, giving the impression that Auckland and Wellington experienced similar outcomes, when they did not. Second, the graph indexes consents *to 2016*. Per Section 3.1, Greenaway-McGrevy and Phillips (2023) find evidence that SpHA were already having positive impacts on consents in Auckland from 2013. That is, consents are indexed to a point in time where Auckland is already being affected by upzoning. Third, the graph compares Auckland to the Wellington *region*, which comprises several councils. One of these councils — namely Lower Hutt — also upzoned from circa 2017 onwards, which quasi-experimental research finds had a significant positive impact on consents (Maltman and Greenaway-McGrevy, 2025). The Wellington data shown in Figure 5 is thus also affected by upzoning.

In contrast, Figure 6 on the following page compares dwelling consents per 1000 residents in Auckland to those in the Wellington region as well as the (non-upzoned) rest of New Zealand. Notwithstanding that the Wellington data includes the effects of upzoning in Lower Hutt, a different picture emerges from Figure 6 vis-à-vis Figure 5.

In short, Murray and Helm's critiques of the linear trends that are used in Greenaway-McGrevy and Phillips (2023) suffer from basic errors and are highly misleading. For these reasons, we consider this aspect of Murray and Helm's critique to have no merit.

4. Reasonableness of the counterfactuals

We now consider a unifying theme in Murray and Helm's critiques that is alluded to above: A scepticism of the counterfactuals presented in Greenaway-McGrevy and Phillips (2023). Murray and Helm (2023b), for example, argue:

> "Was the counterfactual Greenaway-McGrevy and Phillips (2023) used to estimate growth in consents due to upzoning realistic? Here's a test for you. It's the end of 2015 … After a marathon debate, the proposed Auckland Unitary Plan (AUP) is rejected … Zoning rules stay as they are. If you lived in 2015 in this alternative no-AUP world, which path would you bet on in the image below for dwelling consents?"

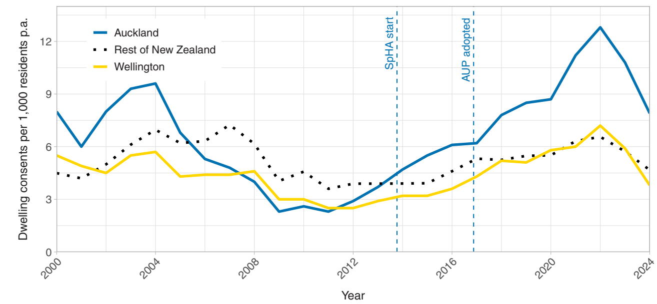

Fig. 6. Dwelling consents per 1000 residents in Auckland, Wellington, and rest of New Zealand 2000–2024. *Notes*: The "Rest of New Zealand" includes all other parts of New Zealand with the exception of Canterbury and Wellington regions, which were affected by earthquakes and upzonings in this period. The vertical line labelled "SpHA start" denotes when upzoning under the AUP was selectively applied to some areas of Auckland. The dwelling consent data for recent years is provisional and subject to revisions.

Murray and Helm (2023b) present the chart illustrated in Figure 7 and then ask:

> "Would you have picked D? We wouldn't have either. But D is the counterfactual used by Greenaway-McGrevy and Phillips (2023) to conclude that anything above this is the effect of the AUP on new dwelling consents …"

Murray and Helm's comments are mistaken for two reasons: First, even if D was the counterfactual in Greenaway-McGrevy and Phillips (2023), the available evidence indicates this is ex ante reasonable. Second, D is *not* the counterfactual used in Greenaway-McGrevy and Phillips (2023). We expand on both of these two points below.

4.1. *Counterfactual D is ex ante reasonable*

To proceed, assume we want to predict consents per 1000 residents in Auckland from 2016–24 in the hypothetical situation where the AUP was not implemented. Consider three simple methods for generating such a prediction. As a first pass, we might assume consents in the future continue at their historical mean.[20] The second method is almost as simple but subtly different: We could calculate average consents in other regions of New Zealand that did not upzone (per Figure 1). Third, we could calculate average consents in the Northland, Waikato, Bay of Plenty, Wellington, and Otago regions, which are either geographically close to Auckland and/or home to larger urban centres.

In Figure 8, the grey shaded area shows the range in consents per 1000 residents that we might expect for Auckland in the period from 2016–2024 based on these three methods. The solid dark and light blue lines, in contrast, illustrate observed consents in Auckland for the periods 2000–2015 and 2016–2024, respectively. Similarly, Murray and Helm (2023b)'s interpretation of the counterfactuals in Greenaway-McGrevy and Phillips (2023) and Greenaway-McGrevy (2023a) are denoted by the higher and lower dotted orange lines, respectively. Finally, the green dotdash line denotes the counterfactual proposed in Murray and Helm (2023b), which extrapolates the growth in consents in the pre-treatment period (12.6 % p.a.) into the post-treatment period.

We draw four main conclusions from Figure 8. First, circa 2017–18 actual consents per 1000 residents p.a. in Auckland surged above the levels implied by the three simple methods described above (per the

[20] From 1996–2015, Auckland issued an average of 5.9 consents per 1000 residents p.a. In 2016, Auckland issued close to this number: 6.3 units per 1000 residents. Although consents might fluctuate over time, we could expect them to revert to this historical average in the long run and absent any policy changes.

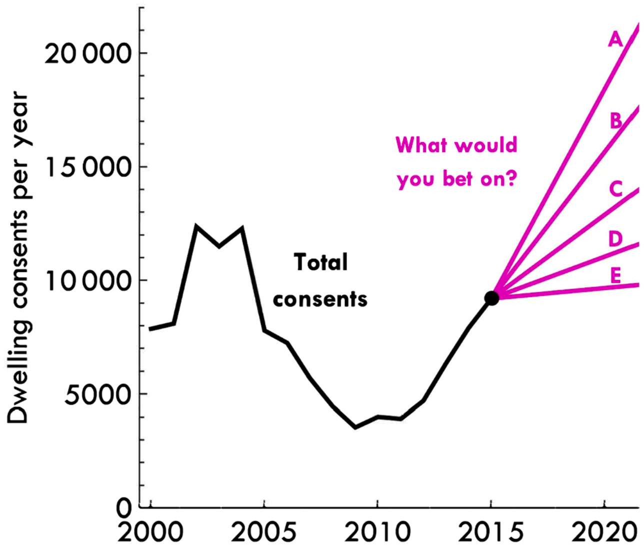

Fig. 7. Murray and Helm's alternative counterfactuals (Source: Murray and Helm 2023b).

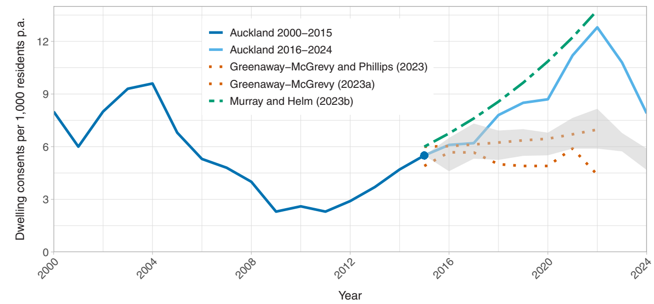

Fig. 8. Comparing observed dwelling consents per 1000 residents in Auckland 2000–2024 to alternative counterfactuals discussed in the text and in Murray and Helm (2023b). *Notes:* The grey shaded area denotes the range in dwelling consents that are defined by the three methods discussed in the preceding paragraph for the period from 2016–2024, specifically 1) mean dwelling consents from 1996–2015, 2) mean dwelling consents in regions of New Zealand that did not upzone, and 3) mean dwelling consents in the Northland, Waikato, Bay of Plenty, Wellington, and Otago regions. We note that Greenaway-McGrevy and Phillips (2023) analyses total consents, rather than consents per 1000 residents. The dwelling consent data for recent years is provisional and subject to revisions.

grey shaded area). Second, these simple methods imply levels of consents that are similar to the counterfactuals that Murray and Helm ascribe to Greenaway-McGrevy and Phillips (2023) and Greenaway-McGrevy (2023a) — per the higher and lower orange dotted lines, respectively. The counterfactuals used in these two quasi-experimental studies are therefore close to what we would reasonably expect based on both historical data for Auckland and outcomes elsewhere in New Zealand.[21] Third, the counterfactuals implied by the simple tests in Figure 8 are close to D in Figure 7.[22] As such, the counterfactual D is, in our view, *ex ante reasonable*. Fourth, when considered in this broader context, the counterfactual proposed by Murray and Helm (per the green dotdash line) is seen to be absurdly high, exceeding both the pre-AUP maximum (by approximately 40 %) *and* the level of consents that are observed in the wake of the AUP.

In short, Figure 8 both dispels Murray and Helm's critiques of the counterfactuals that are used in Greenaway-McGrevy and Phillips (2023) and Greenaway-McGrevy (2023a), *and* illustrates the absurd nature of the alternative counterfactual proposed in Murray and Helm (2023b).[23] Ex ante, we consider it extremely unlikely that Auckland could achieve these levels of consents without a major policy change, such as the AUP.

4.2. D is not, in fact, the counterfactual

We have established that the counterfactual D in Figure 7 — which Murray and Helm ascribe to Greenaway-McGrevy and Phillips (2023) — is not ex ante unreasonable. However, contrary to Murray and Helm's claims, D is not, in fact, the counterfactual that is used in Greenaway-McGrevy and Phillips (2023).

Figure 9 presents a graph from Murray and Helm (2023b), which illustrates their interpretation of the counterfactual used in Greenaway-McGrevy and Phillips (2023) (per the solid pink line). Clearly, if this was the counterfactual used in Greenaway-McGrevy and Phillips (2023), then it would be quite odd — as it is a relatively poor fit for the observed data (per the black line in the pre-treatment period 2010–2015). Murray and Helm are, however, mistaken and their own words reveal the origins of their error:

> "… [the counterfactual] looks reasonable with the sample data, but quite odd when applied to the city-wide total data, as in the chart below."

Here, Murray and Helm tacitly admit that Figure 9 was created by applying the counterfactual from the data in Greenaway-McGrevy and Phillips (2023) (per Section 3.1), to the *full sample* for all of Auckland, including SpHAs, business, and rural areas.

One can readily show the solid pink line in Figure 9 is not the mean counterfactual used in Greenaway-McGrevy and Phillips (2023) by calculating the difference between it and total consents (per the black line). This calculation provides an approximate point estimate for the effects of the AUP of around 34,000 consents, which is significantly higher than the 21,808 that is reported in Greenaway-McGrevy and Phillips (2023).

Murray and Helm's mistake is to extrapolate the growth rate to the *full* sample. Neither Greenaway-McGrevy and Phillips (2023) nor the Extension Paper use this approach. As discussed in detail in Section 3.1, the main paper excludes SpHA and business/rural areas to provide for like-for-like comparisons. By construction, the linear pre-treatment trend in Greenaway-McGrevy and Phillips (2023) will not include growth in these areas. Put simply, it is erroneous for Murray and Helm to compare the counterfactual in Greenaway-McGrevy and Phillips (2023) to the trend in consents for Auckland as a whole.

5. Corroborating evidence

In this section, we now expand the discussion beyond Greenaway-McGrevy and Phillips (2023) to consider corroborating evidence on the impacts of the AUP on housing outcomes in Auckland. Specifically, we discuss the implications of the two other quasi-experimental studies, namely Greenaway-McGrevy (2023a) and Greenaway-McGrevy and So (2024), which consider the impacts of the AUP on

[21] The Auckland "functional urban area" used in Greenaway-McGrevy (2023a) excludes large rural areas, which is why the latter's counterfactual is slightly lower than the other data points. If we scale this counterfactual by the difference in consents, then it shifts up to lie within the grey shaded area.

[22] In Figure 7, Line D implies that Auckland would issue approximately 12,000 consents in 2021. In that year, the mid-point of the grey shaded area implies Auckland would issue approximately 6.75 consents per 1000 residents p.a., while Stats NZ estimates Auckland's resident population was 1.72 million. These simple methods thus imply a counterfactual of around 11,600 consents, which lies between D and E.

[23] Murray and Helm's counterfactual also exceeds the maximum consenting rate that was observed in post-earthquake Canterbury and upzoned Lower Hutt — as illustrated in Figure 12 in Appendix B.

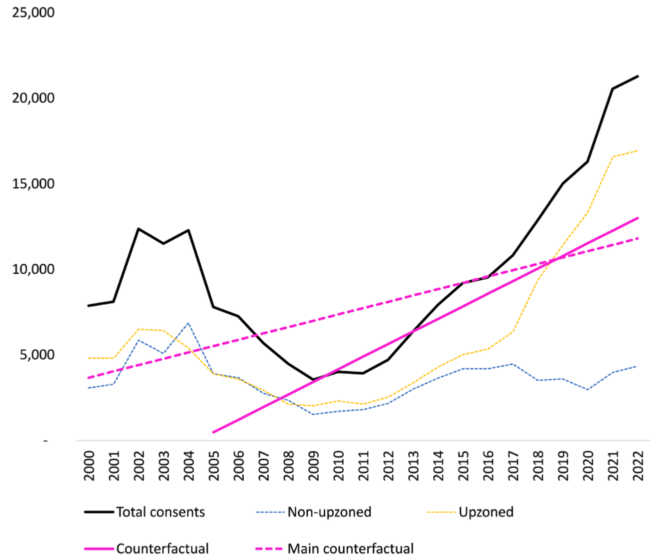

Fig. 9. Murray and Helm's comparison of total consents to their interpretation of the counterfactual in Greenaway-McGrevy and Phillips (2023) (Murray and Helm, 2023b). *Notes:* Murray and Helm claim the solid pink line represents the counterfactual that Greenaway-McGrevy and Phillips (2023) estimate using data for the pre-treatment period from 2010–2015. Murray and Helm go on to note that this counterfactual seems to be an "odd" fit for total consents city-wide denoted by the black line. In practice, the counterfactual in Greenaway-McGrevy and Phillips (2023) excludes consents in business / rural areas and SpHAs, as previously discussed in Section 3.1.

consents and rents, respectively. In doing so, we relate the findings of these studies to aspects of Murray and Helm's critiques.

5.1. Greenaway-McGrevy (2023a)

Whereas Greenaway-McGrevy and Phillips (2023) identifies the impact of the AUP by comparing consents between upzoned and non-upzoned areas within Auckland, Greenaway-McGrevy (2023a) compares consents between Auckland and other similar cities that did not upzone. Crucially, Greenaway-McGrevy (2023a) bypasses the question of linearity entirely — as discussed in Section 3.3.2 — by using another quasi-experimental method known as a "synthetic control".[24] The synthetic control method is non-linear and non-parametric: The counterfactual can go wherever is implied by the data that are used in its construction. To the extent that data on consents is affected by broader property cycles, for example, then this will be captured in the counterfactual. In Figure 10, the red dashed line ("Synthetic Auckland") denotes the counterfactual in Greenaway-McGrevy (2023a) whereas the solid black line ("Actual Auckland") shows observed consents.

The findings of Greenaway-McGrevy (2023a) provide support for several of our earlier comments on Greenaway-McGrevy and Phillips (2023). First, by using data for Auckland's entire urban area Greenaway-McGrevy (2023a) mitigates Murray and Helm's critique of the sample used in Greenaway-McGrevy and Phillips (2023), as discussed in Section 3.1. Second, Figure 10 reveals that actual dwelling consents in Auckland initially diverged around 2013 before then diverging further

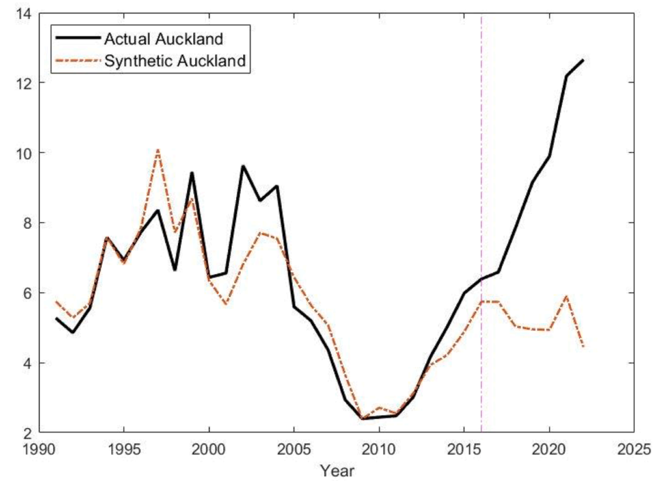

Fig. 10. Dwelling consents per 1000 residents in Auckland 1993–2024 (Source: (Figure 5, Greenaway-McGrevy, 2023a)).

after 2016. These changes coincide with the beginning of SpHA and the full adoption of the AUP, respectively, as discussed in Section 3.1. Third, Figure 10 shows growth in the counterfactual ("Synthetic Auckland") levelled off from 2016 onwards. As discussed in Section 3.3.2, this highlights the importance of external validity and the risks involved in extrapolating non-linear trends into the post-treatment period without considering the broader context, such as outcomes observed in cities elsewhere in New Zealand that are similar to Auckland but that did not upzone.

Compared to Greenaway-McGrevy and Phillips (2023), Greenaway-McGrevy (2023a) finds the AUP had even larger effects (21,808 and 43,500 consents, respectively). While this partly reflects the latter's coverage and timelines, it also suggests that the methods used in Greenaway-McGrevy and Phillips (2023) may understate, rather than overstate, the effects of the AUP. Specifically, the levelling off of the counterfactual in Figure 10 after 2013 implies that extrapolating linear pre-treatment trends forward into the post-treatment period — as done in Greenaway-McGrevy and Phillips (2023) — is likely to overstate consents in the counterfactual and thereby understate the effects of upzoning.

To end this section, we note that comparing Auckland to similar cities that did not upzone, as done in Greenaway-McGrevy (2023a), is *precisely* what Murray and Helm suggest in their second blog post where they write, "What might have been better? Comparison with other cities, for one" (Murray and Helm, 2023b). Despite aligning with the advice to compare Auckland to other cities, Helm has nonetheless taken to social media to criticise Greenaway-McGrevy (2023a) as follows (Helm, 2024a):

> "While the published paper assumed permit growth without upzoning would have halved, this unpublished paper presents an even more pessimistic counterfactual. Again, there is no story for why growth without upzoning would have fallen off a cliff midway through the 2014–2019 migration boom, during which NZ's population growth rate topped the OECD …"

Helm's comment reveals two fundamental misunderstandings of the synthetic control method that is used in Greenaway-McGrevy (2023a). First, the latter's counterfactual flat-lines because that is what happened to consents in cities that are similar to Auckland but that did not upzone. This is the simple story that Helm seems oblivious to. Notably, a similar flat-lining is predicted by the simple counterfactuals that are illustrated in Figure 8. Second, to the extent that population growth in the period from 2014 to 19 also affected the cities that contribute to the synthetic control, then it will be controlled for. In the wake of the AUP, we note

[24] This method constructs a synthetic version of Auckland that provides the counterfactual for what would have happened in the absence of the AUP. The impact of the latter is estimated by comparing observed outcomes in Auckland to predicted outcomes in synthetic Auckland. While sophisticated methods are used to identify the appropriate units and weights for the synthetic control, the latter can be simply understood as a weighted average of building consents in locations with similar characteristics and behaviour to Auckland before the AUP *but that did not implement major zoning reforms in this period.*

that observed population growth in Auckland was close to that predicted by "Synthetic Auckland", which suggests that the cities in the synthetic control grew at a similar rate to Auckland.[25] Put simply, the use of a non-linear synthetic control method in Greenaway-McGrevy (2023a) challenges many of Murray and Helm's critiques and corroborates the findings of Greenaway-McGrevy and Phillips (2023). If anything, we again find the latter study seems likely to understate the impacts of upzoning.

5.2. Greenaway-McGrevy and So (2024)

Whereas Greenaway-McGrevy and Phillips (2023) and Greenaway-McGrevy (2023a) quantify the impacts of upzoning on housing supply, the working paper by Greenaway-McGrevy and So (2024) instead quantifies its impacts on housing prices, specifically rents. Like Greenaway-McGrevy (2023a), Greenaway-McGrevy and So (2024) uses a synthetic control method to compare rents in Auckland to other similar cities in New Zealand that did not upzone. Six years after the AUP was fully adopted, Greenaway-McGrevy and So (2024) estimate rents for comparable properties in Auckland are 28 % lower than they would have been otherwise. By using independent data to estimate a negative effect on prices, Greenaway-McGrevy and So (2024) implicitly corroborates the positive effects on supply documented in Greenaway-McGrevy and Phillips (2023) and Greenaway-McGrevy (2023a). The effects of Auckland's upzoning on housing supply and prices thus seems to accord with the theoretical predictions of conventional economic models.

Although Murray and Helm's two blog posts did not directly engage with the findings of Greenaway-McGrevy and So (2024), Helm has critiqued the latter's findings on social media. On 22 August 2024, for example, Helm commented (Helm, 2024a):

> "Another unpublished paper looks at rents. It claims rents would be 28 % higher without upzoning. The chart below shows what that implies. Does this pass the sniff test? NZ is a small country with easy internal migration. Would people hang on for grim life in Auckland when they could move to another city and reduce housing costs by a third? It's utterly implausible."

We note three problems with Helm's critique of Greenaway-McGrevy and So (2024). First, there are several theoretical reasons why differences in rents — for example, due to changes in housing supply — might not be eliminated by the movement of people between locations. Helm's argument seems to implicitly assume perfect mobility, which is contrary to a large body of economic evidence.[26] Plausible reasons why we would expect to observe imperfect mobility in response to lower rents include moving costs (both monetary and non-monetary) and the imperfect transmission of information between locations (see, e.g., Glaeser et al., 2014; Nenov, 2015).

Second, other empirical evidence finds that housing supply affects rents. At a regional level, Mense (2023) finds a 1 % increase in the flow

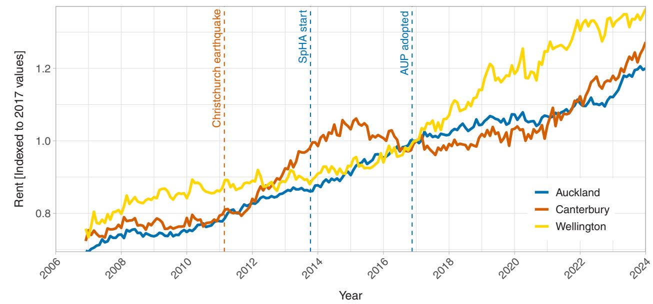

Fig. 11. Rents in Auckland, Canterbury, and Wellington regions 2006–2024.

of housing supply lowers rents by 0.2 %. More locally, Li (2022) finds that a new apartment building decreases rents and prices in nearby areas relative to those further away. Similarly, Asquith et al. (2023) finds that new apartment buildings reduce rents nearby by approximately 6 %. Although the AUP appears to have had relatively large effects on rents compared to the existing literature, this could be explained both by the relatively large size of the upzoning and/or the relatively expensive nature of housing in Auckland before the AUP. The empirical economic evidence thus seems to directly undermine Helm's theoretical critique.

Third, Helm supports his claim with a chart that compares rents in Auckland to Wellington and Canterbury. This chart suffers from two problems. First, Helm's chart implies Wellington and Canterbury are reasonable counterfactuals for Auckland. As noted in Section 3.3.2, however, upzoning in Lower Hutt means Wellington is a poor counterfactual for Auckland.[27] Meanwhile, Canterbury is also a poor counterfactual for Auckland because the former's largest city, namely Christchurch, suffered an earthquake in 2011.[28] Second, Helm's chart plots rents from 2006. If one instead indexes rents to just after the adoption of the AUP — that is, the start of 2017 — then a different picture emerges, per Figure 11. Of these regions, we see Auckland had the fastest relative growth in rents before 2017 but the slowest growth thereafter — directly contradicting Helm's claim.[29]

Importantly, the negative impact of the AUP on rents documented in Greenaway-McGrevy and So (2024) is also evident in other housing affordability indices for Auckland (see, e.g., Ministry of Housing and Urban Development, 2024). Similarly, the recent study by Greenaway-McGrevy (2025) uses a structural economic model to analyse Auckland's zoning reforms, which are predicted to cause a 15–27 % fall in house prices in the long run. For these reasons, we suggest Greenaway-McGrevy and So (2024) provides robust evidence of the negative impact of the AUP on housing rents and implicitly corroborates the positive impacts on supply that are found in Greenaway-McGrevy and Phillips (2023) and Greenaway-McGrevy (2023a). Contrary to Murray and Helm's claims, there is robust evidence that Auckland's upzoning led to more housing and lower rents.

[25] See Section 3.2 in Greenaway-McGrevy (2023a) for a discussion of the matching variables that are used to identify the units and weights in the counterfactual. We note the counterfactual in Greenaway-McGrevy (2023a) implies that population growth in Auckland would have, in the absence of the AUP, outstripped growth in the housing stock, which is consistent with observed outcomes in the pre-AUP period.

[26] Perfect mobility implies the elasticity of migration, or labour supply, is infinite, which contravenes several empirical studies that report finite elasticities. Per Ahlfeldt et al. (2023), for example, Caliendo et al. (2019) and Caliendo et al. (2021) estimate elasticities of 0.5 for the US and Europe, respectively; Tombe and Zhu (2019) estimate elasticities that range from 1.5–2.5 in China; Bryan and Morten (2019) estimate elasticities of approximately 2.7 for Indonesia; Beaudry et al. (2014) estimate elasticities of around 2.0 for the US; and Morten and Oliveira (2024) estimate elasticities of 4.5 in Brazil.

[27] This is confirmed by the matching exercises that are used to identify the units that contribute to the synthetic control in Greenaway-McGrevy and So (2024), which assign zero weight to Wellington.

[28] The earthquake damaged or destroyed many dwellings and led to a large rise in rents as well as the adoption of zoning reforms (West and Garlick, 2023). The Canterbury region is a poor counterfactual to Auckland in terms of pre-trends, post-trends, and on a theoretical basis. Due to these problems, Greenaway-McGrevy and So (2024) removes the Christchurch metropolitan area from their donor pool.

[29] We are not suggesting it is appropriate to compare rents in Auckland to Christchurch and Wellington nor to index rents to 2017. Rather, we are merely highlighting that shifting the starting point of the data used in Helm's graph contradicts his critiques and supports the finding of Greenaway-McGrevy and So (2024).

6. Conclusions

At a time of growing concern with housing affordability, Auckland's upzoning has provided a rare opportunity to study the impacts of major zoning reforms on housing outcomes and address an important gap in the extant economic literature. Three quasi-experimental papers — specifically, Greenaway-McGrevy and Phillips (2023), Greenaway-McGrevy (2023a), and Greenaway-McGrevy and So (2024) — have found Auckland's upzoning increased housing supply and reduced housing prices. These findings dovetail with a large body of economic evidence and align with the views of a majority of economists.

For these reasons, assigning equal merit to "both sides" of the debate on zoning reforms strikes us as a false equivalency. The quasi-experimental evidence from Auckland simply confirms what is a common finding in the economic literature that is accepted by a large majority of economists. Housing is, in many places, a major policy challenge that warrants urgent action. We suggest it is unreasonable to delay action on the pretence the 'jury is out' on zoning reform. Rather, the jury is in: Auckland's upzoning worked.

Although we find critiques of the Auckland upzoning studies have little to no merit, arriving at this point has produced useful insights and raised interesting questions.

Firstly, there is value in critiques of economic and econometric papers, especially where they introduce new ideas, challenge the prevailing "groupthink", or contest evidence where there exists only a nascent consensus. All empirical work, including these three studies from Auckland, have limitations that are worth probing, testing, and addressing.[30] Such critiques are, however, of most value when they are carefully documented and undertaken by impartial observers who focus on the methods more so than the findings.

Secondly, despite their informal nature and lack of merit, these critiques have managed to influence formal planning and policy processes in New Zealand and Australia with surprising ease. In our view, this raises important questions about how these processes engage with economic evidence. Guidelines and sanctions could, for example, be strengthened to encourage expert witnesses to represent the economic evidence in an accurate and balanced manner. Planners and commissioners, who often lack training in economic and econometric methods, might benefit from additional support to help them assess the credibility of economic arguments. No doubt economists could also do better at summarizing and communicating the weight of evidence in formats that are palatable to wider audiences, as we attempt to do here. Expert surveys from professional organisations that represent economists, like those cited in this paper, might also help to identify the level of consensus that exists on questions that are of importance to policy.

Thirdly, rebutting these critiques has helped to highlight some areas for further research. With the effects of upzoning on housing supply and prices well-established, future work should explore unresolved questions. We see value, for example, in understanding the aspects of Auckland's context that contributed to such large effects, which can, in turn, shed light on their relevance in other contexts ("external validity"). Research could also investigate the impacts of upzoning on a variety of other outcomes that are relevant to policy, such as distributional impacts ("winners" and "losers"), rates of household formation, levels of urban amenities, commuting patterns, firm locations, workforce participation, and labor productivity.[31] Additionally, studying how upzoning interacts with other policies like income support, transport investment, and social housing seems likely to generate further relevant insights.[32] Rather than angsting over the relatively clear and intuitive effects of upzoning on housing supply and housing prices, we suggest our collective attention is better focused on unanswered questions like these.

CRediT authorship contribution statement

Matthew Maltman: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Stuart Donovan:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of Competing Interest

- The authors declare their affiliations as per the submitted work
- The authors acknowledge helpful comments from Matthew Bowes, Eric Crampton, Ryan Greenaway-McGrevy, Stephen Hoskins, Keaton Jenner, Tony Richards, and Peter Tulip

The authors confirm that (1) this work has not been published previously, (2) that it is not under consideration for publication elsewhere, and (3) that its publication is approved by all authors and by the responsible and relevant authorities where the work was carried out.

If accepted, we confirm it will not be published elsewhere in the same form, in English or in any other language, including electronically.

Data availability

Data will be made available on request.

Appendix A. Additional critiques

In addition to their critiques of the Auckland upzoning studies, Murray and Helm hold a range of related views on housing that are worth briefly discussing here.

First, Murray and Phibbs (2023) question the credibility of observational studies of upzoning due to the presence of endogeneity. In response, we simply note that no empirical methods are perfect but there exists a high degree of alignment in the findings of different observational, quasi-experimental, and theoretical economic studies on the effects of planning policies on housing outcomes. For more details, we refer interested readers to studies such as Hilber and Vermeulen (2016); Jackson (2016); Eriksen and Orlando (2022); Molloy et al. (2022); Ahlfeldt et al. (2023);

[30] Here, we feel compelled to note that we do not consider any of the three studies discussed in this paper to be perfect or infallible. For instance, we consider it likely the methods used to estimate spillovers in Greenaway-McGrevy and Phillips (2023) are too conservative, such that the baseline results underestimate the effect of upzoning on housing consents in Auckland, as implied by the results of Greenaway-McGrevy (2023a). Additionally, the paper's broad counterfactual set serves more as a test of statistical significance than a precise estimation of economic effects. Future research should focus on improving econometric methods to better capture spillovers, given their prevalence in most urban economic settings.

[31] Maltman (2024) provides some preliminary evidence of strong construction productivity growth in New Zealand since upzoning, although detailed analysis using firm-level data would be valuable.

[32] Greenaway-McGrevy (2024) analyses the effects of upzoning on "state housing" — that is, public or social housing — and finds supply increased significantly in the wake of the AUP. Indeed, the share of permits for state housing increased from 3 % to 10 % of permits before and after upzoning, respectively.

Asquith et al. (2023); Maltman and Greenaway-McGrevy (2025); Greenaway-McGrevy (2025). For this reason, we do not find the arguments in Murray and Phibbs (2023) to be compelling.

Second, Murray and Helm have — like other supply sceptics — asserted that upzoning will not affect quantities or prices because developers will instead choose to landbank and dripfeed new housing supply into the market at a rate that maintains price levels (see, e.g., Murray, 2020; Helm and Murray, 2024). Most economists tend to dismiss such ideas for a variety of reasons.[33] From a theoretical perspective, developers aim to *maximize profits*, not *maintain prices*. This means developers can be expected to increase supply if the additional revenue from selling more houses exceeds the additional cost of building them. Even if increasing their own-supply did cause house prices to fall, the increase in quantities could nonetheless more than offset the decline in prices such that it was still profitable for the developer to supply more houses. While development decisions are dynamic rather than static, upzoning shifts the supply curve at all points in time.

Central to the landbanking / dripfeeding theory advanced by Murray and Helm is the concept of market power. For a developer to benefit from restricting housing supply, the impact of their own-supply on price — that is, their level of market power — needs to be relatively high. There is, however, little to no evidence that developers have high levels of market power. In 2023, for example, the largest home builder in Australia (Metricon Homes) was responsible for just 4693 of the 171,302 homes started nationally, or 2.7 %. There is also little formal empirical evidence that finds landbanking occurs in practice. The small number of existing studies are limited by a lack of data on developers' cost structures, which prevents them from ruling out that delayed construction or large "land banks" are driven by factors like managing dynamic production costs (e.g., labor constraints, material price fluctuations) or attempts to smooth costs over time. Evidence of "drip-feeding" also tends to stem from exurban markets with highly concentrated land ownership, which seems unlikely to generalise to suburban or urban environments where land ownership is much more dispersed (see, e.g., Murray, 2020; Fitzgerald, 2022). Many of these studies also make poor econometric choices that undermine their findings.[34]

That said, even if developers did have market power and engage in landbanking and dripfeeding, then this strikes us as an argument for upzoning, rather than vice versa. From a theoretical perspective, even neoclassical models of market power — including but not limited to a pure monopoly — predict that reductions in marginal costs will elicit an increase in supply. For this reason, where upzonings serve to lower development costs by reducing the land input required per dwelling, then they can also be expected to increase housing supply even in situations where developers have complete market power. Moreover, in high-demand areas where "price premiums" exist due to the presence of market power, then upzoning might allow new developers to enter the market and supply more housing — thereby eroding the premium. As developers are incentivised to seek out and exploit price premiums when and where they exist, there is competitive pressure to move quickly. This is an important point: If market power is leading to landbanking and dripfeeding, then upzoning to enable more development opportunities and enhance competitive pressure would seem to be the appropriate policy response. From an empirical perspective, Auckland's experience — as documented in the three quasi-experimental studies discussed in the main body of this paper — suggests upzoning can increase supply and mitigate the problems of landbanking and dripfeeding.

B. Additional figures

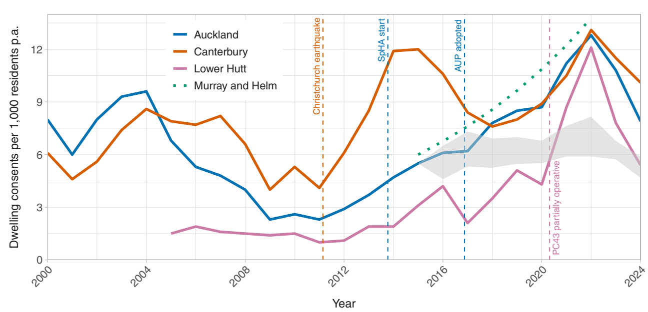

Fig. 12. Comparing observed consents per 1000 residents in Auckland, Canterbury, and Lower Hutt to alternative counterfactuals from Section 4.1 and Murray and Helm (2023b). *Notes:* The grey shaded area denotes the range in dwelling consents that are defined by the three methods discussed in Section 4.1 for the period from 2016–2024, specifically 1) mean dwelling consents from 1996–2015, 2) mean dwelling consents in regions of New Zealand that did not upzone, and 3) mean dwelling consents in the Northland, Waikato, Bay of Plenty, Wellington, and Otago regions. The dwelling consent data for recent years is provisional and subject to revisions.

C. A note on spillovers

In Section 3.1, we discuss treated and control group selection in the framework of a standard DiD study. However, it is important to note that Greenaway-McGrevy and Phillips (2023) is not a standard DiD, as it attempts to account for "spillovers" — or, the displacement of consents — between non-upzoned and upzoned areas.

In typical DiD studies, treatment in one area should not impact outcomes in control areas.[35] Given plausible spillovers between treated and control areas, this assumption does not hold in Greenaway-McGrevy and Phillips (2023). Upzoning one area, for example, may prompt a developer to choose

[33] Tulip (2021); Productivity Commission (2022), for example, conclude there is insufficient economic evidence to support the landbanking / dripfeeding theory.

[34] Murray (2020), for example, argues that developers reduce housing supply during hot markets by letting approvals lapse, stating: "when lot production and approved stocks are high, so too is a delaying behaviour of letting approvals lapse." This conclusion is based on a reported correlation between high housing production and high levels of lapsed approvals within a region. However, the regression specification contains a critical flaw: it does not control for the size of the region. Instead, it simply observes that larger areas have both more housing activity and more lapsed approvals. When council fixed effects are included to control for differences in the size of areas, the positive relationship between lapses and housing market activity becomes *negative*, contradicting the paper's claim. Despite this, the paper asserts: "The positive relationship between approval lapses and new lot production observed here is … consistent with this prediction if developers with approvals who have made irreversible investments increase their supply, whereas those who have not made such investments wait and let their approvals lapse."

[35] Formally, this is referred to as the Stable Unit Treatment Value Assumption (SUTVA).

to develop in the newly-upzoned location rather than in non-upzoned areas, which in turn implies the control area is indirectly affected by the policy. To our knowledge, Greenaway-McGrevy and Phillips (2023) is the first study to formally address these spillovers. To do so, it estimates the maximum spillover effect that would need to occur for the AUP to have a statistically insignificant impact on dwelling consents. While the method is not flawless, and will likely be refined in future research, Murray and Helm's critique overlooks this novel contribution.

One possible interpretation of Murray and Helm's critique regarding Greenaway-McGrevy and Phillips (2023)'s sample is that, by excluding certain areas, the paper might overlook potential spillovers between these excluded and upzoned areas. We make two points on this potential concern. First, any spillovers between excluded and treated areas are likely minor, as these areas are not highly substitutable. Large spillovers are more likely to occur between housing types within similar neighborhoods, such as single-family zones, rather than between rural and single-family urban areas. Second, and more crucially, the Extension Paper includes all data in Auckland, fully accounting for spillovers between all areas. This analysis shows an even larger effect from upzoning.[36]

For these reasons, the impact of the AUP identified in Greenaway-McGrevy and Phillips (2023) appears robust to spillovers between upzoned and non-upzoned areas, even in settings that exclude data from business/rural areas.

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[36] Further, Greenaway-McGrevy (2023a) also includes the full sample, and also finds a larger effect.

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INFRASTRUCTURE VICTORIA

March 2023

Our home choices

How more housing options can make better use of Victoria's infrastructure

About us

Infrastructure Victoria is an independent advisory body with 3 functions:

- preparing a 30-year infrastructure strategy for Victoria, which we review and update every 3 to 5 years
- advising the government on specific infrastructure matters
- publishing research on infrastructure-related issues.

Infrastructure Victoria also helps government departments and agencies develop sectoral infrastructure plans.

Infrastructure Victoria aims to take a long-term, evidence-based view of infrastructure planning, and we inform community discussion about infrastructure provision.

Infrastructure Victoria does not directly oversee or fund infrastructure projects.

Acknowledgement

Infrastructure Victoria acknowledges the Traditional Owners of Country in Victoria and pays respect to their Elders past and present, as well as Elders of other First Peoples' communities. We recognise that Victoria's infrastructure is built on land that has been managed by Aboriginal people for millennia.

Contents

Summary

People from around the world have chosen to make Victoria home, most of them in Melbourne. By 2051, Victoria will be home to around 3.7 million more people than today, with over 3.1 million more people in Melbourne alone.[1] Melbourne is expected to overtake Sydney as Australia's biggest city in 2031 or 2032.[2]

Population growth has fuelled Victoria's economic prosperity and created the vibrant, diverse community enjoyed today. But with more people Victoria also needs more homes. Melbourne will need about 1.3 million new homes between 2021 and 2051, or around 44,000 new homes every year.[3] The supply challenge is large, especially if new homes are to meet the needs and aspirations of Victoria's diverse and growing population at prices they can afford.

Understanding why homebuyers and renters choose to live where they do helps to plan for population growth and to shape Victoria's cities. In June 2022, we asked over 6,000 Victorian households about the type of home they would choose in Melbourne, Geelong or Ballarat if they had to move, factoring in current house prices and their household budget – the largest survey of its kind ever conducted in Australia.

Many people we spoke to share a similar vision of their ideal home: a detached 3-bedroom house in an established suburb, close to family and friends.[4] But this ideal is well out of reach for moderate income households in most Melbourne suburbs. People's preference for a large, detached home combined with household budget constraints is driving demand for homes in Victoria's new growth suburbs, or greenfield areas, where the median household income among new homebuyers is just over $90,000.[5]

Of the households we surveyed, 25% told us they would choose to live in a detached house in one of Melbourne's growth areas if they had to move.[6] Many people buying in greenfield areas are households with children, or who are planning for children. Greenfield suburbs, on average, attract higher numbers of first home buyers, households with young children and those intending to have children in future. They are also more likely to be moderate income earners. Most greenfield residents say that living in these new suburbs is their preferred choice. Greenfield homes offer the features these households want at a price they can afford, in a community where they feel connected and safe.[7]

The 7 local government areas home to Melbourne's greenfield suburbs accounted for 50% of Victoria's total population growth over the last 10 years.[8] Greenfield suburbs in Ballarat and Geelong also grew rapidly in this time.[9] Greenfield homes are built in areas with little existing infrastructure, and residents often move in before schools, public transport, community centres and hospitals are in place. Our survey shows that Victorians who choose a new home in a new suburb are usually very happy with their choice,[10] but they acknowledge it can take many years before their community has all the infrastructure it needs.[11]

Building new infrastructure in these areas can be up to 4 times more expensive than adapting existing infrastructure in established suburbs that have the capacity to support growth.[12] Paying for Victoria's growing infrastructure needs comes at a time when governments are dealing with multiple challenges, such as escalating construction costs and shortages of skilled labour and materials.[13] And as Victoria grows, so does the pipeline of new infrastructure needed to meet the needs of rapidly growing communities. With competing interests and budget constraints, governments must make difficult choices on how and where to invest.

Encouraging more people to live in established suburbs closer to existing infrastructure creates a more compact city with higher population density. Melbourne is one of the lowest population density cities in the world, even lower than Los Angeles and around half that of Paris, despite being roughly the same geographic size.[14] Compact cities offer good access to jobs, services, cultural and sports activities and public transport. They can support better health outcomes by encouraging more walking and cycling. They can improve the viability of infrastructure delivery and promote better use of existing infrastructure. They can also offer diverse housing options for many different sizes and types of households.

But our research shows that Melbourne's existing suburbs do not offer a choice of homes at a price that many households can afford. A household with a stable income of $88,000 a year and a deposit saved can currently buy a 3-bedroom house if they want one. But it will only be possible in a small number of growth suburbs on Melbourne's fringe, some 30 kilometres or more from the city centre. And suitable options in many growth areas are already out of financial reach for a homebuyer with this income.[15]

The Victorian Government's metropolitan planning strategy, *Plan Melbourne 2017–2050*, aims to promote a more compact city. It includes an aspirational scenario for 70% of new homes to be built in established suburbs by 2051. The remaining 30% would be in greenfield areas.[16] This is a major undertaking, equivalent to 932,000 new homes in Melbourne's existing suburbs, or 8 times the number of homes in the whole of Geelong today.[17] But Victoria's capital city is falling short of these aspirations. The share of new homes built in established suburbs is declining, and in 2021 fewer than half were in Melbourne.[18]

Encouraging more people to buy and live in homes in higher density established suburbs will be a challenging task. Our research has found that high-rise apartments are not attractive to many people buying in greenfield areas, so increased density must come in many different forms including townhouses, villas and both low-rise and high-rise apartments.[19] Building more homes in established suburbs comes with its own challenges including high urban land and construction costs, some community opposition and uncertainty around the timeframe and outcome of development assessment decisions.[20] These and other factors influence which homes are built where, and the prices people must pay for them.

If the Victorian Government wants to increase the share of new homes built in established suburbs, it needs to understand what people are looking for when they buy a home and how these needs can be met in established suburbs. Our work aims to clarify these requirements and to propose policy options for government to help achieve them.

Many households told us they would choose to live in greenfield areas even if established suburbs were more affordable. The greenfield areas will continue to play an important role in Melbourne's future for the many people who prefer the features offered by these areas. However, we found that 1 in 5 would trade house and land size to live in an established suburb in a medium density home, such as an apartment or townhouse, if it was available at a more comparable price. These are the buyers and renters the Victorian Government must provide more choices for if it wants to rebalance the distribution of new homes between existing suburbs and new growth areas.[21]

But focusing on household demand will not be enough. The government can also facilitate private sector investment to build more homes that meet the needs and preferences of people who would otherwise choose a greenfield home. Established suburbs must accommodate many more new homes to create the scale of change aspired to in Plan Melbourne, including homes affordable to moderate income households who have, or are planning for children. Apartments make up most new homes in Melbourne's existing suburbs, and most of these are not designed to meet the needs of households with children (see **Option 10**).[22] More diverse new homes in all areas can give people more choices to suit their needs (see **Options 7** and **8**).

The Victorian Government has identified several urban renewal precincts in established suburbs to accommodate some of Melbourne's population growth, including in Fishermans Bend, Sunshine and Arden. These can be part of the solution and there are opportunities to streamline planning approvals for development in these areas (see **Option 6**). However, urban renewal precincts alone will not generate enough homes to meet projected population growth. For example, the 12 precincts connected by the Suburban Rail Loop will deliver around 15% of the homes needed to support an aspiration of 932,000 new homes in existing suburbs.[23]

Our policy options outline reforms for the Victorian Government to consider. They aim to give moderate income households more housing choices in established suburbs that are genuine substitutes for greenfield area homes. They include changes to existing financial incentives that distort home choices and favour greenfield development (see **Options 2, 3** and **4**), and planning reforms that can encourage more affordable homes in established suburbs (for example, **Options 5, 8, 9** and **10**). We also suggest reforming infrastructure contribution schemes to better reflect the costs of building infrastructure in different areas (see **Option 1**). Collectively, the options we propose can give communities more certainty about what to expect and developers more clarity in how to deliver well-designed, higher density homes in established suburbs.

Options for government

Established suburbs can accommodate more new homes in many different ways. This report presents a suite of policy options for the Victorian Government to consider. The options can give people more choices to buy homes in established suburbs rather than greenfield areas and promote better use of existing infrastructure by helping create more compact cities. The Victorian Government can make decisions on the policies it pursues.

Our research demonstrates the size of the challenge ahead will require many different approaches to resolve. We have identified 3 outcomes that the proposed options seek to address:

- Reduce price disincentives to buying in established suburbs.
- Build more homes in established suburbs near transport and services.
- Increase diversity and choice of homes in established suburbs.

The 10 options collectively suggest ways the government can offer more choice for moderate income households who might prefer to live in established suburbs. No single policy option will cause enough new homes to be built in established suburbs in Melbourne, Geelong and Ballarat. Instead, many of the options can be combined to achieve more impact and will need to work together to be effective in expanding the choice and diversity of homes available to Victorians now and in the years ahead.

We provide options for the Victorian Government to implement now and keep pursuing over the next decade. We outline our view of how to sequence them in Figure 1. The government should monitor progress and consider whether it needs more policy reforms to deliver the change required in the future.

Reduce price disincentives to buying in established suburbs

1: Reform infrastructure contributions to send the right price signals

Develop a clear, efficient and transparent infrastructure contribution system that better reflects the true cost of infrastructure in different development settings and supports better use of existing infrastructure.

2: Reform stamp duties that distort home choices

Remove the distortions created by stamp duty concessions and ultimately abolish stamp duties altogether, potentially by replacing them with a broad-based land tax.

3: Remove home subsidies that encourage greenfield choices without improving affordability

Avoid subsidies that inflate house prices and remove the First Home Owner Grant.

4: Use government ‘shared equity’ schemes to encourage established suburb home ownership

Over time, change the locations eligible for the Victorian Homebuyer Fund, to encourage people to buy homes in established suburbs.

Build more homes in established suburbs near transport and services

5: Measure and incentivise progress towards new local housing targets

Set targets for the number, type and size of new homes in each Melbourne local government area, in collaboration with local governments. Offer local governments incentives to meet the targets. Measure progress by closely monitoring new housing supply and publishing detailed statistics at least every year, including by home type and characteristics.

6: Prioritise and streamline approvals for urban renewal precincts

Prioritise urban renewal precincts for development, with streamlined planning approvals. Set targets in each precinct for the number, type and size of new homes. Develop suitable housing demonstration projects that specifically include 3-bedroom homes.

7: Develop better standards for low-rise apartments, then increase their supply by expanding use of the Residential Growth Zone

Develop better standards for low-rise apartments (4 or fewer storeys) in the Victoria Planning Provisions. Introduce more low-rise apartments by supporting local governments to rezone more residential areas near public transport and services to the Residential Growth Zone.

Increase diversity and choice of homes in established suburbs

8: Develop a dual occupancy and townhouse code

Give property owners as-of-right permission to bypass red tape and supply more diverse homes when they comply with the new dual occupancy and townhouse code. Give better visual guidance for well-designed dual occupancies and townhouses.

9: Allow homebuyers more parking options

Reduce or remove compulsory minimum parking requirements to improve choice and affordability of new established area homes, close to good public transport. Allow homebuyers to choose how much onsite parking they want to pay for above minimum requirements.

10: Encourage child-friendly design in new apartments

Update the Better Apartments Design Standards to specify better access, versatility and safety features so apartments are more attractive for households with children. Introduce voluntary design guidelines for best practice child-friendly apartment design.

Figure 1 Timelines for delivery

Begin now

1. Reform infrastructure contributions to send the right price signals

3. Remove home subsidies that encourage greenfield choices without improving affordability

5. Measure and incentivise progress towards new local housing targets

Deliver within 3 years

6. Prioritise and streamline approvals for urban renewal precincts

7. Develop better standards for low-rise apartments, then increase their supply by expanding use of the Residential Growth Zone

8. Develop a dual occupancy and townhouse code

9. Allow homebuyers more parking options

Deliver over the medium term

2. Reform stamp duties that distort home choices

4. Use government 'shared equity' schemes to encourage established suburb home ownership

10. Encourage child-friendly design in new apartments

Guiding Victoria's future housing growth

Victoria grew rapidly in the decade to 2020, welcoming more than 1 million new residents to reach a population of 6.7 million.[24] This growth placed considerable demands on infrastructure as more people used Victoria's roads, trains, hospitals and schools.[25] It also increased the demand for housing.

Historically, Victoria accommodated population growth in new suburbs at the edges of Melbourne, contributing to the city's large urban footprint.[26] Melbourne has around 5 million people, making it the 102nd largest global city by population, but it has the 33rd largest built-up land area in the world.[27]

The COVID-19 pandemic interrupted Victoria's population growth. The population dropped by almost 45,000 people in the year to June 2021, and by over 80,000 in Melbourne. Despite this, more people kept moving to Melbourne's growth areas. The cities of Cardinia, Casey, Hume, Melton, Whittlesea, Wyndham and the shire of Mitchell, home to Melbourne's greenfield suburbs, all experienced population growth in 2021.

Some Victorians also moved to the regions during this time. Regional Victoria added 23,000 new residents in 2021.[28] Like Melbourne, regional cities face pressure to expand outwards into new suburban estates to meet rising demand for new homes.[29]

The pandemic changed the way Victorians live and work. For much of 2020 and 2021, anyone who could work from home did so. While its longer-term effects are unclear, a shift towards remote working might keep reinforcing strong population growth in outer suburbs as it becomes less important for people to live near their workplace.[30] Workers can save time and travel costs if they no longer need to travel to work every day.

More new suburbs put extra pressure on infrastructure

Planning decisions made now will affect the shape of Victoria's cities for decades to come. The places where new homes are built affects the amount and location of infrastructure Victoria needs.

People living in new homes in urban growth areas, or greenfield developments, require new infrastructure for their daily lives. This includes transport, utilities and social infrastructure such as schools, hospitals and childcare facilities. In rapidly growing new suburbs, people move in before much of the supporting infrastructure is in place.[31] Their access to services and infrastructure will improve over time, but in the interim new residents must rely on cars to access the services they need.[32]

Infrastructure can also be expensive to deliver. Labour shortages are contributing to delays in infrastructure delivery, and the costs of construction are rising.[33]

> Our previous analysis shows that infrastructure to support new homes can cost up to 4 times more in greenfield areas than in established suburbs that have the capacity to support growth.[34]

A larger urban footprint affects the environment. More expansion can lead to new homes being built in areas that are more vulnerable to the effects of climate change, which can expose residents to higher bushfire or flood risks.[35] It can also contribute to biodiversity, ecosystem and species loss, as homes and other development use up more habitat.[36]

Comparing Melbourne's low housing density with other global cities shows that many established suburbs can accommodate more people and homes while offering good access to existing infrastructure.[37] *Victoria's infrastructure strategy 2021–2051* explores ways to better use and manage existing infrastructure, and to plan the timing and delivery of new infrastructure where necessary. It recommends building more homes in established suburbs with good access to jobs, services and transport, by integrating land use and infrastructure planning to deliver a denser urban form.[38]

Greenfield areas will continue play an important role in Victoria's future growth. But balancing their role with that of established suburbs is important to continue to provide a good quality of life with access to jobs, education, social and leisure opportunities for everyone in Victoria.

More compact cities offer social, economic and environmental benefits

Compact cities help slow down urban expansion by consolidating land use inside the existing city boundaries. They prioritise building new homes in established suburbs, near to jobs and activity centres.[39] Cities that are more compact promote public transport use by focusing population growth in places that already have good access, and encourage walking and cycling by reducing the distances people need to travel.[40]

More compact cities can provide opportunities for positive social interaction, and improve access to community services.[41] They can create vibrant and diverse suburbs while supporting shops and services, stimulating local economic development and job opportunities.[42] Higher density neighbourhoods can improve the viability of infrastructure delivery and promote better use of existing infrastructure.[43] Denser suburbs tend to have economic and productivity benefits due to higher concentrations of jobs.[44]

More compact cities can offer more transport options, including more public transport, walking and cycling, and can reduce trip lengths and travel times. A more active lifestyle can improve health outcomes.[45] People using more sustainable transport options can also reduce vehicle emissions.[46] Other environmental benefits include less land taken up by homes, meaning less development pressure on valuable agricultural and environmental resources.[47]

Other urban forms are possible, and each has its own benefits and drawbacks. The Victorian Government's land use and infrastructure planning decisions will help determine whether Victoria realises the benefits more compact cities can offer.

What we mean by low, medium and high density

We use the terms low, medium and high density often in this report to refer to different types of homes and developments. There are many definitions for these terms, but we generally mean the following:

- Low density – detached homes of any size.
- Medium density – townhouse and terrace homes, as well as low-rise apartments (up to 4 storeys).
- High density – apartment developments of 5 storeys and above.

Melbourne is a low density city by global standards. The city centre includes many high density homes, and some established suburbs have high density along major transport routes. These are interspersed with low density suburbs, many of which are dependent on cars because of sparse public transport. Growth area suburbs are, in general, low density and not as well served by infrastructure and transport as established suburbs.

Melbourne can increase its population density, with all the benefits that can bring, while remaining a relatively low density city. But it will need more diversity and choice in home types to achieve this.

Each density category has many different forms. Building higher density, more compact cities does not mean all new homes will be high-rise apartments. And apartments can be designed in different ways to incorporate open space and communal areas while offering good access to transport and services.

Victoria can build more well-designed, medium and high density homes, including townhouses and low-rise apartments, in established suburbs to offer an affordable substitute for greenfield homes. Figure 2 gives existing examples of these home types in Victoria.

Figure 2 Medium and high density homes in Ballarat, Doncaster and Richmond

Nightingale, *Nightingale Ballarat*, Mirvac, *Tullamore*, SJB, *8 Burnley Street*

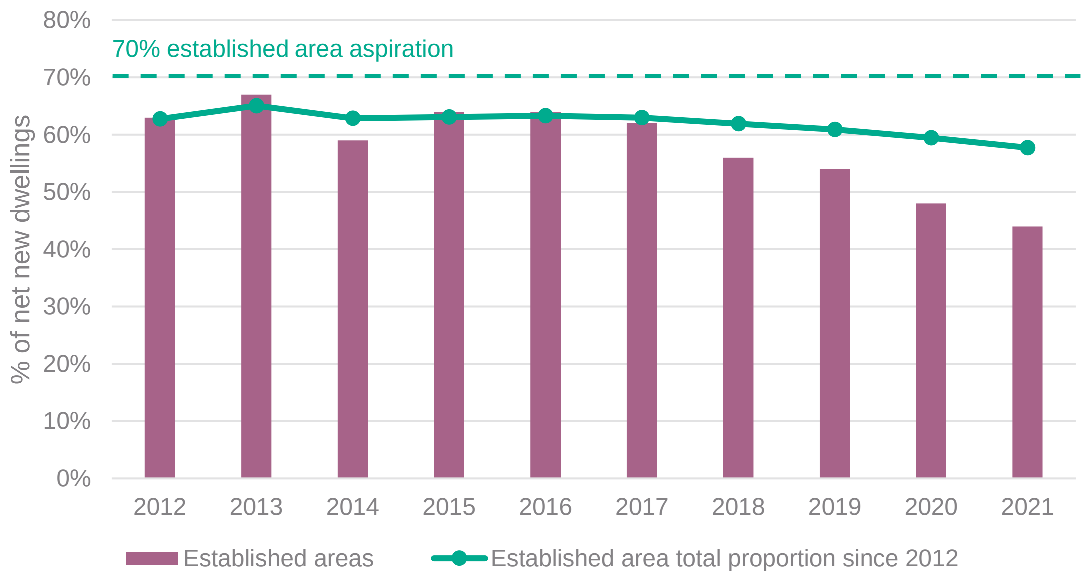
Planning strategies aim to build more homes in established suburbs

Plan Melbourne 2017–2050, the Victorian Government's metropolitan planning strategy, aims to increase the proportion of new homes in established suburbs. It includes an aspirational scenario for 70% of new homes to be built in Melbourne's established suburbs by 2051, compared with 30% in greenfield areas.[48]

Some regional cities also aim to increase the share of new homes built in established suburbs. The City of Greater Geelong has an aspirational target of 50% of new homes in established suburbs by 2047.[49] Likewise, the City of Ballarat is encouraging the housing market to move towards 50% of new homes in established suburbs between 2020 and 2040.[50]

However, current trajectories show that greenfield development increasingly delivers more of Victoria's new homes. Just 44% of new homes in Melbourne were built in established suburbs in 2021. This compares with over 60% in 2016 (see Figure 3).[51] In Geelong, 21% of new homes were built in existing suburbs in 2021, down from 32% in 2020.[52]

Figure 3: Share of net new dwellings in Melbourne's established suburbs, 2012 to 2021



Department of Transport and Planning, *Urban development program*

Building more homes in existing suburbs will be challenging

Melbourne will need an estimated 1.3 million new homes between 2021 and 2051 to accommodate expected population growth.[53] Reaching the 70/30 aspiration in Plan Melbourne by 2051 would therefore require around 399,000 new homes in greenfield areas and 932,000 in Melbourne's established suburbs. This is equivalent to building 8 times the total current number of homes in Geelong within Melbourne's established suburbs.[54]

Accommodating this growth in Melbourne's established suburbs means increasing housing density in suitable places. Plan Melbourne identifies over 130 metropolitan and major activity centres that can support higher density development.[55] However, challenges associated with building higher density homes in established suburbs include high land prices and construction costs, planning system risks, some community opposition, and uncertainty around the timing and outcome of development assessment decisions.[56] These and other factors influence which homes are built where, and the prices people must pay for them.

If the Victorian Government wants to increase the share of new homes built in established suburbs, it must understand what people are looking for in new growth areas, and how it can deliver this in established suburbs. This study aims to clarify these requirements and propose reforms to give people more home choices in more areas.

Gathering new evidence on housing preferences

Infrastructure Victoria undertook new research to gather reliable and up-to-date information about Victorians' home choices and preferences. Our findings can help decide which set of policy options can successfully influence the location of people's home choices.

In 2011, the Grattan Institute conducted the last major study into Victoria's housing preferences, summarised in their report *The housing we'd choose*.[57] Victoria's population grew by more than a million people after that research. The type and location of new homes being built also changed. Developers built many inner-city apartment buildings and produced more large homes in new growth suburbs. Melbourne's middle suburbs had less development.[58] At the same time, more new housing estates were built at the edges of Ballarat, Geelong and smaller regional towns near Melbourne.

Our research builds on the Grattan Institute's findings and gives new insights into the homes and choices available to Victorians today. We surveyed many more people, included Geelong and Ballarat in our research, and considered a greater variety of choices in more specific areas of Melbourne. We talked with people directly so they could tell us about the home choices they made. We also developed new models to explore how people value different types of homes and infrastructure. Our research highlights how people's housing preferences are different more than a decade later. It also gives us new insights into home choices as Victoria emerges from the COVID-19 pandemic.

We focused on people who choose to live in new growth areas as our starting point – people who live in greenfield estates or might choose to move there. Our research focused on better understanding their available home options, the choices they made, and what might influence them to live in established suburbs instead. We considered this question from the perspective of both housing demand (what and where people want to buy) and supply (what is being built where), as well as the choices and trade-offs people face when they buy their home. We also included many people who decided not to live in greenfield areas to understand how their preferences and choices differ from those who do.

We used our findings to help develop a wide suite of policy options for the Victorian Government to consider. If the government wants to offer more home options in established suburbs, it should consider substantial changes to many of its planning and financial policies. No single, isolated reform can deliver the massive scale of change required. This report outlines some options for the Victorian Government that can give people more attractive options to buy homes in established suburbs. By pursuing them, Victoria can maximise people's use of existing infrastructure and services in established suburbs, and integrate land use and infrastructure planning to guide urban development in good locations. Some of our proposals can be done quickly, but others might take longer.

Our research explores factors influencing home choices

We investigated the reasons people chose to buy homes in growth areas, and what might help change their mind. Our research objectives were to:

- identify the most important home, location or community attributes for households when deciding to live in Victoria's greenfield locations, and the trade-off decisions they make
- test whether they can meet these housing preferences in other places
- elevate the voice of households who feel they have few home choices outside of greenfield locations but would prefer a different location if their housing needs can be met elsewhere.

Our research explored whether households in new suburbs would accept a smaller house and land size to live in an established suburb in a medium density home, if it were available at a comparable price. Our primary research question in considering this choice was:

> What would be the necessary pre-conditions for a proportion of households living in new suburbs to have chosen a different residential location?

We focused on moderate income households in Melbourne, Geelong and Ballarat, defined under the *Planning and Environment Act 1987* (Vic) as households with an annual income range between $88,021 and $132,030.[59] These households are more likely to live in outer suburbs and growth areas where homes tend to be more affordable.[60] The median household income for new homebuyers in Victoria's greenfield suburbs between 1996 and 2021 was $90,977 a year.[61]

We analysed housing affordability for moderate income households to identify homes that might be a suitable alternative to growth area homes. Households buying in growth areas are more likely to have children or be planning for children in the near future.[62] They are unlikely to choose homes with fewer than 3 bedrooms.

Our research focused on moderate income households' available home choices. This means we did not attempt to solve the urgent wider housing affordability issues in Victoria, or explore issues related to overall housing supply shortages.

Our policy research focused on households seeking to buy rather than rent. Few homes are purpose-built for the private rental market,[63] and the Victorian Government has limited policy levers to increase the supply of rental homes, outside of providing more social housing. But we included renters within the scope of our qualitative research and choice modelling as they are a significant part of the overall housing market, and a source of future demand for homes.

The critical issue of social housing for low and very low income households was out of scope for this work. The Victorian Government released its *10-year strategy for social and affordable housing* in 2022.[64] In *Victoria's infrastructure strategy 2021–2051* we recommended that the Victorian Government set statewide targets to grow social housing, to reach at least the national average of 4.5 social housing dwellings for every 100 households by 2031.[65]

Our approach combined different methods to uncover new evidence

We took a robust, mixed methods approach to study greenfield housing preferences. We conducted new quantitative and qualitative research, stakeholder consultation, and policy research and analysis.

During our research we spoke to over 100 Victorians about their home choices and surveyed over 6,000 households living in greenfield and established areas of Melbourne, Geelong and Ballarat. They told us about the homes they live in, the homes they would choose and the factors that influence their decision.

This chapter summarises the different research components and the following chapters outline core research findings. We published technical reports containing full details of the research, including methodologies and findings, on our website.

Research into home and location choices

We commissioned Wallis Social Research to talk to 122 Victorians about their home choices and the trade-offs they made.[66] Wallis led 22 focus groups during June and July 2022, and captured perspectives from owner-occupiers and renters in greenfield suburbs in Melbourne, Ballarat, Geelong and Bacchus Marsh. We contrasted these perspectives by talking to other groups, such as medium density home owner-occupiers in established suburbs, and residents in established suburbs who had decided not to live in greenfield areas.

We focused on young couples and households with young children in our focus groups, because this is the main household type buying in greenfield areas. But we also included some households with older children and people living in other types of households. We talked with them about their experience of making home and location decisions, and of accessing jobs, services, amenities, social and cultural connections, and infrastructure from their location.

Modelling relative prices for different homes

We built a hedonic price model to investigate how home features, location and access to infrastructure affect property prices in Melbourne.[67] We developed 3 different versions of the model for houses, townhouses and apartments, and used them to examine how people valued different home features (such as parking spaces and extra bedrooms) based on the prices of different homes.

Our analysis was based on real-world price data on homes sold in Melbourne. The model included more than 340,000 home sales over a 5-year period (January 2017 to June 2022). We combined this with data on transport, services and infrastructure, and with population and census data. We divided Melbourne into 13 geographic areas, which were broadly consistent with the areas used in our choice modelling, excluding regional Victoria (see Figure 4 for details).

This method allowed us to find how much people actually valued different types of homes by showing us how much they were willing to pay for them. We included infrastructure variables in the model to explore how much people would pay for homes located near different types of infrastructure, after controlling for other variables. We used the model to analyse housing affordability for moderate income households and find out the home types that might substitute for growth area homes at similar prices. We considered homes to be affordable if mortgage repayments were less than 30% of the household income (before tax). Repayments were estimated using an interest rate of 4.53%, offered in June 2022.

Choice survey and modelling to understand housing trade-offs

We commissioned the Centre for International Economics to develop a model of housing preferences in Melbourne, Geelong and Ballarat.[68] We used an approach called choice modelling. The choice model lets us predict people’s home choices, and how they respond to housing market changes.

We surveyed over 6,000 households in Melbourne, Geelong and Ballarat to get data to build the model. We asked people to imagine they had to leave their current home and choose another one to live in, whether by buying or renting. The survey asked them to choose between different homes based on dwelling features (including type of home, number of bedrooms and car parking), location, and the home price or weekly rent. We also collected data about their current home, family, living conditions and attitudes to housing.

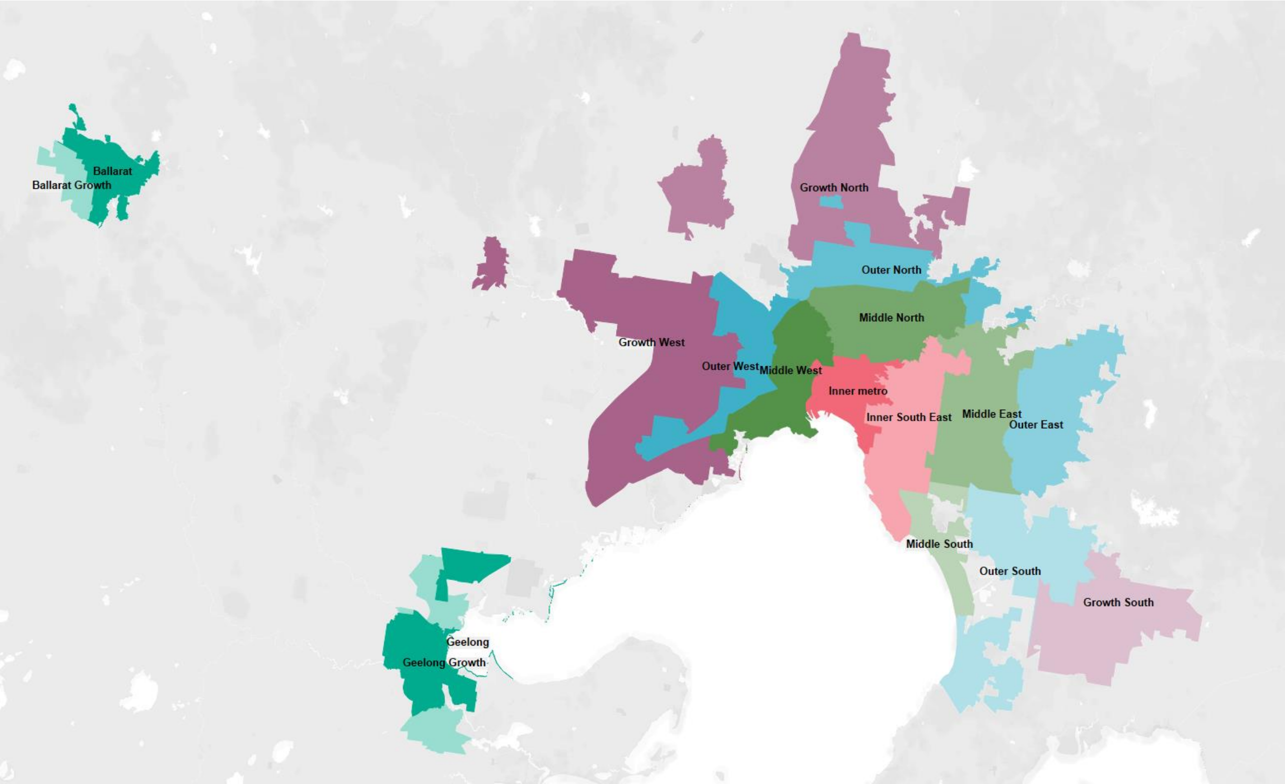
We used our choice model to:

- identify which housing features are most important in household decision-making
- determine under what circumstances households living in (or likely to live in) growth areas would choose to live in a different area
- identify the characteristics of households who are more likely to shift their home choice from growth to established areas.

We used 17 geographic areas in the choice model, focusing on inner, middle, outer and growth areas in Melbourne (including Bacchus Marsh), and established and growth areas in Ballarat and Geelong (see Figure 4). We did not include areas of environmental significance, such as the Mornington Peninsula or Yarra Ranges, as new residential developments are restricted.

Our survey sample was close to being representative, and we applied sampling weights to the data so our analysis can be generalised to the wider population in the cities we surveyed.

Figure 4: Geographic areas used in choice modelling



The Centre for International Economics, *Demand for housing in Victoria: stated preference research*, 2022

Analysing policy options that can influence home choices

Building on our findings from the focus groups and modelling, we reviewed reports and articles from academia, governments, industry and think tanks that explored ideas and barriers to delivering affordable, medium density homes in established suburbs. We also analysed Victorian housing and planning policies. This helped us identify potential policy options that can encourage more homes to be built in established suburbs, instead of building so many new homes in greenfield areas.[69]

We researched national and international case studies that encouraged more medium density homes in established suburbs. We also explored whether alternative housing models can offer more affordable larger-sized homes as part of a more diverse housing mix.

We evaluated possible policy options using a qualitative assessment framework. We used this to consider their effectiveness, ease of delivery, stakeholder acceptance and whether they can be scaled up to increase the supply of new homes over time. We used this to select the 10 options presented in this report from among the many potential policy levers available.

Stakeholder views informed our findings

We consulted many stakeholders during our research. They represented a diversity of views from organisations and individuals working in the housing and infrastructure sectors, including developers, industry organisations and government. We also spoke to academics, researchers and other industry experts.

We talked to stakeholders to identify relevant research about the trade-off decisions that greenfield residents made when they made their home choices, to seek feedback and advice about our proposed research methodologies and to find high quality sources of data. We also asked for feedback and advice on how the Victorian Government can help develop alternatives to greenfield homes in established suburbs, as well as any supporting evidence. This helped us to focus the scope of our policy research on the areas included in this report, which are necessarily selective.

We shared our preliminary research findings and asked for feedback on the potential policy options for government. These were used to further develop and test the options presented in this report.

The feedback we received from stakeholders during this project gave us valuable insights on their priority issues and concerns. Their input helped shape our research questions, build our evidence base, test our findings, and determine potential options for the Victorian Government to consider. We would like to thank everyone who contributed to this work.

Factors affecting the choice of a greenfield home

The places in which new homes are built affects the amount and location of infrastructure that Victoria needs. Current trends suggest greenfield housing development rates will stay high in Melbourne, regional cities and peri-urban areas. If some of these homes can be built in established suburbs instead, it would create a different pattern of urban development and change the need and demand for infrastructure.

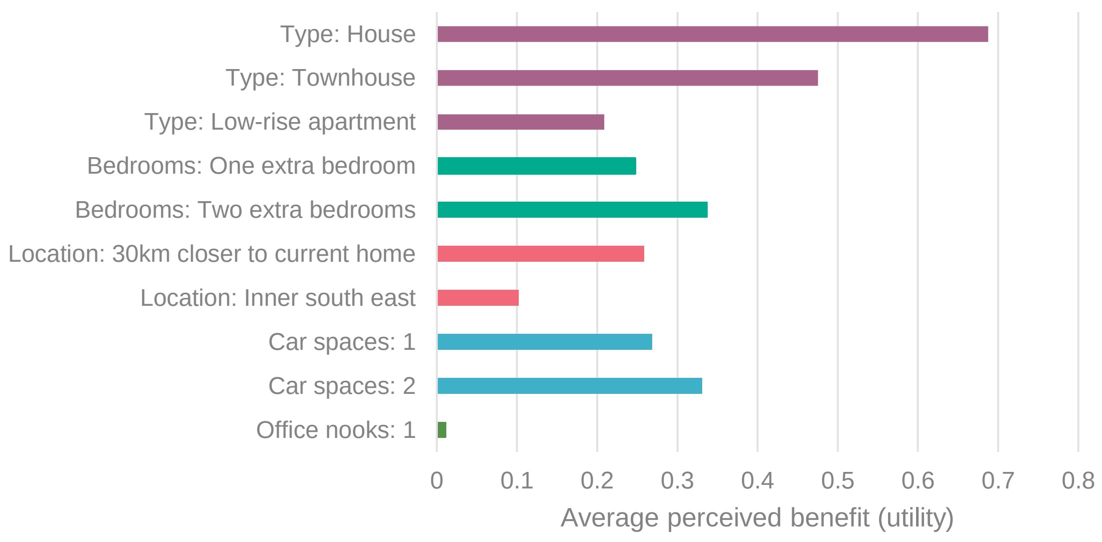
We explored the factors that influence households when choosing where to live, and the trade-off decisions they make. Victorians are giving us clear messages about what they want compared with what is available to them, given the prevailing home prices and their household budgets.

Victorians prefer large, detached homes close to family and friends

We identified a 'notional ideal home' shared by many households in our qualitative research. This was a large (3 or 4 bedroom) detached house with secure parking, in an established suburb close to family and friends. This is consistent with previous studies.[70] This ideal home vision is shared by residents in greenfield and established suburbs, and by renters as well as owner-occupiers.[71]

Our choice modelling confirmed this finding of a notional ideal home. Dwelling type has the biggest influence on home choice, on average. Most households strongly prefer detached houses over apartments (see Figure 5), particularly those who are looking to buy a home. Location, the number of bedrooms, and the number of car spaces also factor into housing decisions, but tend to be less important than the type of home.

Figure 5: Relative strength with which households value different housing features



Note: Relative to a hypothetical high-rise apartment in growth west, minimum number of bedrooms respondents would consider, zero car spaces, zero office nooks.
The Centre for International Economics, *Demand for housing in Victoria: stated preference research*, 2022

Sales data shows that since 2017, a typical home purchased in Melbourne's growth areas is a detached house with 4 bedrooms, 2 bathrooms, 2 car spaces and about 600 square metres land size. This is larger than the average size of a new greenfield block, as it includes re-sold properties in older estates. Its average price in growth areas was $780,000 in June 2022.[72]

Faced with prevailing prices and budget constraints, over two-thirds of households (68%) would choose to live in a detached house if they had to move, compared with 14% for townhouses and 18% for apartments.[73] Over one-third of households (36%) would choose the notional ideal of a large, detached home (with parking) in an established suburb.

Mindset and value for money drive housing decisions

Unsurprisingly, our focus groups showed that affordability and perceived value for money are the constant around which all housing decisions are made. Owner-occupiers and renters consistently seek homes that they believe offer them the best value for money, and this underpins their housing and location choices.[74]

But mindset also affects people's home choice, and this can be very different between households. Factors include the household's:

- needs and preferences, including those associated with their age and family size
- aspirations, such as home ownership
- values, for example, the strength of family ties
- preconceptions and open-mindedness, such as an openness to greenfield areas, or to new versus old homes.

This mindset helps us understand that, for a given budget, one household can prefer to buy in an established suburb, while another with similar demographic characteristics will choose a home in a new suburb. We found that some people felt a strong pull to either location or home features. We surveyed people in June 2022, noting that Melbourne was still recovering from the effects of the COVID-19 pandemic. We found that most households looking to buy favoured the type of home and would compromise on location (a total of 61%). Households looking to rent were more evenly split. About half of households looking to rent would choose location over home type.[75]

Greenfield areas attracted households that prioritised home features, especially for a large, detached house with a garage. Those prioritising location traded home features for a more modest home in an established suburb, close to family and friends and with access to existing infrastructure.[76]

> 'I've got friends that sold up their massive … Cranbourne East house, they lived behind us actually, and moved to Patterson Lakes into a tiny house. And they are so much happier. Yep, they've got 2 young kids as well. And she's just said that the lifestyle is – you just can't compare it. I mean, I'm very happy where we are. But I completely understand what she means when she says the lifestyle is very different.'
>
> - Greenfield owner-occupier, living with husband and 2 children in Clyde North[77]

Some greenfield homebuyers might have preferred an established suburb if their housing preferences had been met, but home prices and perceptions of value for money were strong factors in their decisions. Many people perceived greenfield homes as better value for money than homes in established suburbs.

Most greenfield residents told us that living in these new suburbs is their preferred choice. To choose a home in an established suburb, their preconditions (in many cases, a detached house, minimum of 3 bedrooms and a lock-up garage) would need to be met for a similar budget, close to family and friends.[78] Our research demonstrates just how challenging this is to achieve.

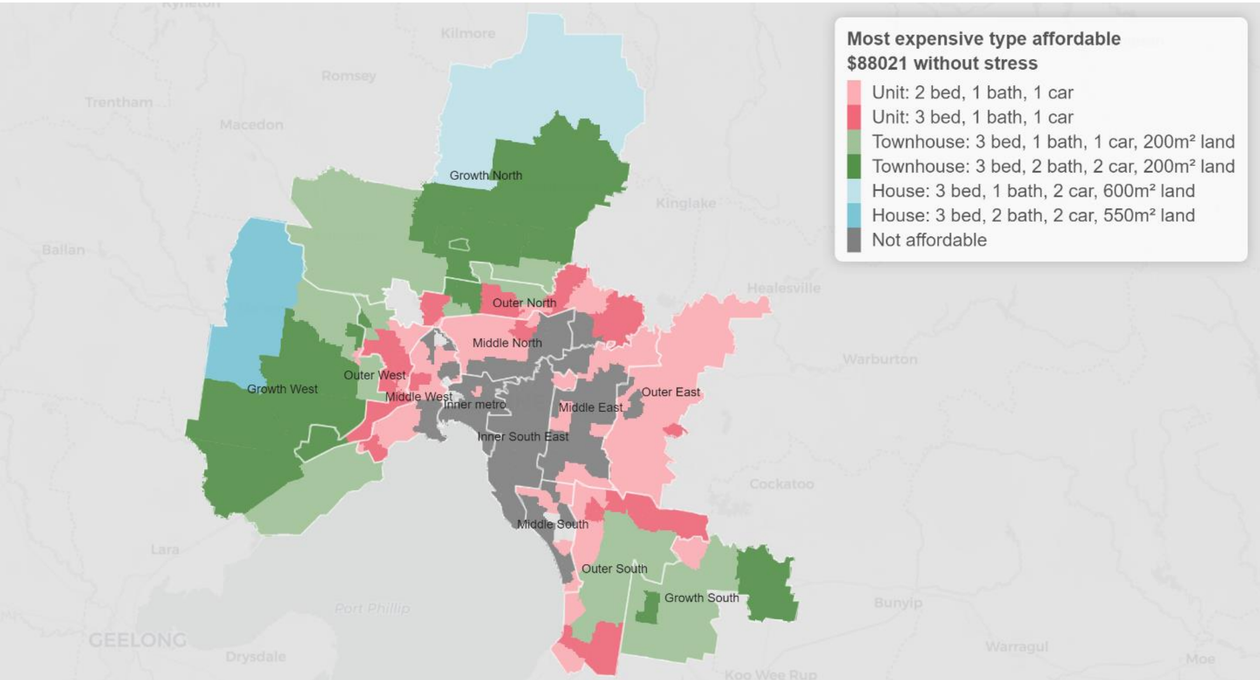
Moderate income households have few home choices

We modelled housing affordability for moderate income households to buy homes in Melbourne, using mortgage repayments as a proportion of household income to measure affordability.[79] We looked at affordability for moderate income households, spanning from the lower ($88,021 a year) to the upper end ($132,030 a year) of their income range, as of June 2022.

We found that moderate income households in Melbourne had few affordable home options. Households earning $88,021 a year and keeping their mortgage repayments to less than 30% of their income could afford to buy a detached house in certain new growth suburbs, a townhouse in growth areas or selected established outer suburbs, or an apartment in the outer suburbs or selected middle suburbs (see Figure 6).

These households could not afford to buy an average-priced home with 2 or more bedrooms almost anywhere in Melbourne's inner suburbs. Affordable options for a detached 3-bedroom house, the preferred type of home for many, are restricted to parts of Melbourne's north and west growth areas.[80] The notional ideal of a large, detached home in established suburbs is entirely out of reach.

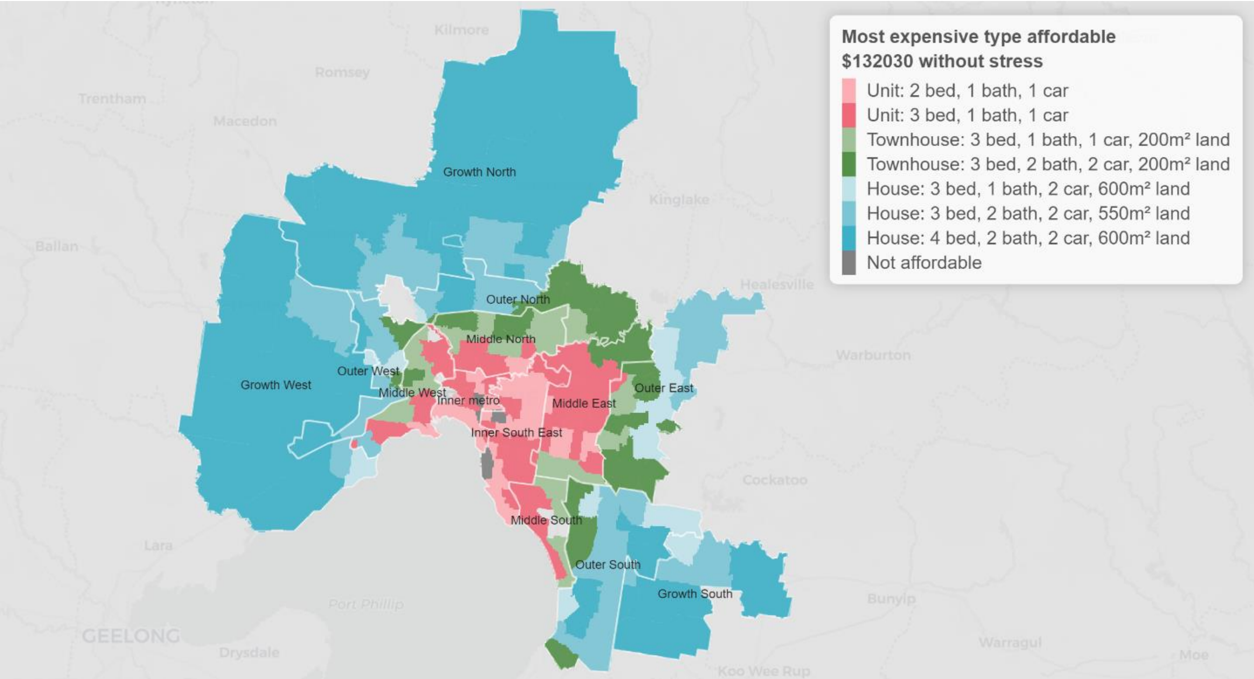
Figure 6: Housing affordability for households earning $88,021, June 2022 (spending less than 30% of income on mortgage repayments)



Infrastructure Victoria, *Measuring home price differences: how features, location and infrastructure affect Melbourne's home prices*, 2023

Moderate income households at the upper income end have a few more affordable options. Households earning $132,020 and keeping their mortgage repayments to less than 30% of their income could afford a larger detached house in most outer or growth suburbs, a townhouse in most middle suburbs, or an apartment in many of Melbourne's inner suburbs (see Figure 7).[81] The notional ideal home is affordable for households within this income group, but only in selected established outer suburbs.

Figure 7: Housing affordability for households earning $132,020, June 2022 (spending less than 30% of income on mortgage repayments)



Infrastructure Victoria, *Measuring home price differences: how features, location and infrastructure affect Melbourne's home prices*, 2023

Households at both ends of the moderate income range have few affordable options outside of growth areas if they want to buy a detached 3-bedroom house. Households willing to consider 3-bedroom townhouses or apartments as an alternative have more options. The notional ideal home in an established suburb is almost entirely unaffordable to moderate income households, but townhouses and apartments can substitute for growth area houses for some, provided supply is available.

Access to infrastructure influences where people live

People told us that the presence or promise of infrastructure played an important part in their decision making. Some greenfield residents accepted that they might need to wait for infrastructure to be delivered, and this was a part of their investment strategy. Some households chose places where available infrastructure, such as schools, matched their family's needs. Others were caught out, with facilities such as childcare lagging their immediate requirements.[82]

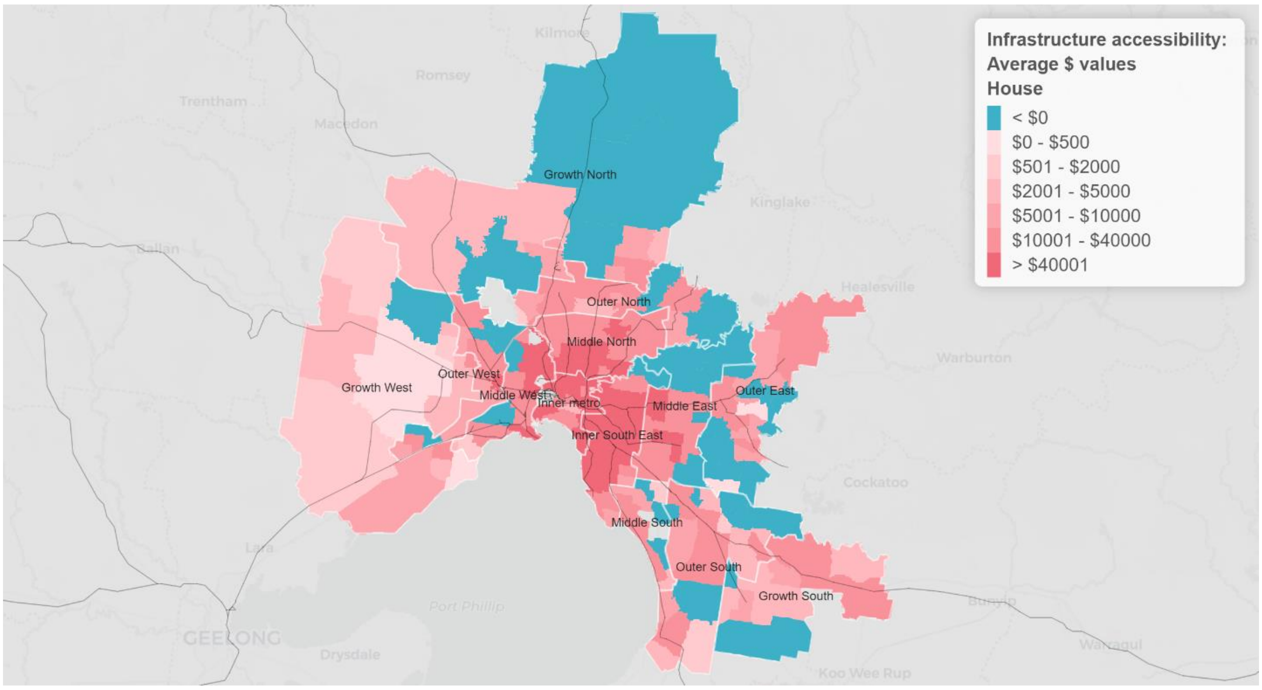
> 'I was more interested in the size of the land, the block and price for the block, that's all I was concerned about… I had to give up my job when we moved for childcare.'
>
> - Point Cook, lives with husband and 2 primary school aged children[83]

We investigated the influence that access to different types of infrastructure has on prices for homes in Melbourne. We looked at 10 different types of infrastructure, and assessed its relationship with prices for homes located near metro train stations, tram stops, arterial roads, major activity centres (suburban centres for jobs, services, homes and transport), metropolitan activity centres (larger hubs for public transport that offer access to jobs and activities for the surrounding suburbs), hospitals, secondary schools, police stations, cemeteries and landfill sites.[84]

Proximity to some types of infrastructure, such as train stations and activity centres, has a positive association with home sale prices while others, such as landfill, have a negative association. We used this analysis to estimate the combined economic value from all 10 infrastructure types for each property. We then averaged this value over all houses in each area. We found much variation in the price effects for houses near to infrastructure in Melbourne (see Figure 8).

Most of Melbourne's inner suburbs have large price premiums associated with being close to infrastructure. Middle areas, including middle south, north and west also benefit to some degree from higher house prices due to infrastructure access, although price increases are lower than the inner suburbs. However, most established outer suburbs and new growth areas do not have access to some infrastructure, particularly public transport, and have low or negative infrastructure price premiums.

Figure 8 Combined average house price effects from access to infrastructure, Melbourne



Note: Data excludes townhouses and apartments.
Infrastructure Victoria, *Measuring home price differences: how features, location and infrastructure affect Melbourne's home prices*, 2023

Limited access to infrastructure is one reason established outer suburbs and new growth areas are more affordable than Melbourne's inner and middle suburbs, and greenfield households factor this into their decisions about where to live. Moderate income households looking for a more affordable home must trade off infrastructure access by choosing to live in outer suburbs or growth areas.

Greenfield developments need timely planning and delivery of essential infrastructure for residents to access the services they need. However, infrastructure is expensive to deliver, particularly in new suburbs when compared with established suburbs that have the capacity to support growth.[85] Early provision of infrastructure to new suburbs is more likely to meet the needs of residents but may also lead to increases in prices that can undermine housing affordability in these areas and further restrict the home choices available to moderate income households.

Growth area houses have strong demand

Many households want to combine the best of home and location features to get their notional ideal home, but find their choices are restricted by their available budget. Most households need to compromise to find an affordable home.

We asked people which home they would choose to live in, if they had to move now and select from homes in Melbourne, Geelong and Ballarat at prevailing prices.[86] Households' willingness to trade off location in favour of the type of home contributes to a strong preference for homes in Melbourne's established outer suburbs and new growth areas.

Nearly 1 in 3 people would choose a home in Melbourne's established outer suburbs if they had to move, factoring in prevailing house prices and the amount they are prepared to spend. A similar number would opt for Melbourne's growth areas. Preferred combinations of home type and location, summarised in Table 1, are large, detached houses in new growth and established outer areas (24% and 20% of total choices respectively), and in Ballarat or Geelong (12% of total choices).

Table 1: The homes people would choose if they had to move in Melbourne, Geelong or Ballarat at prevailing prices, % total

	Inner	Middle	Outer	Growth	Regional	TOTAL
House (1-2 bed)	0.1%	1.0%	2.1%	1.2%	1.4%	**5.8%**
House (3+ bed)	0.9%	5.1%	20.1%	24.2%	11.8%	**62.2%**
Townhouse (1-2 bed)	0.3%	2.0%	3.2%	1.1%	1.2%	**7.7%**
Townhouse (3+ bed)	0.5%	2.0%	1.9%	1.9%	0.5%	**6.7%**
Apartment (1-2 bed)	8.5%	5.6%	1.6%	0.3%	0.2%	**16.2%**
Apartment (3+ bed)	0.5%	0.4%	0.3%	0.1%	0.0%	**1.3%**
TOTAL	**10.8%**	**16.1%**	**29.3%**	**28.7%**	**15.1%**	**100.0%**

The Centre for International Economics, *Demand for housing in Victoria: stated preference research*, 2022

People's life stage and background partly drive their choice for growth areas

We analysed characteristics and attitudes of people living in Melbourne's growth areas and those who would choose to live there if they had to move. People living in growth areas have diverse attitudes, preferences and behaviours,[87] but on average, they display some similar characteristics when contrasted with people who live in established suburbs.[88]

We found that the households most likely to choose a home in growth areas already live there.[89] These households already considered new versus established suburb options and are generally pleased with their choice of location and home.[90]

Greenfield homes attract first home buyers and households with children

Greenfield suburbs, on average, attract higher numbers of first home buyers,[91] households with young children and those intending to have children in future.[92] This means new suburbs have large and growing numbers of young children living there. Households with children make up almost 60% of Melbourne's growth area households, compared with 40% in established suburbs.[93] Melbourne's 7 growth area councils are home to 38% of metropolitan Melbourne's 0 to 4 year olds, and this is projected to increase.[94]

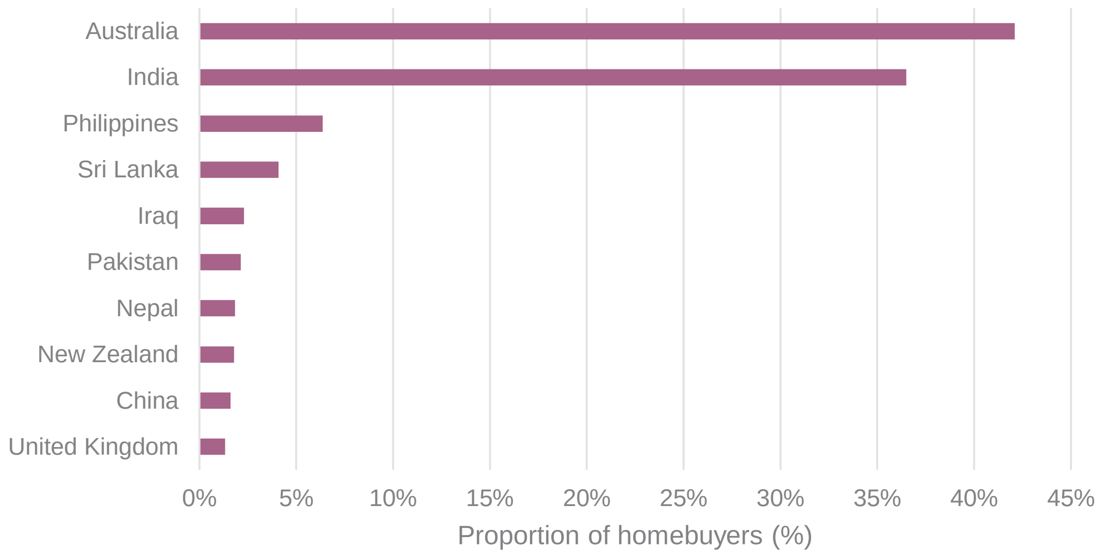
Greenfield developments in peri-urban and regional Victoria have a similar profile. Around two-thirds of households in Geelong and Ballarat's growth areas have children, for example, and young children make up a relatively high share of the population.[95]

This contributes to larger household size in greenfield suburbs relative to established suburbs.[96] It also influences the type of home greenfield households will choose. More than half of Melbourne's growth area homes have at least 4 bedrooms, compared with just one-fifth in established suburbs. Some growth area residents are prepared to consider a smaller house in an established suburb close to jobs, services and transport, and trade a bedroom to achieve this. But smaller homes in established suburbs will need to meet the needs of households with children to be a genuine alternative for many greenfield residents.

Cultural connection is an important driver of greenfield choice

Melbourne's greenfield suburbs are very culturally diverse. More than half of the population in suburbs such as Clyde North, Point Cook and Wollert were born outside of Australia, and this share is growing.[97] Buyer survey data indicates that people born in India are the largest cultural group buying in Melbourne's greenfield suburbs, after those born in Australia (see Figure 9).

Figure 9: Melbourne's greenfield homebuyers, top 10 countries of birth, %



RPM Group, *Buyer survey* data 2016–2021

Greenfield suburbs in regional Victoria are less culturally diverse than those in Melbourne on average, but this might be starting to change. Around one-quarter of Lucas (Ballarat West) residents were born outside Australia at the time of the 2021 census, for example, compared with one-fifth 5 years previously.[98]

We found that community and cultural connections are a big influence on the choice for greenfield homes, particularly for households coming from culturally diverse backgrounds.[99]

> 'We wanted to live in [the] west because of one main reason… friends mostly live in the area, and plus our community centre is in the west.'
>
> - Greenfield renter, living with partner and young children[100]

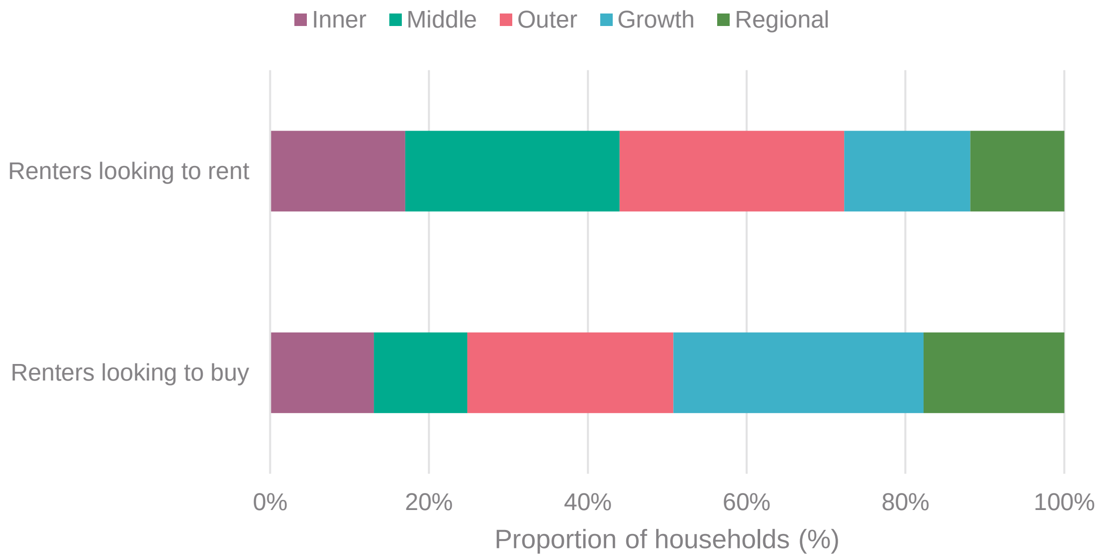
This sense of community was important for many greenfield residents to feel welcome and included. It meant their community shared their children's cultural background, and they could find culturally appropriate shops and restaurants. These factors are likely to keep influencing choices for greenfield homes. We included a representative sample of people born overseas in our focus groups and choice survey to help us understand how culture and cultural connection influence home choices.

Renters are a source of future greenfield demand

Renters make up a relatively small proportion of current greenfield residents (around one-quarter, compared with one-third of households in established suburbs),[101] but they are an important source of future demand for greenfield homes.

Around half of renters in our survey would consider buying a home if they needed to move, if they could find a home they liked that was affordable. These households are much more likely to choose growth area homes than those who intend to keep renting (see Figure 10). Budget constraints and a strong preference for detached houses mean around half of renters looking to buy would select homes in growth and regional areas.

Figure 10: Choice of home location by households currently renting, %



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The number of renters is growing faster than owner-occupiers, particularly in Melbourne's growth areas.[102] Home ownership rates are projected to keep falling.[103] The number of households renting in growth areas increased by 42% between 2016 and 2021, compared with 12% in established suburbs.[104] Renters will likely be a growing source of demand in greenfield suburbs, regardless of whether they plan to buy or keep renting.

Policy options for the Victorian Government to consider

Our research highlights that Victorians value the size and features of their home highly, and that these factors can be more important than location for some households. But affordability has a large effect on people's housing choices, even when they are prepared to make trade-offs to get the home they want. Most 3-bedroom homes in Melbourne are unaffordable for moderate income households, outside of outer established suburbs and new growth areas.

If the Victorian Government wants to increase the proportion of new homes built in established suburbs, it will need make these homes affordable and appealing for the households who currently buy greenfield homes. This means generating more affordable options suitable for households with children.

We used our research findings as a starting point to explore policy options that can help increase housing supply and diversity in established suburbs, as a substitute for greenfield homes. We also considered ways to better use infrastructure, by making the most of what is already in place.

The scope of our research, on greenfield homes and households, and potential alternatives in established suburbs, means we considered affordability for moderate income households. This report does not seek to solve the issue of housing and rental affordability more broadly.

Our policy options explore ways the Victorian Government can influence the price, location and type of homes being built, to give more choice to moderate income households who might prefer to live in established suburbs. We identified 10 options for the government to consider which respond to one or more of these outcomes:

- Reduce price disincentives to buying in established suburbs.
- Build more homes in established suburbs near transport and services.
- Increase the diversity and choice of homes in established suburbs.

Increasing the supply of homes in established suburbs to meet Victoria's future population growth is a very large and complex challenge that will require several different policy solutions. Some of the reforms we propose are more straightforward to deliver than others. We are presenting these as options rather than recommendations, to offer government flexibility in its approach. In our view, all available tools will be needed.

We propose a combination of options, both to start now and to keep pursuing over the medium term as the impacts of any changes begin to be seen. We also suggest ways in which policy options can be packaged together for better results. We present these options alongside more findings from our housing research, to indicate how they can help deliver the type of homes Victorians told us they would choose.

In selecting our policy options we balance the need to achieve significant change against consideration of potential disruption to the housing market. We are suggesting policy options that are practical and proportionate to the challenge of increasing the supply of homes in established suburbs. There are a range of more drastic policies that can be delivered with more dramatic effect, such as the sweeping planning changes currently being considered in Auckland.[105] In our view, these 10 options present a good foundation for ongoing reforms to deliver the homes needed to support Victoria's future growth. However, government should closely monitor the success of any reforms implemented, and consider whether more significant reforms are needed in the future.

Combine options for more impact

This report lays out different policy options for the Victorian Government to consider that help build more homes offering an affordable greenfield substitute in established suburbs. The Victorian Government ultimately decides its policy positions, but this report demonstrates the scale of the challenges and opportunities available.

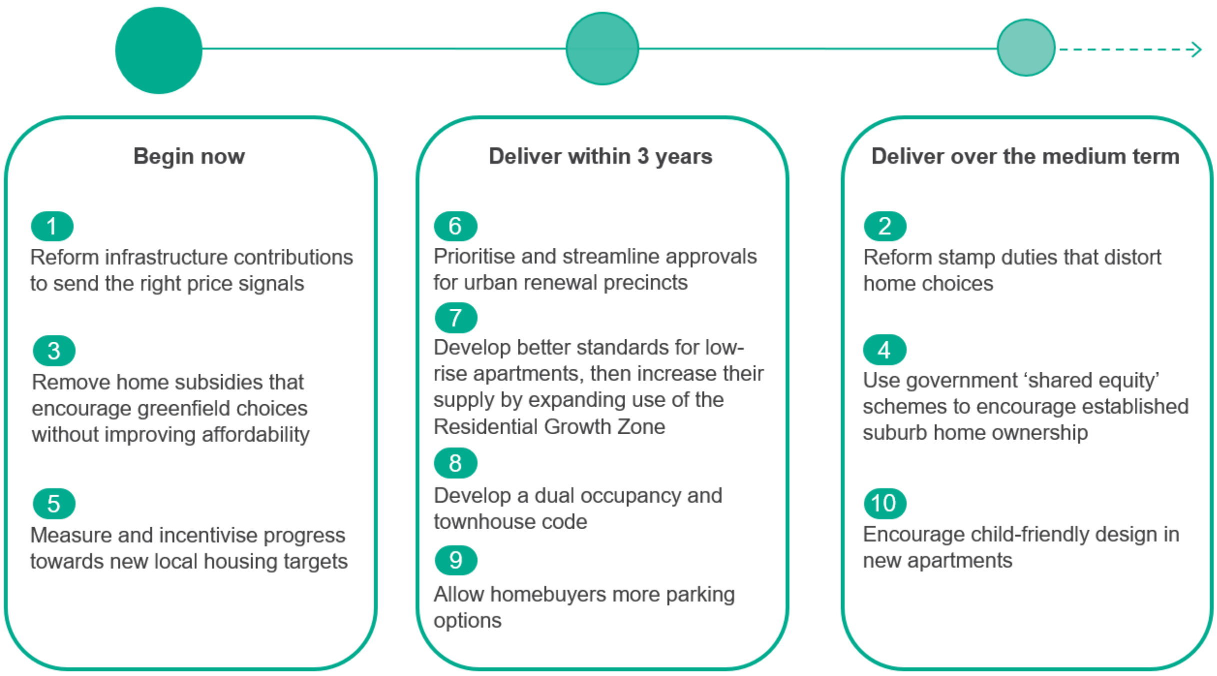
Our options outline interventions the Victorian Government can begin to deliver now, to prepare for further reforms in the decades ahead. We propose 3 combinations of reforms (see Figure 11), with policy options that will work together for larger effect.

Work on the first package of reforms (**Options 1**, **3** and **5**) can begin immediately. These options are complementary and will lay the foundation for subsequent reforms. A consistent approach to infrastructure contributions (**Option 1**) can give funding certainty for any upgrades needed to support new homes. Timely provision of infrastructure can reduce community concerns about development and growth.[106] The Victorian Government can prioritise measuring local infrastructure capacity to inform the size and location of housing targets (**Option 5**) and the contributions needed to achieve them. Reforms to home subsidies (**Option 3**) will work with infrastructure contributions to send a price signal to the housing market.

The second package of policy options (**Options 6**, **7**, **8** and **9**) is likely to require some lead time to prepare, but we estimate they can be delivered within 3 years. These are opportunities to increase the supply of greenfield substitute homes and together they would create a variety of new planning pathways for these homes to be delivered. Planning for priority precincts (**Option 6**) can nominate residential zones suitable for new low-rise apartments (**Option 7**), for example, and recommend the dual occupancy and townhouse code to increase supply of greenfield substitute homes (**Option 8**). Plans can also identify areas suited to lower minimum parking requirements (**Option 9**).

Our third package of policy options (**Options 2**, **4** and **10**) is important in the medium term once priority reforms are delivered. Changes to stamp duty (**Option 2**) will require a longer timeframe to plan and deliver. Work can begin in parallel with the second package of options, but delivery can be carefully phased to allow government to monitor any effects on the housing market and adjust the pace of reform as needed. The Victorian Government's shared equity scheme (**Option 4**) needs time to become established before changes are made to eligibility. More child-friendly apartment design (**Option 10**) will improve viability of apartments as greenfield substitute homes, but benefits are likely to be realised once other priority planning options are delivered due to current preferences of households with children to live in homes other than apartments.

Figure 11 Timelines for delivery



Reduce price disincentives to buying in established suburbs

Home choices respond to changes in price

We found that demand for new homes in greenfield areas is strong. One in 4 people we surveyed would choose a detached house in Melbourne's growth suburbs if they had to move, factoring in prevailing home prices and their household budget.[107]

Affordability is a major factor in people's home choices.[108] Our price modelling shows that few places in Melbourne are affordable for moderate income households looking for a detached house, outside the growth areas. We also found that homes located close to existing infrastructure are more expensive.[109] Faced with these trade-offs, more households are prioritising home features over location.

We modelled how price changes affected choices for different types of housing in different places, to test how this can change demand for greenfield homes. We looked at relative price drops for apartments and townhouses in established suburbs, and price rises for growth area homes.

Modelling changes to prices using the choice model we developed acts as a proxy to help us understand how peoples' decisions would change with different available options. We are not recommending that sales prices be increased or decreased directly for homes in either new growth or established areas.

Fewer people choose growth areas when prices in other areas are more competitive

We found that demand for homes in growth areas is sensitive to price. A modelled price increase of 10% reduced the number of households choosing growth area homes by 11% (see Figure 12). Most of these households shifted their choice to Melbourne's established suburbs, where demand grew by 5%. The number of households choosing regional homes increased by 3%. A 20% price increase shifted demand away from Melbourne's growth areas by 33%.

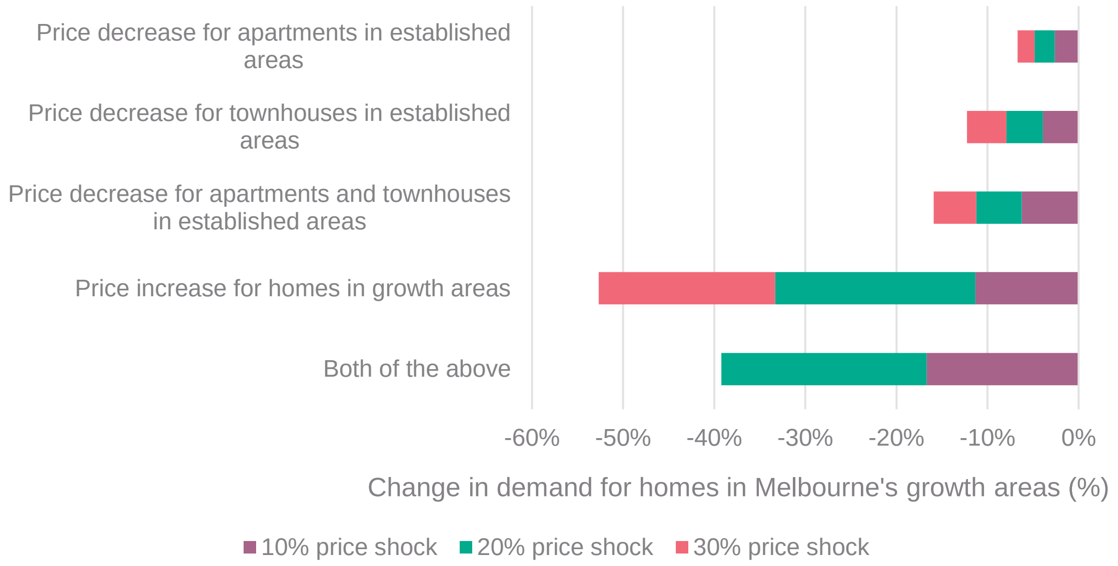
A 10% price drop for townhouses and apartments in established suburbs would lead to 6% fewer people choosing growth area homes, while increasing demand for established suburbs by 4%. If prices dropped 20%, 11% fewer would choose growth area homes.

> A combination of established area price drop and growth area price rise would affect demand for growth area homes the most. A 10% price drop for established area apartments and townhouses, combined with a 10% price rise for homes in growth areas would shift demand by around 17%.[110]

Many households will keep choosing growth area homes even when prices change. These households value larger homes which are more affordable in new suburbs and will still favour home features over location when deciding where to live. Greenfield suburbs will continue to play an important role in Victoria's future to accommodate households with these preferences.

The households who are most likely to change their housing choices from new growth areas in response to changes in price tend to be younger, have lower incomes, or be recent migrants to Australia. They are more likely to say they prefer being able to walk easily to most destinations and they believe in making the most of savings from government grants and tax incentives.[111] Policy options that aim to encourage demand for homes in established suburbs should focus on the households most likely to shift preference. These households are more flexible and place a higher value on living in areas with good access to services and amenities.

Figure 12: Effect of price shocks on home choices, % change



Note: 30% price shock for 'Both of the above' was not modelled, as it would be outside the range of levels used in the survey.
The Centre for International Economics, *Demand for housing in Victoria: stated preference research*, 2022

House prices respond to government policy settings

The Victorian and Australian governments have introduced housing policies to promote home ownership and tackle issues of housing affordability and supply over several decades.[112] These include Victorian Government schemes targeting home ownership among first home buyers and the Australian Government's Housing Accord to increase the supply of affordable homes.[113] We found that many people consider the availability of government grants, subsidies and tax incentives when buying a home.[114]

However, home ownership is becoming more difficult to achieve. Declining affordability is a contributing factor, as house prices have grown faster than wages.[115] Australia has a low rate of outright home ownership (without a mortgage) compared with other developed countries, 13% below the Organisation for Economic Co-operation and Development average and lower than comparable countries such as the United Kingdom.[116] With or without a mortgage, Victoria's home ownership rate was 68% in 2021, down from 70% in 2011,[117] and home ownership rates for younger Victorians fell further. A total of 51% of those aged 30–34 owned their home in 2021 compared with 56% in 2011.[118]

Our modelling shows that housing affordability and relative prices for different types of homes in different areas can influence demand for greenfield homes.[119] Government policies, including tax settings, influence the location and types of homes being built, what and where people want to buy, and how much it costs.[120] They inform the choices people make between home features and location. The right policy settings can influence the speed at which Victoria's cities keep expanding outwards.

Our previous analysis of *Infrastructure provision in different development settings* found that infrastructure, excluding transport, can be 2 to 4 times more expensive in greenfield areas than in existing areas with capacity for growth.[121] This cost difference is not reflected in relative house prices in new growth and established areas.[122] Delivery of expensive infrastructure struggles to keep pace with rapid population growth in greenfield suburbs.[123] Our price modelling suggests that cheaper greenfield home prices partially reflect this absence of infrastructure, attracting more people to the greenfields and adding to pressures on the infrastructure that is there.[124]

We explored policy options for the Victorian Government to consider that can reduce some of the price disincentives for people to buy homes in established suburbs, so that moderate income households looking for homes with 3 or more bedrooms have more choice in where to live.

Reform infrastructure contributions to send the right price signals

Option 1

Develop a clear, efficient and transparent infrastructure contribution system that better reflects the true cost of infrastructure in different development settings and supports better use of existing infrastructure.

Growing suburbs create more demands on infrastructure. Governments might need to upgrade existing infrastructure, or build new infrastructure, to support larger populations. Infrastructure contributions are one way to fund infrastructure for new and growing communities.

Victoria has several infrastructure contribution schemes. The Growth Areas Infrastructure Contribution is a one-off payment by developers towards essential state infrastructure in most of Melbourne's greenfield suburbs.[125] Other developer contribution schemes, such as Infrastructure Contributions Plans and Development Contributions Plans, are mainly used to fund local government infrastructure and can be complex to design and deliver.[126] Outside Melbourne's new growth areas, the Victorian Government has no consistent mechanism to collect development contributions for state infrastructure such as public transport or government-owned schools and hospitals.

Development contributions can encourage developers to account for the costs of building essential infrastructure when land is developed, helping to reflect infrastructure costs in the prices of new homes and promote more efficient use of infrastructure.[127] Victoria's various schemes operate in isolation rather than as an overall system, curbing their potential to influence where new homes are built.[128]

Small scale housing development in established suburbs can often use existing infrastructure, but large scale urban renewal might require considerable infrastructure investment. Urban renewal precincts offer opportunities for major increases in housing supply in established suburbs but the transformation can be expensive if infrastructure needs to be upgraded, or if contaminated soil needs to be removed. Inadequate infrastructure is often the reason why sites remain undeveloped.[129]

We analysed greenfield developments and confirmed that state and local infrastructure costs are higher than in established suburbs, where capacity exists to support more homes.[130] The Growth Areas Infrastructure Contribution is estimated to recover just 15% of these costs, meaning that most infrastructure will be funded by taxpayers.[131]

The Victorian Auditor-General and Better Regulation Victoria have also found that Victoria's infrastructure contribution schemes are not delivering the infrastructure growing communities need.[132] The Auditor-General called for a development contributions framework that sets a strategic direction, states its desired outcomes, and clarifies accountability and governance arrangements.

In *Victoria's infrastructure strategy 2021–2051*, we recommended that the Victorian Government create a consistent and efficient infrastructure contribution system for Victorian and local government infrastructure in established suburbs, growth areas, peri-urban areas and regional cities.[133] The government can start work to reform infrastructure contributions now, to send a price signal that influences the location of new development.[134] A broad-based infrastructure contribution system that better reflects true development costs in different settings can give more certainty to developers and distribute infrastructure costs more equitably, helping to stimulate new home building in established and urban renewal areas.

New South Wales recently committed to reforming its development contribution system. The proposed reforms introduce a broad-based system to fund regional infrastructure through a levy on development. Proposals include a structure-based charge which is higher for detached houses and a variable charge designed to contribute to the cost of major transport projects.[135] An evaluation of the proposed reforms found that they would increase supply of homes, ensure timely delivery of essential infrastructure and build community support for development.[136] A Victorian infrastructure charge can be structure-based, similar to the New South Wales draft reforms, or area-based.

Infrastructure contribution reforms can complement work to develop housing targets (see **Option 5**). A consistent approach to infrastructure contributions can give more certainty to local governments about funding for infrastructure upgrades and improvements to support new homes.

Reform stamp duties that distort home choices

Option 2

Remove the distortions created by stamp duty concessions and ultimately abolish stamp duties altogether, potentially by replacing them with a broad-based land tax.

Our research shows that housing affordability and relative prices for different types of homes are a major factor in many people's decision to buy in a greenfield development. House prices are influenced by many factors, including government taxes and levies such as land transfer duty (commonly known as stamp duty) and negative gearing tax concessions.[137]

Stamp duty is a state government tax on the transfer of land ownership. It is calculated based on the value of the property, on a sliding scale that starts at 1.4% for properties valued at $25,000 and rises to a maximum of 6.5% for property values over $2 million.[138] Stamp duty is the major source of property tax revenue for the Victorian Government. It raised over $10 billion in the 2021-22 financial year, more than 10% of total state revenue.[139]

Stamp duty increases the cost of homes, particularly for households who buy multiple times. It can distort housing choices by incentivising households that plan to have children to buy a larger home earlier than they need, rather than upsizing gradually as their family grows.[140] This is likely to increase greenfield demand among moderate income households, as these suburbs offer more affordable 3-bedroom homes.[141] It can also discourage people from moving house, including those who might consider downsizing after children have left home.[142] Retirees can be further discouraged from downsizing by the Age Pension assets test, which excludes the family home from assessable assets.

The Victorian Government has introduced stamp duty concessions to reduce costs for some homebuyers. These include targeted measures for first home buyers, to remove stamp duty for homes that cost up to $600,000 and give a concession for properties valued up to $750,000.[143] These concessions favour greenfield areas, which are more likely to be below the price thresholds. Five of Melbourne's growth area councils recorded the highest number of waivers and concessions for first home buyers in the year to June 2020.[144] Our research shows that stamp duties and stamp duty concessions influence people's housing choices and decision-making.[145] People are more likely to choose a home that is eligible for a concession.

The Organisation for Economic Co-operation and Development and the Grattan Institute, among others, have advocated for a broad-based land tax to be used as an alternative to stamp duties.[146] Land tax is a yearly charge based on land value rather than a single upfront payment. It can offer a steadier income stream for governments, and does not discourage people from moving house.[147] Modelling suggests that replacing stamp duty with land tax can also increase home ownership rates, particularly among younger people.[148]

Land tax can influence growth patterns in different suburbs by incentivising higher density development.[149] Our research also suggests that a land tax can influence homebuyers' choices when it comes to deciding between a larger home in a growth area or a smaller home in an established suburb.[150] The Australian Capital Territory and New South Wales have already begun to switch from stamp duty to land tax systems.[151]

Sudden changes to property taxes risk causing instability in the housing market. Removing stamp duty can cause a significant increase in housing market activity and further reduce affordability if it is not replaced with an alternative.[152] The Organisation for Economic Co-operation and Development recommends a slow transition away from stamp duties towards land taxes to avoid making homes even less affordable.

The Victorian Government can phase out stamp duties and associated concessions over time to help encourage turnover and mobility in the housing market.[153] As a first step, the government can remove stamp duty concessions that encourage people to choose greenfield developments, while keeping those that encourage mobility in established suburbs such as the pensioner duty concession.[154]

The government can then consider an opt-in land tax model, similar to the approach adopted in New South Wales, to allow homebuyers to choose between upfront stamp duty or a yearly land tax. A phased approach over the long term will allow the government to monitor the effect on housing choices between new and established suburbs, and adjust the pace of reform as needed to avoid making housing affordability for moderate income households worse.

Full transition from stamp duty to a broad-based land tax would need careful phasing, and ongoing monitoring and adjustment to keep pace with property prices. Similar reforms in New South Wales and the Australian Capital Territory are expected to take several decades to fully deliver. This option can be packaged with other medium-term policy reforms, such as **Option 4: Use government 'shared equity' schemes to encourage established suburb home ownership**.

Experience in other jurisdictions indicates that replacing stamp duty with land tax can be revenue neutral, but that the transition can reduce government income in the short term.[155] The Australian Government could support the transition by making up some of the initial revenue shortfall, similar to payments made in exchange for economic reforms under the National Competition Policy.[156] The Victorian Parliament's 2023 inquiry into land transfer duties will consider the tax's impact on housing supply and development and government revenue predictability, as well as potential alternative mechanisms.[157]

Remove home subsidies that encourage greenfield choices without improving affordability

Option 3

Avoid subsidies that inflate house prices and remove the First Home Owner Grant.

People who attended our greenfield focus groups told us that government grants, including first home owner grants, can be a strong motivator in buying a home. For some, the availability of grants meant they could bring forward buying a home as it helped them qualify for a mortgage.[158] This was also reflected in the data we collected on attitudes to housing as part of our choice survey.[159]

The Victorian Government's First Home Owner Grant aims to tackle affordability for first home buyers. It grants $10,000 to people buying a first home for newly built dwellings valued up to $750,000.[160] Many people use the scheme. Around 17,000 Victorians benefited from the grant in 2021–22. The Victorian Government contributed over $213 million.[161]

While on face value this seems to be a good outcome, research suggests that first home owner schemes do not increase home ownership or improve housing affordability.[162] Home ownership rates have stagnated despite periodic government first home owner schemes, while rates among young Victorians are declining.[163]

Grants can drive up property prices in areas where first home buyers can afford to buy.[164] Sellers typically benefit from homebuyer schemes, by receiving higher sale prices that factor in the grant.[165] First home owner grants can make homes less affordable, particularly for those who are not eligible for assistance.[166]

Victoria's First Home Owner Grant is mainly used to buy homes in growth areas. The top 10 postcodes for grant applications in the year to 30 June 2021 were all located in growth areas in Melbourne or Geelong.[167] This is driven in part by the relative affordability of growth area homes, which are lower than the grant's $750,000 price cap.

Our modelling confirms that few Melbourne homes large enough for households with children are affordable for moderate income households outside of new growth areas.[168] However, high use of the First Home Owner Grant in growth suburbs is adding to demand for greenfield homes and can contribute to higher house prices in those areas.

The Victorian Government can end Victoria's First Home Owner Grant to remove any upward pressure on house prices in greenfield areas and more accurately reflect home preferences. The Productivity Commission agrees. It recommended that assistance to first home buyers should be removed, unless targeted towards people who are excluded from the housing market.[169]

Governments have previously moved to reduce or remove first home buyer grants quickly, to reduce speculation and disruption to the housing market.[170] Changes to the First Home Owner Grant can be announced with immediate effect. Victorian Government investment can instead be diverted to measures that encourage demand for homes in established suburbs (see **Option 4: Use government 'shared equity' schemes to encourage established suburb home ownership**). Australian Government initiatives such as the Home Guarantee Scheme, which supports eligible homebuyers to buy a home sooner, will keep supporting Victorians who are working towards a deposit for their first home.[171]

This option can be introduced alongside changes to infrastructure contributions (**Option 1**) and work to develop housing targets (see **Option 5**). A short lead time for delivery can help to reduce any sudden increase in homebuyer demand, if people try to buy homes before the grant is removed.

Use government 'shared equity' schemes to encourage established suburb home ownership

Option 4

Over time, change the locations eligible for the Victorian Homebuyer Fund, to encourage people to buy homes in established suburbs.

We explored how changes in house prices can shift home choices from greenfield towards established suburbs, and the attitudes of people who are more likely to shift. We found that people who change their choice from greenfield to established area homes are more likely to agree with the statement "My home choice must save on stamp duty and maximise government grants and other tax incentives".[172] These households are seeking value for money and are more responsive to financial incentives that aim to shift homebuyer preferences towards established suburbs.

Shared equity schemes can help improve access to home ownership for people who cannot afford it otherwise. The Victorian Homebuyer Fund helps people buy a home by contributing up to 25% of the buying price. It reduces the required deposit to 5% and removes the need for lender's mortgage insurance.[173] Participants in the scheme can buy back the government's share in the property over time. Applicants can earn up to $128,000 or $204,000 as a couple, while the maximum buying price is $950,000 in Melbourne and Geelong and $600,000 in other parts of regional Victoria.[174] More than 2,500 Victorians accessed the fund after it was launched in 2021, and there is capacity to support up to 10,000.[175]

Shared equity schemes can be an effective way of encouraging first home ownership.[176] They can help younger people get into the housing market, enable them to borrow less for their first home, or allow them to buy a larger home to accommodate children.[177] However, like the First Home Owner Grant, this program likely stimulates demand for greenfield homes. Homebuyers who want to buy a larger home to accommodate children are most likely to find homes that meet their needs in greenfield developments under the current price cap of $950,000.[178] Four out of the top 5 postcodes in the scheme to date are in Melbourne's growth areas.[179]

The Victorian Homebuyer Fund currently has very few restrictions to its eligibility to encourage broad uptake. The scheme can be more tightly targeted. The Victorian Government can limit the locations eligible for the fund to established suburbs to encourage more people to buy in existing suburbs, while maintaining price caps to preserve equitable use of the fund. Shared equity schemes can incentivise more housing development in the places they apply.[180] A more targeted eligibility criteria can help stimulate the supply of homes in established suburbs and contribute to developing more compact cities.

The Victorian Homebuyer Fund is a relatively new initiative. Changes can be delivered over time, to allow the fund to first become established. This can also allow time for other policy options aimed at increasing supply to take effect, so that new homes will be available to meet higher demand. This option can be packaged alongside **Option 2: Reform stamp duties that distort home choices** and **Option 10: Encourage child-friendly design in new apartments**, as they have a medium-term timeframe for delivery and likely impact. The fund can in time help direct demand for better designed, child-friendly apartments in existing suburbs.

If the Victorian Government opts to remove the First Home Owner Grant (see **Option 3**), this policy option can become the primary mechanism to support home ownership in Victoria. Funding saved from phasing out the grant can be allocated instead to the Victorian Homebuyer Fund to increase capacity. The Victorian Government can recover its investment over time, as home owners buy back the government's share, meaning funding can be recycled to help many more people.

Build more homes in established suburbs near transport and services

Established suburbs can accommodate more new homes

Planning for new homes in the right places can offer more choice, improve affordability and ensure more efficient use of infrastructure. Plan Melbourne emphasises housing growth in established parts of the city, particularly in places with good access to jobs and services.[181]

Melbourne is a low density city by global standards. It has a bigger footprint than cities with much larger populations, such as London.[182] Average population density is less than half of Sydney's urban areas.[183] Melbourne's population is projected to grow by almost 3 million people by 2050 to reach more than 8 million people.[184] But even with this growth most Melburnians are likely to be living at densities lower than most Londoners today.[185] Melbourne can increase population densities while remaining a relatively low density city.

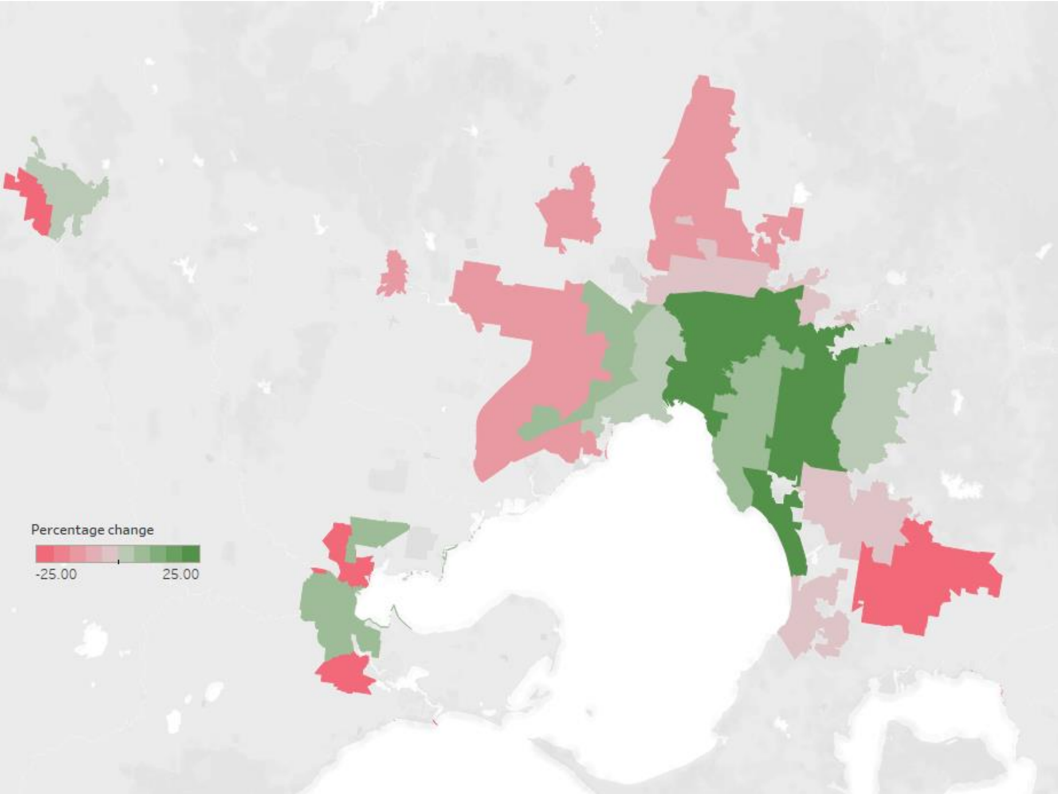
Melbourne will need more housing supply and variety in established suburbs to generate enough new homes to meet the diverse needs of renters and owner-occupiers. An increase in the supply of higher density homes, including townhouses, terrace homes, low-rise and high-rise apartments, can give households more choices.

More people choose established suburbs when house prices change

We found that changes in the price of homes will shift some demand for homes away from greenfield areas. Households shift their home choices to different areas in Melbourne or regional cities, depending on the nature and extent of the price change. For example, our research found that a 10% price drop for apartments and townhouses in established suburbs combined with a 10% price rise in growth area homes can reduce demand for growth areas homes by 17%. Many more people would choose homes in Melbourne's middle suburbs and the inner metropolitan area (see Figure 13).[186]

However, our modelling demonstrates that moderate income households have few affordable home choices, particularly in Melbourne's inner and middle suburbs.[187] Australia has fewer homes per person than most other countries in the Organisation for Economic Co-operation and Development. Inadequate housing supply and diversity affects affordability and reduces peoples' options for where to live.[188] Housing policies that aim to influence demand away from greenfield areas will need to be accompanied by measures to increase supply of affordable homes in good locations.

Figure 13: Change in demand due to a 10% price drop for townhouses and apartments in established suburbs and a 10% price rise for homes in growth areas



The Centre for International Economics, *Demand for housing in Victoria: stated preference research*, 2022

Homes will be needed in all established suburbs

The aspirational 'ideal home' for both greenfield and established area residents is in suburbs close to existing friends and family. New homes will be needed in established suburbs in Melbourne and Victoria's regional cities to meet this preference, and to motivate households to consider medium density homes instead of greenfield houses.[189]

Melbourne has places with good access to existing infrastructure and services that are not accommodating population and housing growth.[190] Plan Melbourne identifies over 130 metropolitan and major activity centres that can support higher density development and deliver more homes closer to jobs and public transport.[191] However, these activity centres accommodated only one-fifth of Melbourne's new homes in the decade to 2018.[192]

Urban renewal projects are an important opportunity to increase the supply of homes in Melbourne's established suburbs. The Suburban Rail Loop project, for example, will invest in station precincts along the new train line to boost jobs and housing options. But precinct development alone will not be enough to deliver the homes in established suburbs that Melbourne's growing population needs. The 12 precincts in the eastern and northern sections of the Suburban Rail Loop are collectively expected to accommodate around 139,500 new households by 2056.[193] Fishermans Bend, Australia's largest urban renewal project, is expected to provide homes for around 37,000 households by 2050.[194] Population projections indicate Melbourne will need an estimated 1.3 million new homes between 2021 and 2051. Over 932,000 of these homes will need to be in existing suburbs to achieve the aspirational scenario in Plan Melbourne for 70% of new homes to be in established areas.[195]

Some areas are accommodating more new homes than others. Around 40% of Melbourne's residential building approvals were in 5 growth area councils in the 5 years to 2022 (Casey, Hume, Melton, Whittlesea and Wyndham). Some established area councils accounted for less than 2% of residential building approvals in Melbourne over the same period,[196] and many of the homes being built in established suburbs are not substitutes for greenfield homes. The proportion of 3-bedroom homes in Melbourne is falling, but this is the preferred size for many greenfield residents who have, on average, larger households. New homes in Melbourne, Ballarat and Geelong's growth areas are more likely to have 3 or more bedrooms, and are more affordable than those in established suburbs.[197]

Progress towards denser housing has been slow.[198] Victoria will need a more coordinated approach to long-term urban planning and development, if it is to increase the supply of well-designed homes in established suburbs that can substitute for greenfield houses. Governments will need to reform existing policies, standards and regulations. Our policy options outline approaches for the Victorian Government to increase the supply of homes in good locations in established suburbs.

Measure and incentivise progress towards new local housing targets

Option 5

Set targets for the number, type and size of new homes in each Melbourne local government area, in collaboration with local governments. Offer local governments incentives to meet the targets. Measure progress by closely monitoring new housing supply and publishing detailed statistics at least every year, including by home type and characteristics.

In *Victoria's infrastructure strategy 2021–2051*, we recommended that the Victorian Government support more homes in priority established places, to increase housing density and better use existing infrastructure (recommendation 35).[199] Higher density areas can typically sustain greater levels of infrastructure and service provision as the costs can be shared by more people.[200] Encouraging housing growth in established suburbs can help reduce government spending on new infrastructure, and deliver social and environmental benefits.[201]

The Victorian Government currently has no mechanism to coordinate local housing strategies so that they will collectively deliver enough new homes to support Melbourne's growing population, in places that will deliver good outcomes.[202] The Productivity Commission recommends that state and territory governments set targets for new homes in major cities so that supply will meet future demand for homes, and work with local governments to achieve them.[203] Other cities, including Sydney and Vancouver, set housing targets that direct new development towards identified areas or specify the type of homes to be built.[204]

The Victorian Government can work with local governments to develop local area housing targets to increase the supply and diversity of new homes in good locations. Targets can help direct new homes to the most suitable areas and increase housing density in places with good infrastructure access, such as near activity centres. They can encourage a variety of home types and sizes, including larger homes that are suitable for households with children (see **Option 10: Encourage child-friendly design in new apartments**). Targets can give clarity to the housing sector, giving developers confidence that local governments will support more homes in their area.[205]

The government can support targets by assessing infrastructure capacity in places targeted for housing growth.[206] This work can start now, to inform the size and location of housing targets and any infrastructure investment needed to achieve them. Local government input can ensure that targets for each area reflect local context, existing housing stock and ideal densities. The Victorian Government's priority urban renewal precincts can also include housing targets and can pilot this approach (see **Option 6: Prioritise and streamline approvals for urban renewal precincts**).

The government is already developing *Land use framework plans* to guide land use and infrastructure development in Melbourne. They include housing distribution scenarios for each metropolitan region that can inform more detailed housing targets for local government areas.[207] The final plans can include targets, which can also be considered in any future updates to Plan Melbourne. The Victorian Government can consider extending the approach to regional cities by including them in updated *Regional growth plans*, which guide land use and development in regional Victoria.[208] The Victoria Planning Provisions, the framework for Victoria's planning schemes, can also include the targets.

Local area planning for dwelling targets can be achieved by updating local government housing strategies to measure capacity, infrastructure needs, and preferred locations for medium and high density homes.[209] Local governments can be incentivised to meet housing targets and complete the necessary strategic and statutory planning,[210] for example by funding them to analyse existing infrastructure capacity and to develop strategies to achieve housing targets. The Victorian Government can also provide targeted access for programs such as the Growing Suburbs Fund, for local governments who meet their housing targets.[211]

The government must monitor the supply of new homes to accurately measure progress towards meeting targets and inform future target adjustments to reflect changes in supply and demand.[212] Current approaches to data collection do not support this. The Victorian Government can develop a housing supply monitoring system to assess progress in meeting targets, which includes collecting data on housing attributes such as type of home and number of bedrooms. A Victorian system can inform development of a national housing supply monitoring framework in the longer term.[213]

This policy option will complement **Option 1: Reform infrastructure contributions to send the right price signals**. A consistent approach to infrastructure contributions in established suburbs can give more funding certainty to local governments for infrastructure upgrades to support new homes. When infrastructure is delivered as more homes are built, communities are more likely to accept changes in density.[214] The Victorian Government can start work with local government on both options immediately.

Housing targets will only be effective if accompanied by other policies to stimulate the supply and diversity of new homes. A dual occupancy and townhouse code which streamlines planning approvals can help increase townhouse supply (see **Option 8**). Better standards and expanding zoning for low-rise apartments can result in more homes in established suburbs (see **Option 7**). These options can work together to support local government progress in meeting targets and increase home choices for moderate income households in established suburbs. They can form part of a second group of policy interventions once housing targets and reforms to infrastructure contributions and home subsidies are underway.

Prioritise and streamline approvals for urban renewal precincts

Option 6

Prioritise urban renewal precincts for development, with streamlined planning approvals. Set targets in each precinct for the number, type and size of new homes. Develop suitable housing demonstration projects that specifically include 3-bedroom homes.

Most households told us they prefer to live in a detached 3-bedroom house, but one in 5 households would choose to live in an apartment if they had to move house now. A majority of those would prefer to live in Melbourne's inner suburbs.[215] But only 1 in 10 Melbourne apartments have 3 bedrooms, meaning they do not offer a substitute for growth area homes.[216] We also heard that people who had lived in apartments with children before moving to greenfield areas felt that current noise and amenity standards did not provide a comfortable living environment for their needs.[217]

Precincts are areas in Melbourne that can accommodate more jobs and population growth. They typically have a mix of activities, businesses, good public transport and land suitable for redevelopment.[218] They are an important opportunity to deliver new homes in established suburbs. Precincts are well suited to more housing development, and can accommodate a range of home types and densities.[219] For example, high density developments can be located next to high frequency public transport, low-rise and medium-rise apartments within 400 to 800 metres, and townhouses between 800 and 1,200 metres of train and tram stops. Plan Melbourne identifies more than 130 areas to be the focus of growth and development, but it does not prioritise precincts for Victorian Government action or specify the amount and type of new homes they can be expected to deliver.[220]

Precinct planning and delivery are challenging. They require ongoing monitoring and re-appraisal to measure whether long-term growth is producing desired outcomes for Victorians. Planning processes can be slow and complex. Reviews of previous urban renewal projects point to opportunities to improve performance monitoring, governance arrangements and cross-government coordination, and to clarify roles and responsibilities.[221]

Residential projects that require large capital investment and development financing are rare in established suburbs.[222] Developers want to be certain of the return on their investment, and they balance this against a project's risk and uncertainty. Projects in established suburbs can have more timing and cost uncertainties than greenfield development. Approval processes vary in length and can be subject to third party objections, and the timeline and cost of utility connections can be unclear.[223] Established suburb developments are more commonly small-scale projects built by small developers, but these do not deliver many new homes.[224] Precinct-scale renewal can build many more new homes than is possible in small projects.

The Victorian Government can establish a prioritisation framework and clear governance for precincts, to focus government investment and clarify the planning and decision-making mechanisms for these places. Identifying a pipeline of priority precincts can help streamline strategic planning and improve the timing of infrastructure delivery to support precinct development.[225] Streamlined planning and approval processes can give more certainty to developers and help catalyse housing development. The Victorian *Major Transport Projects Facilitation Act 2009* and *Suburban Rail Loop Act 2021* are 2 examples of legislation that seek to introduce streamlined planning for areas close to future infrastructure projects, but other important precincts identified by the government do not have access to the same provisions.

Housing targets can clarify the role for each precinct in delivering new homes (see also **Option 5**). They can specify housing diversity and density, such as a minimum number of 3-bedroom apartments to help generate potential substitutes for greenfield homes. Targets should vary depending on the development context and the intended role of the precinct.

The Victorian Government can pilot innovative and best-practice medium and high density homes using housing demonstration projects. These can test the feasibility and marketability of high quality design and help to address community concerns about density.[226]

Ideally, identifying priority precincts comes with an ongoing Victorian Government commitment to infrastructure investment and precinct governance. In *Victoria's infrastructure strategy 2021–2051* we recommended that the Victorian Government should publish plans for priority infrastructure sectors, including sequencing and timelines for investment (recommendation 32).[227] We also recommended that the government identify an appropriate body to monitor infrastructure delivery, including in precincts, and advise on sequencing and funding (recommendation 72).[228] Delivering these recommendations can help improve private sector confidence and catalyse market housing development.

Work to develop a precinct prioritisation framework and governance approach can begin within the next 12 months, to help guide future planning and development. We think this policy option will have more effect if delivered alongside other options to increase homebuyer choice in established suburbs, including **Option 7: Develop better standards for low-rise apartments, then increase their supply by expanding use of the Residential Growth Zone** and **Option 9: Allow homebuyers more parking options**. This package of policy reforms can be delivered within 3 years, following reforms to infrastructure contributions, home subsidies and housing targets.

Case Study

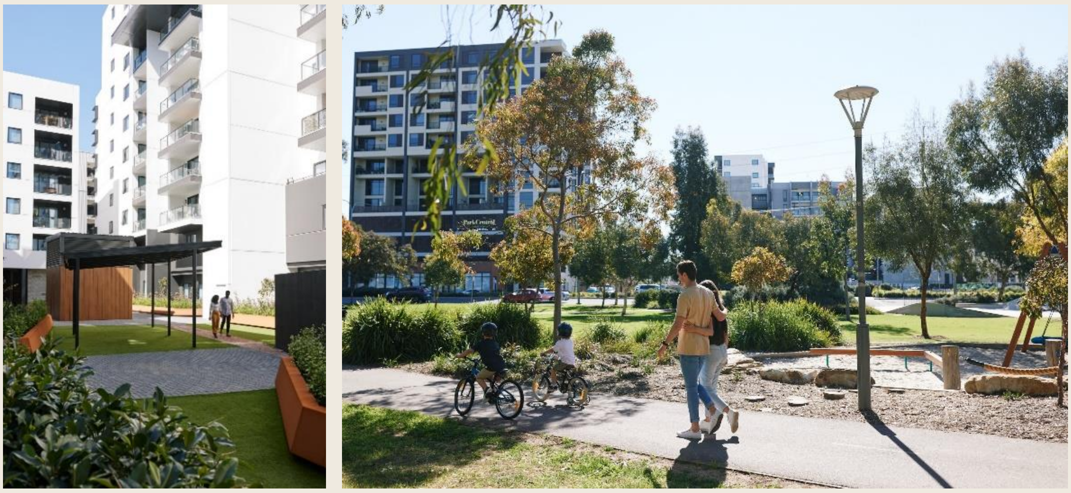
Urban renewal in South Australia

Renewal SA, the South Australian Government's urban development agency, is responsible for managing the redevelopment of Bowden, a 16 hectare site located 2.5 kilometres from central Adelaide, into the state's first high density precinct.[229] In 2008 and 2010, the government bought 2 parcels of former industrial land next to existing public transport. One year later, Renewal SA began soil remediation, planning and infrastructure construction. The government invested over $264 million in roads, open space and essential services.[230]

Private sector developers buy individual lots from Renewal SA. Design credentials are one of the buyer criteria. Renewal SA works closely with site owners by using the Bowden Design Review Panel and design guidelines to ensure high quality outcomes.[231] It aims to achieve a minimum of 160 homes per hectare by using a mix of medium and high density residential projects.[232] Bowden includes completed projects with 3-bedroom terraces, townhouses and apartments. It also has affordable apartments with "the much-loved attributes of a suburban home."[233]

Renewal SA uses strategic pathways and levers to partner with developers and builders to unlock innovative projects. It supported Nightingale Housing's entry into the South Australian market by committing to underwrite part of its Bowden development. To reduce Nightingale's risk in obtaining pre-sales, it provided certainty to the developer and secured the delivery of the state's first affordable zero-carbon apartment building. The project was ultimately so well received that all homes sold within 24 hours, and the underwrite was not necessary.[234]

Figure 14 Bowden, South Australia



Renewal SA, Bowden promotional photography.

Develop better standards for low-rise apartments, then increase their supply by expanding use of the Residential Growth Zone

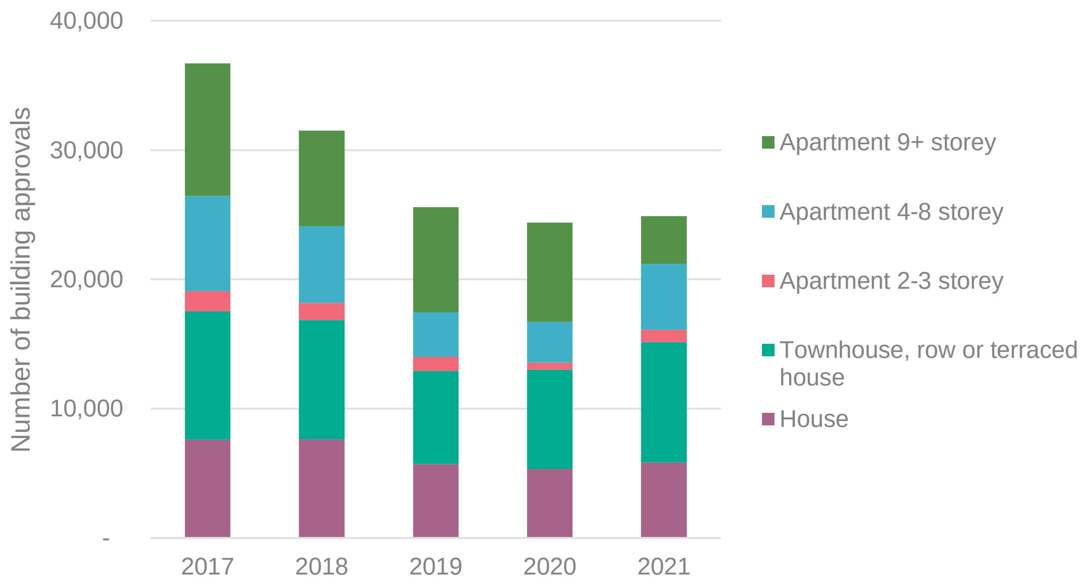
Option 7

Develop better standards for low-rise apartments (4 or fewer storeys) in the Victoria Planning Provisions. Introduce more low-rise apartments by supporting local governments to rezone more residential areas near public transport and services to the Residential Growth Zone.

While many households do not consider the current supply of apartments suitable for their needs, households who would choose apartments if they had to move now have a strong preference for low-rise compared to high-rise apartments. Around 60% of people who chose an apartment preferred 2 or 3 storeys compared with 20% who preferred an apartment of 11 storeys or higher.[235]

Low-rise apartments make up a very small proportion of new homes in Melbourne's established suburbs (see Figure 15). Apartments of 2 to 3 storeys accounted for just 4% of new dwelling approvals in established suburbs in 2021.[236] Melbourne's middle suburbs are traditionally low density neighbourhoods containing few housing options other than detached homes and townhouses.[237] Many homes in these areas have good access to public transport, and better access to other infrastructure, shops and services than established outer or new growth areas. However, much of the housing stock is ageing, and requires upgrades to bring it up to date with contemporary energy efficiency and sustainability standards.[238] This presents an opportunity to develop medium density homes when existing stock becomes available for development.

Figure 15: Building approvals by home type, established Melbourne, 2017–2021



Australian Bureau of Statistics, *Building approvals, Australia*, 2022

Established suburbs have the capacity to support higher density homes, but development is restricted by limited application of residential planning zones that support higher densities. For example, the Residential Growth Zone allows building heights of up to 13.5 metres, or 4 storeys, and applies to places suitable for more new homes with good access to services and transport.[239] Its purpose is to encourage increased density,[240] but it is applied inconsistently in places that are well served by infrastructure. Just 1% of residential areas in Melbourne's middle suburbs are currently zoned for residential growth.[241] This hinders housing diversity and curbs the supply of new homes in good locations.

Developers have difficulty securing planning approval from local governments using the current residential guidance for low-rise apartments in the Victoria Planning Provisions.[242] Residential planning proposals are regulated by the residential development standards (ResCode) in planning provision clauses 55 and 56.[243] Local governments assess low-rise apartments (4 or fewer storeys) using ResCode metrics that consider developments in the context of their surrounding neighbourhoods, which are typically low density.[244] Assessments typically focus on neighbourhood character and community concerns, which can lead to more uncertain outcomes and development delays.[245]

The Victorian Government introduced the Better Apartments Design Standards in 2017 to improve apartment design.[246] They provide guidance for apartment developments of 5 or more storeys. Some of this guidance is included in ResCode (clause 55.07), resolving some earlier limitations.[247] However, the standards focus on general development quality and internal design issues such as layout and private open space, rather than the effect on neighbourhood character.[248] Low-rise apartments are still assessed using the same development standards as lower density townhouses and terraces.[249]

Community objections create extra uncertainty and risk that discourages apartment development in established suburbs. Some residents and local governments are concerned that building higher density homes will negatively affect neighbourhood character and existing property values.[250] Planning objections can add major time delays and costs to new developments, but rarely produce substantial changes to the outcome. In 2021–22, over 60% of cases heard by the Victorian Civil and Administrative Tribunal that related to development of higher density homes such as apartments were eventually approved.[251]

The Victorian Government can create specific objectives and residential development standards for low-rise apartments and include them in the Victoria Planning Provisions. Changes can customise existing ResCode guidance (including site layout, building massing and amenity impacts) for 3 and 4 storey buildings. New standards can support local government review of proposed low-rise apartments, give clarity, help developers with project design and increase the likelihood of planning approvals for medium density homes. This may also contribute to the potential for use of modular construction techniques by developers, which could in turn improve the affordability of these homes.

Use of the Residential Growth Zone can be expanded in established suburbs, to allow development of more low-rise apartments in locations with good access to public transport and services. The Victorian Government can develop criteria to identify priority places for expanded zones. These can specify appropriate levels of access to public transport, infrastructure and services that can support more low-rise apartments as a substitute for greenfield homes. The government can work collaboratively with local governments to make the zoning changes. Councils can benefit from funding to assess and update their residential zones and schedules, and to identify any infrastructure upgrades that might be needed to support growing communities (see also **Option 1: Reform infrastructure contributions to send the right price signals** and **Option 5: Measure and incentivise progress towards new local housing targets).**

The benefits of this policy option are likely to be realised over the medium term. More apartments will be needed for Victoria's growing population, but it will take time for households to accept apartments as a substitute for greenfield homes. This option will have more effect when packaged with policies to improve the supply of well-designed townhouses as a more immediate greenfield substitute (see **Option 8**). It will also complement precinct planning and delivery (see **Option 6**), as strategic master plans for priority precincts can nominate suitable places for residential zoning. Collectively these options can help increase housing supply to meet targets for the number, type and size of new homes (see **Option 5**) and can be delivered once housing targets are set.

Case Study

Victoria's Future Homes program

Future Homes is a Victorian Government initiative to encourage high-quality 3 storey apartments in established suburbs. It sets high design standards in exchange for streamlined planning approvals. The program offers ready-made architectural designs of 3 storey apartment buildings for development in trial locations.[252]

Applications will be assessed by the Department of Transport and Planning in collaboration with the Office of the Victorian Government Architect. The approval process will have limited third-party notification and no appeal rights. The program is currently in a 2-year pilot phase with the City of Maribyrnong.

The Victorian Government can draw on its experience in Future Homes to collaborate with local government and the development industry to improve development standards for low-rise apartments.

Figure 16 Future Homes designs

Designed by (from left to right): McGregor Westlake Architecture, Spiral Architects Lab, Strategy Architecture with IncluDesign and LIAN Architects.
Department of Transport and Planning, *Future Homes*

Increase diversity and choice of homes in established suburbs

Creating more housing options in established suburbs

Many Victorians would prefer to live in a large, detached home near family and friends.[253] Over two-thirds of households in Melbourne, Ballarat and Geelong (68%) would choose to live in a detached house if they had to move. This rises to over 80% for owner-occupiers.[254]

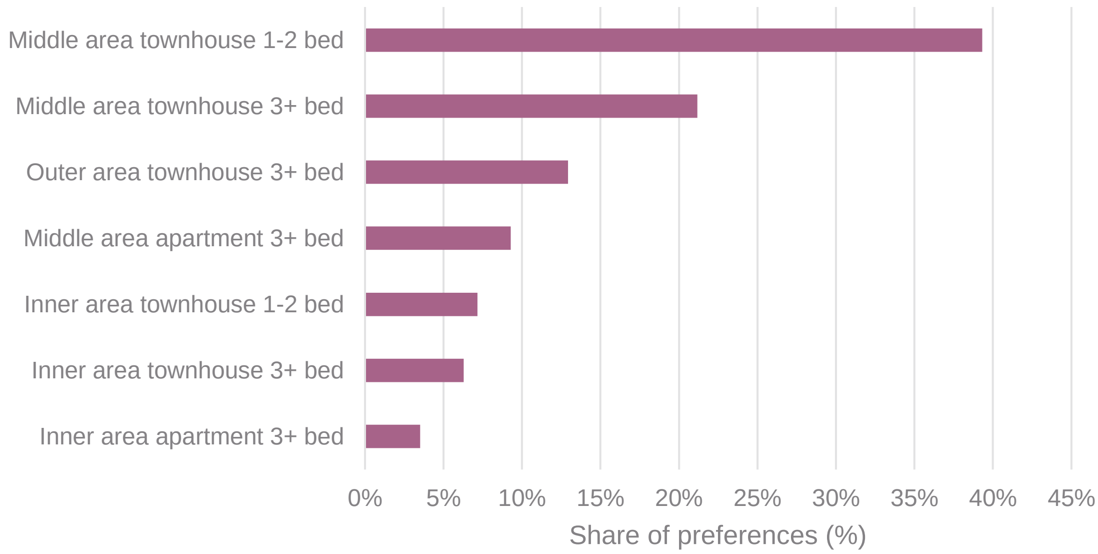
Some households are prepared to compromise on certain features of their future home to stay in their preferred location, particularly renters (50% compared with 39% of owner-occupiers).[255] But attributes such as the number of bedrooms and access to secure parking are important to many, particularly in greenfield areas where many households are planning for, raising or caring for children.[256]

We found that households perceive detached homes to be better quality, and better designed for raising children, compared with townhouses and apartments. This strengthens household preferences for detached houses. New homes in established suburbs must be able to meet peoples' expectations at an affordable price for households to consider them a substitute for greenfield houses.[257]

Households will consider higher density homes for the right price

We found that the home choices people make are influenced by price, and that some households will consider different types of home in the right circumstances. Some households who initially chose detached houses in growth areas would substitute to townhouses in established suburbs if they were cheaper (see Figure 17). They will also consider centrally located apartments with 3 bedrooms, but they would not substitute to smaller apartments with 1 to 2 bedrooms.

Figure 17: Share of preferences shifting from growth area houses when established area townhouse and apartment prices fall by 10%, by home type, %

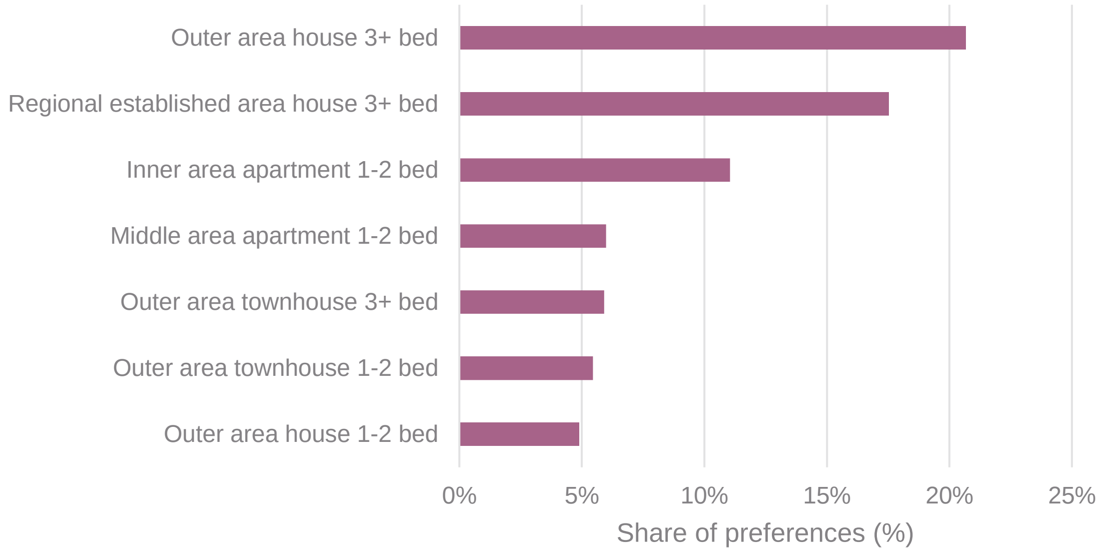


The Centre for International Economics, *Demand for housing in Victoria: stated preference research*, 2022

If homes in growth areas were to become more expensive, those who could afford it would switch their preference to Melbourne's outer suburbs, or to established suburbs in Geelong and Ballarat (see Figure 18).

Others would consider medium density homes instead of detached houses, including smaller apartments in Melbourne's inner and middle areas, and townhouses in outer areas.

Figure 18: Share of preferences shifting from growth area houses when growth area prices increase by 10%, by home type, %



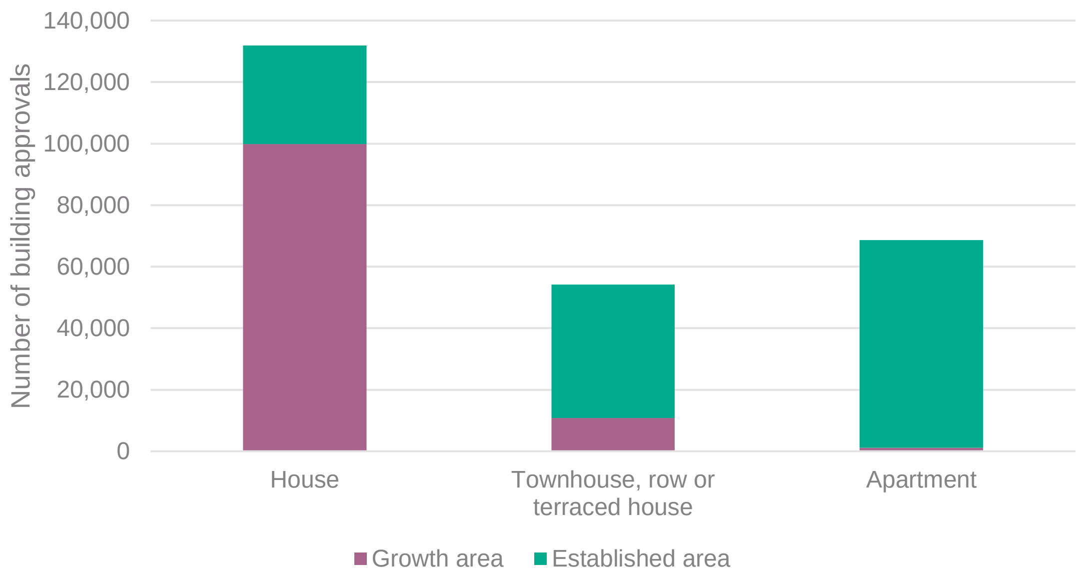
The Centre for International Economics, *Demand for housing in Victoria: stated preference research*, 2022

For households to make these alternative choices, medium density homes in established suburbs will need to be available at a price that is affordable for those on a moderate income.

Homogenous housing restricts people's choices

While some growth area households would consider other places, few new homes in established suburbs meet their needs. Most new homes in Victoria's cities are delivered in the form of detached houses in greenfield areas and, to a lesser extent, high-rise apartments in established suburbs.[258] Detached houses accounted for just over half of all approvals for new homes in Melbourne between 2017 and 2021, and the majority (76%) were in Melbourne's 7 growth area councils (see Figure 19). New homes in regional areas have an even higher proportion of detached houses. Nine in 10 residential building approvals in Ballarat and Geelong were for detached houses over the same period.[259]

Figure 19: Building approvals by home type, greater Melbourne, 2017–2021



Australian Bureau of Statistics, *Building approvals, Australia*, 2022

More new homes are being built in Melbourne with 1, 2 or more than 4 bedrooms than 3-bedroom homes,[260] despite this being the preferred home type for many households. Increasing the supply of medium density, 3-bedroom homes in established suburbs can help to improve affordable options for households currently choosing greenfield homes, such as first home buyers and households with children. It can also offer an alternative to households looking to downsize.[261]

More housing diversity will help create affordable established area alternatives to greenfield homes. Our research indicates that townhouses are an immediate opportunity to substitute. They fulfil the requirements of many greenfield residents, such as number of bedrooms, secure parking and outdoor space,[262] and they are likely to be more affordable than detached houses in the same area.[263] Apartments can also be an alternative for some,[264] although most existing stock does not substitute for greenfield homes. For example, just 1 in 10 Melbourne apartments have 3 bedrooms.[265]

Limited flexibility in planning schemes can inhibit housing diversity and add to development costs, which are passed on to homebuyers.[266] Costly requirements such as compulsory minimum on-site parking influence developers' decisions about apartment size and bedroom mix. A one-size-fits-all approach can lead to homebuyers paying for dwelling features they do not value or need.

Offering people an affordable, established area alternative to greenfield homes will only be possible with many more well-designed, medium density homes that serve the needs of growth area households, including those with children. The diversity of homes available in established suburbs will also need to increase to achieve this goal.

We propose options for the Victorian Government that aim to increase the supply of townhouses in good locations as a priority, and that work towards improving the availability, diversity and design of apartments in established suburbs so that they become a more affordable substitute for greenfield homes.

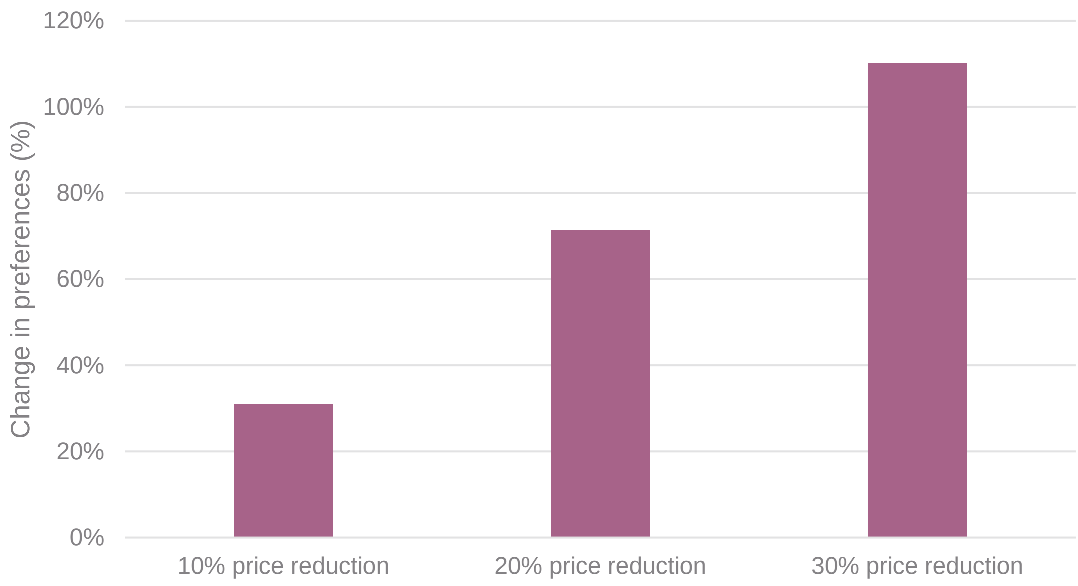
Develop a dual occupancy and townhouse code

Option 8

Give property owners as-of-right permission to bypass red tape and supply more diverse homes when they comply with the new dual occupancy and townhouse code. Give better visual guidance for well-designed dual occupancies and townhouses.

We found that medium density homes, particularly townhouses, can meet many of the requirements of households currently choosing to live in growth areas, particularly when they are more affordable. Our modelling indicated that a 10% price drop for townhouses in established suburbs would lead to an increase in demand of more than 30% (see Figure 21).[267] Some greenfield residents are reluctant to consider medium density homes due to concerns over noise, privacy, security and space.[268] Increasing the amenity, accessibility and design quality of medium density homes can increase their appeal as an immediate substitute for greenfield homes.

Figure 20: Change in townhouse preferences in established suburbs when prices are reduced, %



The Centre for International Economics, *Demand for housing in Victoria: stated preference research*, 2022

Poor townhouse design is restricting supply of greenfield substitute homes in established suburbs. Clause 55 of the Victoria Planning Provisions (ResCode) regulates developments of 2 homes (dual occupancy) or more on a single block, including townhouses.[269] It includes objectives and standards to address neighbourhood contexts, site layout, amenity and design. But while examples of good design exist, ResCode does not always produce high quality townhouses at an affordable price. Solar orientation, open space and environmental performance can all be inadequate.[270] Clause 55 includes some visual guidance to help developers meet the required standards, but more can be provided.

Delays and uncertainty in planning approvals add to development costs, which are ultimately passed on to home owners and renters.[271] Planning applications can take a long time to assess – over 10 months in some instances.[272] Community opposition adds to the assessment time. A 2018 review of planning permit applications by Merri-bek City Council found that 1 in 2 dual occupancy developments received objections from the community, even though most of them complied with planning requirements. Only 1 in 10 objections caused any change. Third party appeals added time, resources and cost to development approvals but had little effect on outcomes.[273]

In our community research to support *Victoria's infrastructure strategy 2021–2051*, we found that local communities are willing to support higher density homes under the right conditions.[274] Communities nominated quality urban design as the most important principle when considering density, including buildings that integrate well into the local neighbourhood. Better evidence of high quality townhouses can help to build community understanding and acceptance, and reduce concerns about potential effects on neighbourhood character.[275]

The Victorian Government can encourage well-designed small scale development by introducing a dual occupancy and townhouse code for established suburbs with good access to public transport. The code can first apply to dual occupancy and then expand to include 3 or more homes on a single block (townhouses). Use of the code can be incentivised by allowing compliant homes to choose a quicker assessment process than the standard planning permit system, offering developers faster approvals and more certainty. Evaluating proposed homes against a clear code supports a fast track approvals process and can improve choice, diversity and supply.[276] It can reduce housing costs by achieving planning process time savings, and by building homes on smaller lots that offer a greenfield substitute. It can also help improve townhouse design by incentivising well-designed homes,[277] and could provide opportunities for developers to use less expensive design and construction methods such as modular construction.

The code can consider how development accounts for neighbourhood character, amenity and infrastructure, for example, by minimising overshadowing and mitigating urban heat.[278] Site-specific heritage, environment and landscape controls play an important part in the planning system and should continue to trigger a planning permit application. The Victorian Government can invite local government and developer input in creating the code, to help build support for this approach.

New visual guidance can accompany the code to give clear direction to developers and the community on expected design, sustainability and accessibility outcomes, including environmentally sustainable design and universal access. Guidance can also specify functional layouts, based on the Better Apartments Design Standards and including new standards for dining areas and flexible spaces for home offices, storage and space to play.[279] The Victorian Government can also add visual guidance to ResCode to give clearer information about the desired outcomes for projects that do not take up the voluntary code, and discourage minimum compliance with ResCode standards.

Use of the code and eligibility for fast track approvals can be restricted to residential areas that present good opportunities for townhouse developments. The Office of the Victorian Government Architect identified suitable opportunities for medium density in middle suburbs (7 to 25 kilometres from central Melbourne) developed between 1950 and 1979, with good access to public transport.[280] The government can ensure that the code does not encourage underdevelopment close to public transport by introducing maximum lot sizes for each new home.

Some local governments, including Darebin, Glen Eira, Knox and Merri-bek, are already developing guidelines to improve townhouse development outcomes.[281] The Victorian Government's Future Homes program, which tested the development feasibility of its 4 design packages, can also offer useful insights.[282] The Victorian Government can build on these initiatives as a first step to increase the supply of well-designed townhouses that are affordable to moderate income households.

This option represents an immediate opportunity to increase the supply of greenfield substitute homes. It will require time to develop the code and pilot it with local governments, but this can occur within 3 years. The code can be developed and introduced alongside other policy options to increase home choice and diversity in established suburbs, including **Option 6: Prioritise and streamline approvals for urban renewal precincts**, **Option 7: Develop better standards for low-rise apartments, then increase their supply by expanding use of the Residential Growth Zone** and **Option 9: Allow homebuyers more parking options**.

Case Study

The NSW Government is encouraging housing diversity

New South Wales needs more housing diversity to meet its current and future housing needs.[283] The government introduced a Low Rise Housing Diversity Code in 2018 to encourage housing development in existing residential areas.[284] The code introduces fast track approvals for well-designed medium density developments such as townhouses, low-rise apartments and terraces. It is accompanied by a *Housing diversity design guide* to give consistent planning and design guidance for new development, including clear visual representation of the expected design outcomes.[285] Permits for compliant developments are issued within 20 days.

The code aims to increase housing diversity by encouraging more alternatives to greenfield detached houses and high-rise apartments. It has 4 main benefits: promoting choice and diversity, increasing supply, encouraging good quality design, and creating liveable communities.[286] It also has an affordability objective. The price of new attached dwellings is anticipated to be around 25% more affordable than a detached home in the same neighbourhood, by using more housing construction that is affordable by design.[287]

The code faced resistance when it was first introduced in 2018, including from some local councils. An independent review identified strong support for more housing diversity but found that the code was poorly understood.[288] Several amendments were made to clarify its intent and operation, and to give more certainty for councils, developers and the community. Following a staged introduction, the code was introduced in all local government areas in 2020.[289]

Allow homebuyers more parking options

Option 9

Reduce or remove compulsory minimum parking requirements to improve choice and affordability of new established area homes, close to good public transport. Allow homebuyers to choose how much onsite parking they want to pay for above minimum requirements.

Off-street parking provision adds to the cost of new homes. In central Melbourne, one parking space can add between $40,000 and $80,000 to the cost of development.[290] Our modelling confirms that more parking increases house prices, particularly for apartments. We found that apartments with 2 parking spaces were 34% more expensive than similar homes with no parking.[291] We also found that the number of car spaces is an important factor in home choices, and that some growth area households are open to trading off a parking space for a cheaper home in a more central location.[292]

Victoria's planning provisions require at least one on-site parking space for each 1-bedroom and 2-bedroom home, and 2 car spaces for homes with 3 or more bedrooms.[293] Developments that propose less parking require an extra planning permit. Changes to parking minimums can trigger community objections, particularly for apartment developments, due to concerns that parking will spill into surrounding streets.[294] However, research indicates that residents in detached homes are the greatest users of street parking. They generally have off-street parking but use it for storage or other purposes.[295] The City of Melbourne found apartments typically have too much on-site parking, and an average of 1 in 3 parking spaces sit empty overnight.[296]

Minimum parking requirements contribute to poor housing diversity in established suburbs,[297] by increasing construction costs and incentivising developers to build homes with fewer bedrooms to maximise their profits.[298] Planning permit requirements for parking exemptions add to assessment costs and introduce extra administration. Third party appeals can cause substantial delays, further adding to costs and uncertainty for developers.

Generous on-site parking provision combined with the widespread availability of street parking (that is often free) makes driving seem cheaper and easier.[299] The cost of providing parking is included in development costs and passed on in higher home prices, meaning households must still pay for car parking even if they do not need it.[300]

The Victorian Government can reduce or remove compulsory minimum parking requirements to increase certainty in development processes, improve affordability and boost the supply of homes in established suburbs. Reducing minimum parking rates can increase choice, by allowing households to pay for parking only if they need it (above any minimum requirements), and lower housing costs for households who choose other transport options. It can also increase development feasibility, lowering costs for developers by allocating space to homes rather than parking. This removes a disincentive to build 3-bedroom homes and can help improve home choices for greenfield households who are prepared to trade a parking space for a home with good access to public transport in an established suburb.

Research indicates that good public transport access can help reduce levels of car ownership, and that service quality and frequency affects ownership the most.[301] Minimum parking rates can be reduced or removed for new homes that are close to train and tram stops in the first instance. The government can also consider locations near good quality, frequent bus services, with ideal locations having a service frequency every 5 to 10 minutes.

Minimum parking requirements can be reduced in several ways. For example, parking requirements for 3-bedroom apartments can be reduced to one on-site car space, while compulsory parking minimums might be removed for smaller apartments located near good quality, frequent public transport services. Developers can provide more than the minimum requirements, or homebuyers can choose to pay for more parking if they need it. Changes can be phased in over a transition period, during which the government can support local governments to adopt better parking management practices to help manage any shifts in demand for street parking from new residential developments.

This policy option can be packaged with other planning options to increase the supply and range of homes available in established suburbs (see **Options 6**, **7** and **8**), and delivered within 3 years.

Encourage child-friendly design in new apartments

Option 10

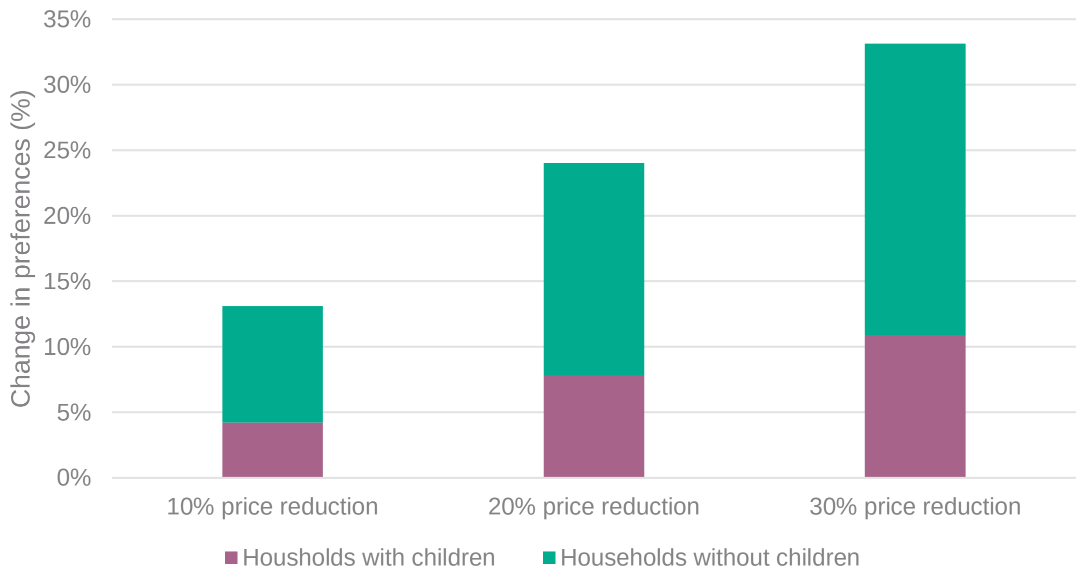
Update the Better Apartments Design Standards to specify better access, versatility and safety features so apartments are more attractive for households with children. Introduce voluntary design guidelines for best practice child-friendly apartment design.

Greenfield homes serve a particular segment of the housing market. Households with children made up almost 60% of growth area households in 2021, compared to an average of 40% in Melbourne's established suburbs.[302] Many other growth area households are planning to have children. Some people at our focus groups told us that this was a factor in their decision to buy or rent a greenfield home. They valued access to private open spaces for play and enough bedrooms for each of their children.[303]

Most focus group participants living in a greenfield detached home would not consider moving to an apartment in an established suburb. However, apartments will be an important component of future diversity for households with children. Concerns about apartments included anxiety around noise, space to play and ease of access to car parking. Others were concerned about design quality and safety.[304] Research into liveability for households raising children in apartments confirms our findings.[305] This work identified the lack of suitably sized apartments, communal play space, indoor and outdoor storage and soundproofing as design oversights that affect apartment liveability in inner city locations for households with children.

Despite these considerations, our choice modelling shows that more households with children would be prepared to live in apartments if the price is right. The number of households choosing an apartment in an established suburb increased by 13% when apartment prices were reduced by 10%. This rose to 24% when apartment prices dropped by 20% (see Figure 21). Households with children made up around one-third of those willing to consider apartments when the price was reduced, even with current apartment designs that do not cater for their needs.[306]

Figure 21: Change in apartment preferences in established suburbs when prices are reduced, %



The Centre for International Economics, *Demand for housing in Victoria: stated preference research*, 2022

These results indicate that well-designed, larger apartments can be an alternative to greenfield homes in some instances. Children and their parents can benefit from living in established suburbs that offer better access to infrastructure such as schools, childcare and public transport, but few alternatives to greenfield homes are built that meet their needs.[307] For example, our modelling indicates that households who prefer detached houses in growth areas will not substitute for apartments with less than 3 bedrooms,[308] but the supply of new 3-bedroom apartments is often confined to luxury apartments that moderate income households cannot afford.[309]

Design standards can help to make apartments a realistic and attractive option for households with children. Victoria's Better Apartments Design Standards were introduced in 2017 to improve the internal design of new apartments of 5 or more storeys and make them more liveable and sustainable. They were extended in 2021 to improve external design, for example to create more green space and attractive street fronts.[310] The Victorian Government can extend them further, to make apartments more accessible, versatile and safer for children.

Design solutions for apartments to appeal to households with children must include features that compensate for greenfield housing attributes such as private yards and extra living space.[311] They can also respond to the noise, safety and design concerns raised by greenfield residents.[312] Child-friendly amendments to the Better Apartments Design Standards can build on the 2022 *Inquiry into apartment design standards*, which proposed several recommendations for apartments to better meet the needs of households with children. These include new guidelines on accommodating households with children in apartments and updated guidance on open and communal spaces.[313]

The Victorian Government can also introduce voluntary design guidelines to go beyond the minimum requirements set in the Better Apartments Design Standards, to support developers to achieve best-practice child-friendly design without mandating uniform changes. These can be informed by a competition to produce child-friendly apartment designs that can be easily replicated, similar to the Future Homes design competition which sought designs for 3 storey apartment buildings.[314]

The government can encourage uptake of the voluntary guidelines with developer incentives, for example by streamlining assessments or using an accreditation scheme to demonstrate quality and enable fast track planning approvals. The Victorian Government can also establish design review panels to improve compliance with design standards while supporting design innovation, as recommended by the *Inquiry into apartment design standards*.[315] We recommended that the government establish design review advisory panels in *Victoria's infrastructure strategy 2021–2051*.[316]

The Victorian Government can also model best-practice child-friendly design in its own housing developments. Government demonstration projects can influence building industry and community acceptance of new and innovative designs by showing their feasibility and commercial appeal.[317]

We estimate that updating standards to achieve better apartment design outcomes for households with children can happen within the next 2 years, but changes to actual development projects will take longer. It will also take time for households with children to be more confident that apartments can be a genuine substitute for greenfield homes. This is therefore a medium-term option. It can be introduced alongside reforms to stamp duties and proposed changes to the Victorian Homebuyer Fund (see **Options 2** and **4**), which can in time help direct demand for better designed apartments in existing suburbs.

Case Study

Vancouver's approach to child-friendly density

Households with children historically made up around 35% of the City of Vancouver's population. New housing delivery in the city is shifting into higher density forms while affordability and availability of the 'traditional family home' is in decline. In response, the city has been introducing policies since the 1990s for new homes to meet the needs of households with children.

Vancouver's *High density housing for families with children guidelines* offer guidance on child-friendly design features such as play areas. The city also introduced a mandatory minimum for 'family-sized' apartments, including a minimum of 10% 3-bedroom units in new residential developments that are rezoned.[318] The family housing policy and guidelines are being modernised as part of the *Housing Vancouver strategy: three-year action plan (2018–2020)* to improve supply of family housing and the experience of children living in high density homes.[319]

Vancouver is making progress in increasing the supply of homes suitable for households with children. The city approved over 33,000 new apartment units between 2017 and 2021. Almost half (45%) were for family-sized homes.[320] The high density housing guidelines were well received by residents. A 2008 post-occupancy survey found that the apartment guidelines are largely successful, and that households with children enjoy the lifestyle of high density communities.[321]

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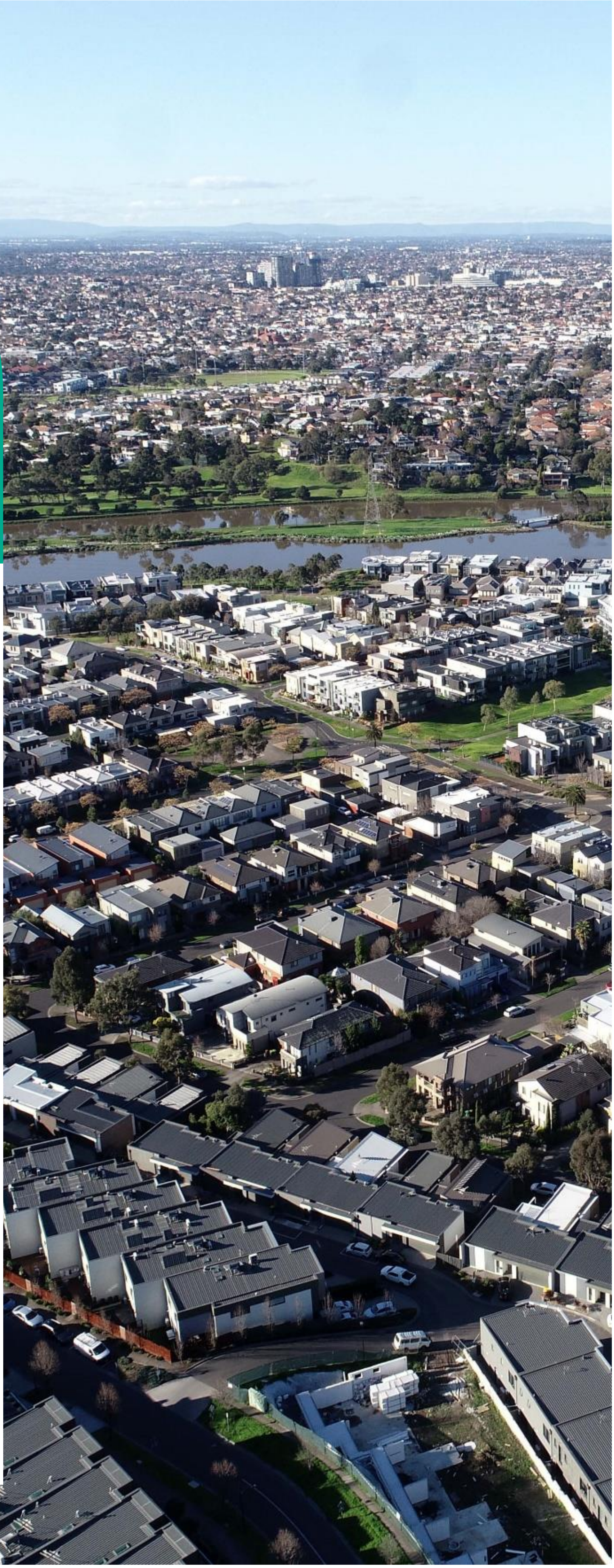

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Can zoning reform increase construction productivity? Suggestive evidence from New Zealand.

OFE onefinaleffort.com/blog/can-zoning-reform-increase-construction-productivity-suggestive-evidence-from-new-zealand

September 14, 2024

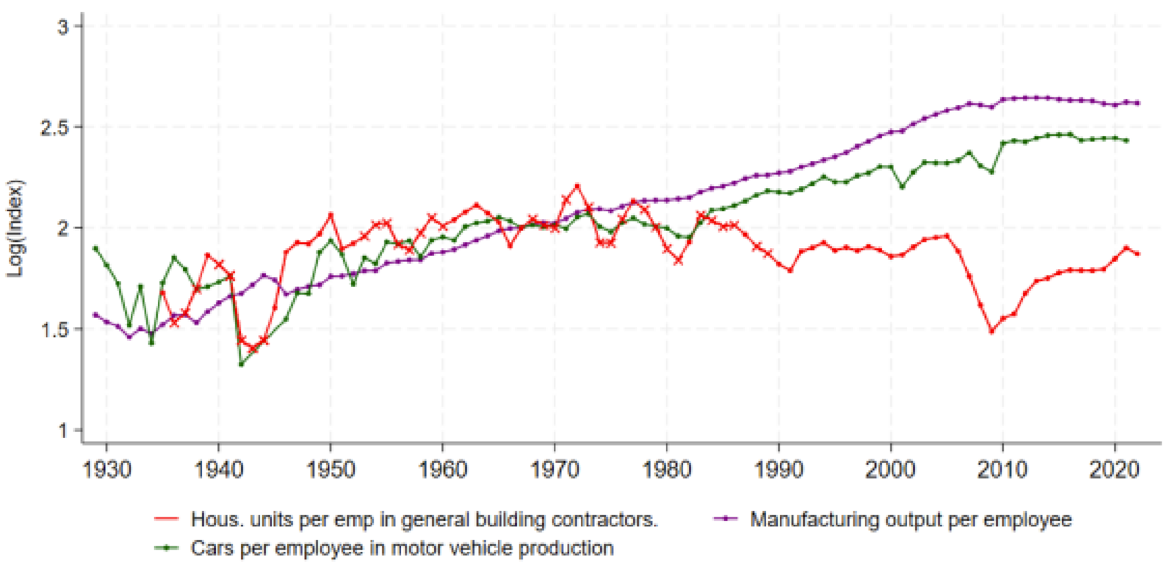
14 Sept

Economists frequently emphasize the importance of productivity growth, as it's the main driver of living standards and prosperity. A rise in productivity means we're able to do more with less; we can have more and better products with fewer hours of work and resources.

Economists define productivity as the output produced for a given level of input. To make this concept a little less abstract, in this post we're going to focus on labour productivity, which refers to how much a worker can produce within a given time frame (e.g. an hour, or a year).

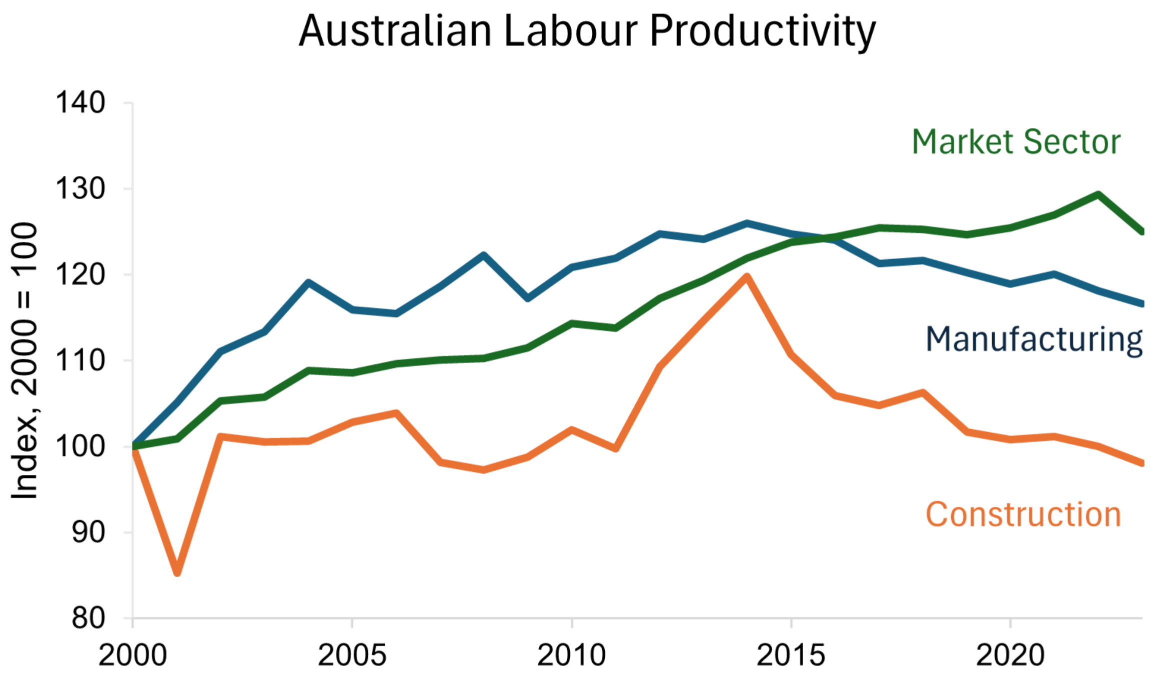
The construction sector presents a global productivity puzzle. Around the world, while we have gotten better at making all kinds of stuff – cars, phones, pharmaceuticals, etc. – we haven't gotten better at building houses. Indeed, a recent paper shows that the productivity of a construction worker in the U.S. has remained unchanged since the 1960s.

Figure 5: Housing Units per Employee Against Manufacturing Output per Employee and Cars per Employee



This productivity divergence mirrors a diverge in price: houses have become more expensive over time, while cars and other goods have gotten cheaper. The improved quality of houses don't explain these trends, nor do the techniques we use to measure construction output.

Australia is no exception to this phenomenon: our construction sector is about as productive as it was at the turn of the century, and labour productivity has been *declining* over much of the past decade. For comparison the 'market sector' – an aggregation of most major non-government industries – is about 25% more productive than 20 years ago.



This issue is particularly concerning for Australia, as the construction sector makes up a much larger share of GDP than other rich countries. In most OECD nations, construction contributes around 5% to economic output, but in Australia, it accounts for over 9%. As a result, productivity in the rest of the Australian economy needs to grow faster just to keep pace with global standards.

So why we have we gotten so much better at building goods which you can pick up, play with, or drive but not things fixed on a block of land?

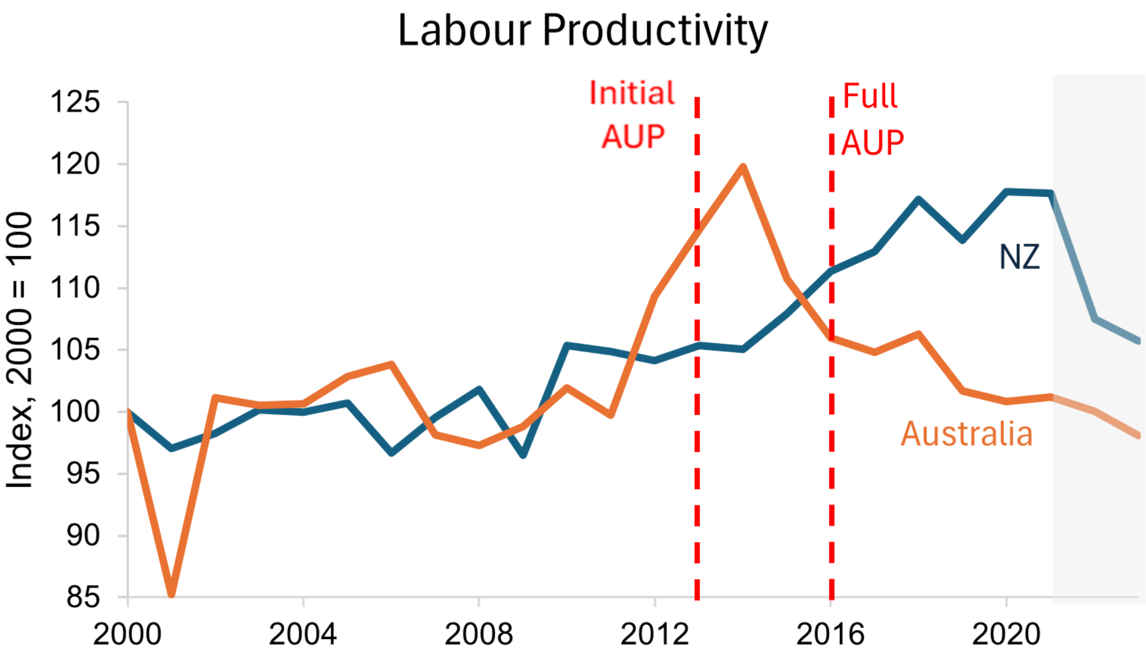
An emerging literature has pointed the finger at zoning regulations. The aforementioned paper noted that a) construction productivity plummeted after modern land use regulations came into effect, and b) areas with stricter zoning regulations have smaller and less productive firms. Zoning may reduce the capacity for construction firms to grow, achieve economies of scale, and invest in new technology.

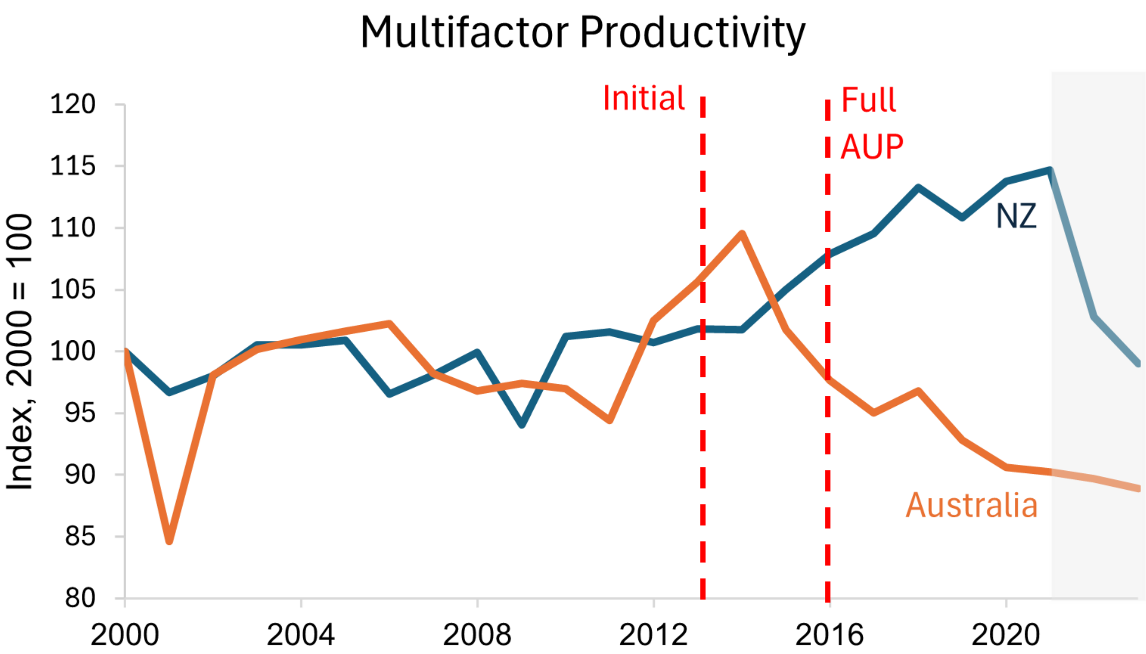
Lower productivity could be a significant factor in how zoning regulations drive up housing costs. When firms are inefficient, they may struggle to build enough houses each year to prevent prices from rising. Additionally, the homes that are built are more expensive because they require more capital and labour to construct. Higher costs can squeeze profit margins, discourage new firms from entering the market, and means many projects are unfeasible.

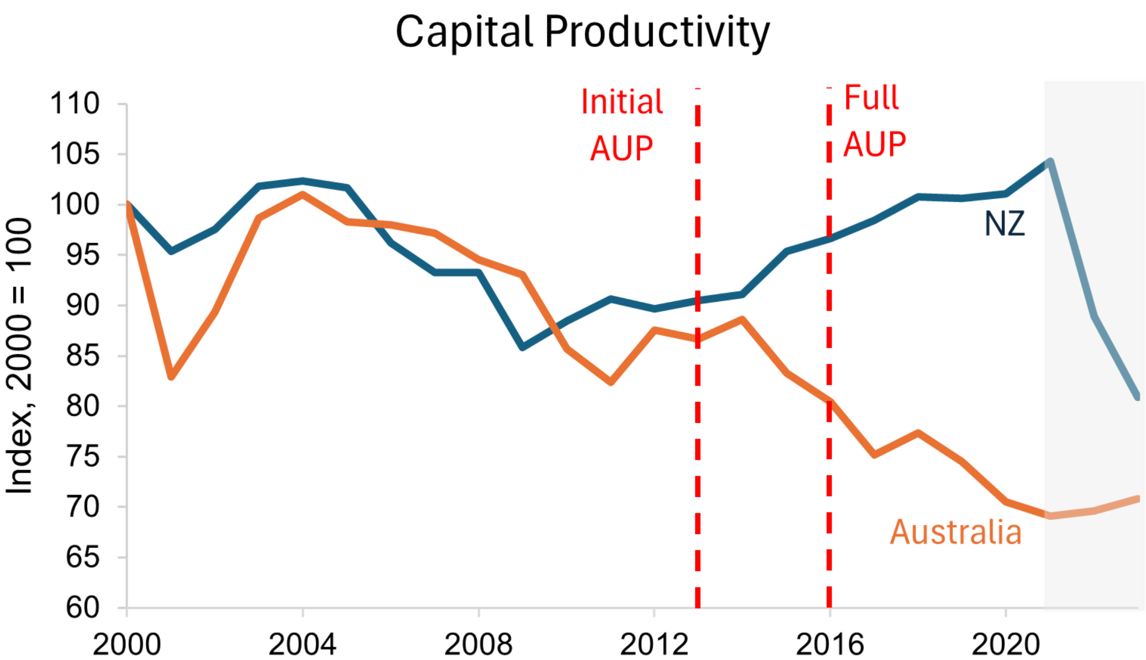
A case study that tests these theories is New Zealand's experience following major changes to land use regulations in the 2010s. Auckland, home to around a third of the country's population, adopted widespread upzoning through the Auckland Unitary Plan (AUP) from 2013 to 2016. The AUP upzoned residential land to allow for medium density development throughout much of the city, and high-density around transit corridors.

Australia and New Zealand have the same definitions for categorising industries (Australian and New Zealand Standard Industrial Classification (ANZSIC) Codes) so we can make direct comparisons in construction productivity growth on both sides of the Tasman. On all three metrics of productivity – Labour, Capital, and Multifactor – the two countries track each other closely until 2013. This isn't unexpected, given the global stagnation in construction productivity and the lack of any structural factors that would lead to differences in technology adoption or capital accumulation between the two nations.

However, following the implementation of the AUP construction productivity in New Zealand began to rise, while Australia's continued to stagnate. Indeed, in 2020, New Zealand's construction multifactor productivity was around 15% higher than 2000, while Australia's was 10% *lower*.







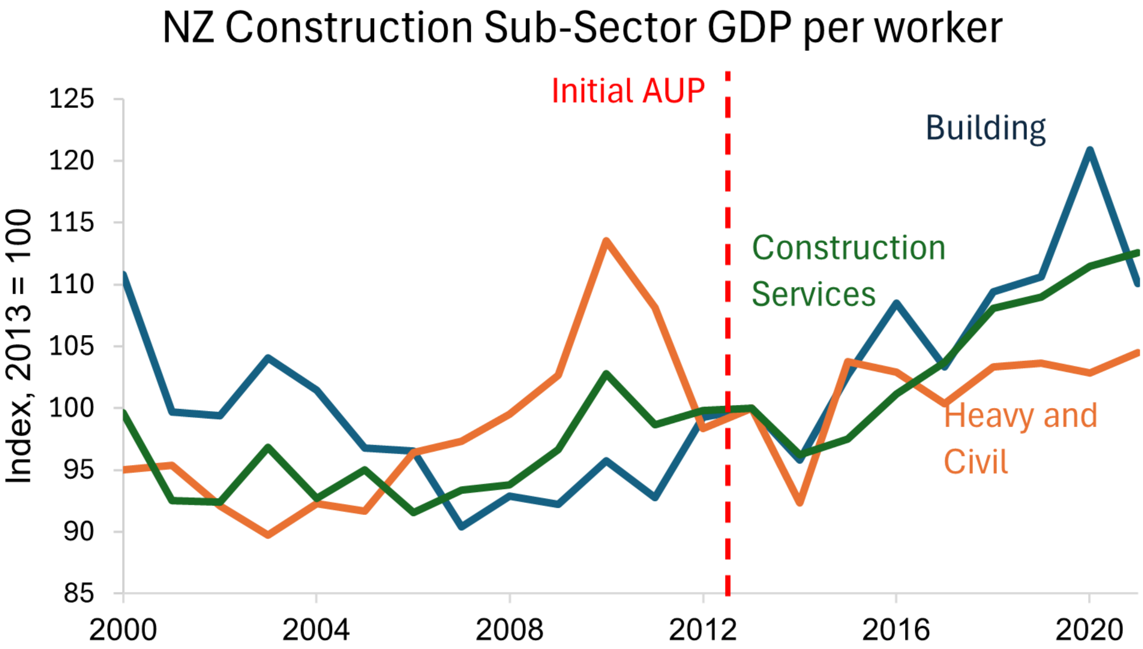
You can note that much of these gains were rapidly eroded over COVID-19 pandemic – a period I've shaded in grey. This reflects New Zealand-wide, rather than construction industry specific, factors. Lockdowns across New Zealand reduced productivity in goods producing sectors in 2021, followed by recessionary periods in 2022 and 2023, with multiple quarters of negative growth and high inflation. Indeed, labour productivity in all goods producing industries are 8% lower than pre-pandemic levels, according to the latest measurements. This serves as a reminder that poor macroeconomic conditions can undo a lot of the benefits from microeconomic policy reform.

Given this drop doesn't reflect factors in the construction sector *specifically*, rather is an macroeconomic shock *generally*, I'm going to focus on the 2013-2021 period. You should caveat the below analysis appropriately and note that basically every line will see a sharp decline from 2022. Whether there will be a bounce back in future years as the economy recovers remains to be seen.

While the above charts suggest that *something* happened that made NZ's construction sector more productive around the time of zoning reform, correlation is not causation. While I won't make any causal claims, a closer look suggests zoning reform is a highly plausible explanation for the increase in construction sector productivity.

First, let's rule out some alternative hypotheses. Perhaps NZ was experiencing a general productivity boom over the 2010s while Australia wasn't. This doesn't appear to be true: productivity in other goods producing industries was flat during the 2010s, while construction productivity spiked, and - in a sharp contrast to the global story - *outperformed* other sectors.

Construction is also a broad sector. Perhaps New Zealand got better at building infrastructure, rather than houses, and our sector-wide measure is picking that up instead. This doesn't seem to be the case either. “Heavy and Civil” construction productivity was flat, while “Building Construction” and “Construction Services” grew.



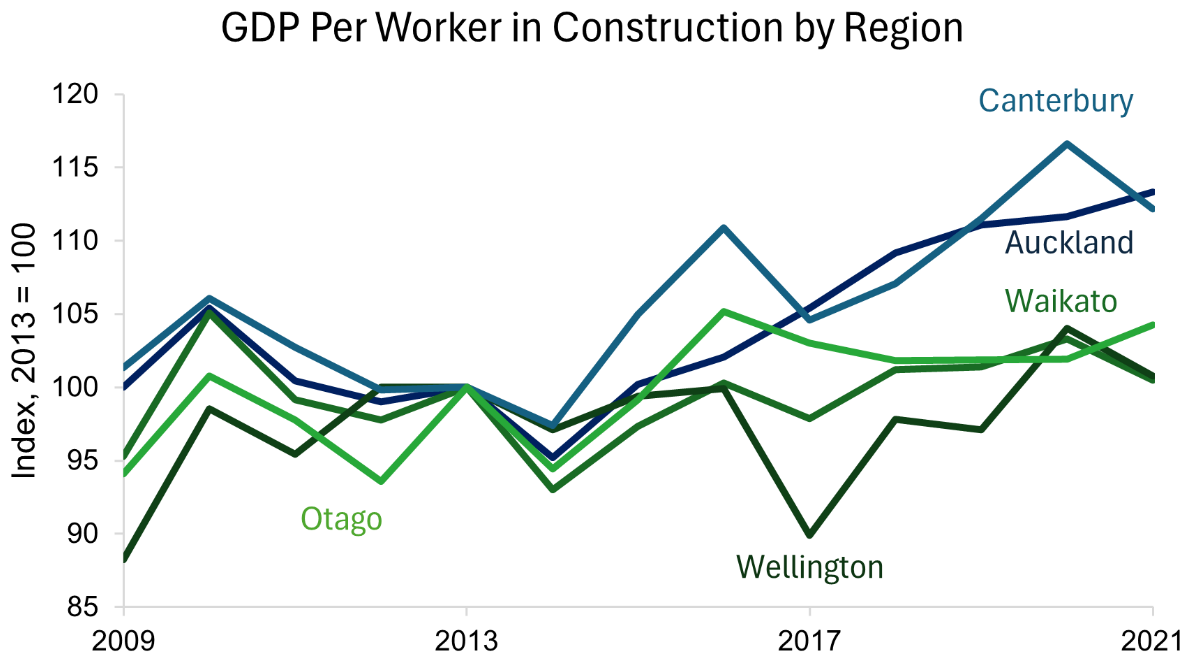
Second, we can estimate labour productivity by region to see if growth was driven by upzoned areas. Stats NZ publishes estimates of industry GDP and employment by region. We can combine the two to obtain an estimate of construction productivity by region. (Note that this variable is slightly different to the published productivity measures I was using above).

We will focus on two regions in New Zealand. Auckland which, as we noted above, adopted major zoning reform from 2013. And Canterbury, which includes Christchurch.

The story in Christchurch is complicated, and not as clean as in Auckland. In 2011, Christchurch experienced a major earthquake which damaged around 167,000 buildings. In response to the earthquake the NZ Government used emergency powers to override local land use plans, rezone large amounts of farmland for housing, and allow townhouses in areas previously zoned for detached housing. You can read an excellent summary of these changes here.

So, there are many factors influencing construction productivity in Canterbury over this period. The earthquake may have spurred investment and capital into the sector, and damage to the built environment may have opened the door to more efficient construction techniques. It's important to keep this in mind when interpreting the below analysis.

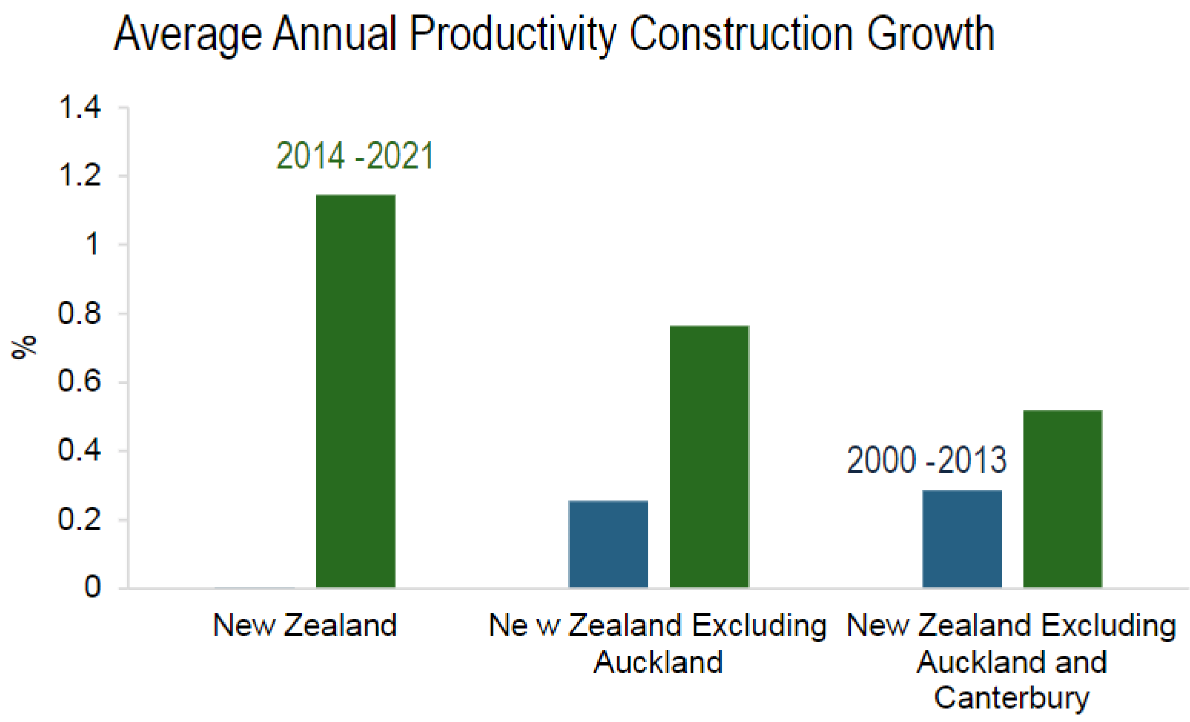
NZ construction productivity growth was almost entirely driven by Auckland and Canterbury from 2013 to 2021. In both areas, output per worker grew by around 13%, while the rest of New Zealand – much like Australia – barely saw any productivity growth.



Auckland's turnaround is quite remarkable. From 2000 to 2013, Auckland's productivity *fell* by around 0.2% per year. Once the AUP was adopted, it instead grew by 1.6% per year. This was faster than economy-wide productivity growth in Australia over the same period.

The increased size of Auckland's construction sector also provided a double dividend. Auckland has the highest construction productivity in New Zealand in *levels* —reflecting a well-established fact that large cities are the most productive— and saw its share of NZ's construction output increase from about 30% to 37%. This meant there was more construction activity in the country's most productive region.

If we decompose New Zealand's productivity growth over this period, we can indeed see that most of it was driven by Auckland and Canterbury. Sector productivity grew at a rate of 1.1 per cent annually once the AUP was adopted, compared with effectively no growth from 2000-2013. Comparatively, from 2014 to 2021 regions outside of Auckland saw 0.76% annual growth, dropping further to 0.5% when we exclude Canterbury.



More analysis is needed to understand the impacts of zoning regulations on construction productivity, and the mechanisms at play here. But, if upzoning did increase productivity, how could it have done so? I'll conclude with a few theories.

First, as noted earlier, a more flexible construction market could have enabled firms to grow and achieve economies of scale, and invest in new capital and technology. While this is plausible, a preliminary look at the data suggests that the average Auckland construction firm grew at about the same rate as other regions over this period. More detailed analysis using firm-level microdata will be needed to provide further insights.

Second, and contrastingly, the legalisation of the "missing middle" housing market may have created opportunities for *smaller* firms to enter the market and compete. Firms may need large amounts of capital to compete in the high-density market (e.g., needing cranes), and large amounts of land to compete in the low-density market. The "missing middle" requires neither of these. The smaller scale of projects may also have allowed for less overhead or more efficient construction techniques.

Third, there may be gains from a reduction in bureaucracy and red tape. "As-of-right" zoning could reduce uncertainties and delays from planning decisions. Firms may need fewer staff to navigate government processes. It may also allow firms to manage and time their capital more efficiently. Moreover, a shift from greenfield to infill may have eliminated the need to coordinate construction with infrastructure development.

Fourth, there is a direct effect on land productivity, as each square metre can now hold more floorspace. Further, upzoning gives builders a greater selection of sites from which they can feasibly choose to develop. Instead of being limited to the subset of sites planners have said they can use (some of which might be on hills, etc.), they can go out and simply find those that can be developed at least cost.

Overall, these points suggest that economists should take seriously the idea that zoning reform can improve residential construction productivity. A common critique of upzoning is that it is only a partial solution and might not be useful in a tight construction market. It is argued that in poor macroeconomic conditions the construction sector may not be able to scale up sufficiently to meet demand. However, if upzoning can both legalize new construction *and* improve the efficiency with which it is carried out, it could address multiple aspects of our housing affordability challenge.

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Reexamining lackluster productivity growth in construction☆

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A B S T R A C T

Of all major industries, construction is the only one to have registered negative average productivity growth since 1987. Mechanically, this lackluster performance owes to the fact that indexes measuring the cost of building a constant-quality structure have risen much faster than those measuring the cost of producing other goods. We assess the extent to which growth in construction costs could be biased upward by improvements in unobserved structure quality. Even under generous assumptions, our estimates of the magnitude of this bias are not large enough to alter the view that construction-sector productivity growth has been weak. Next, we calculate new estimates of single-family residential construction productivity growth by state and metropolitan area from 1980 to 2019. These estimates reveal that productivity has declined the most in areas with a larger fraction of construction in the urban core and with tighter housing supply constraints, especially in locations with long permitting times.

1. Introduction

According to data published by the Bureau of Labor Statistics (BLS), productivity growth in the construction industry has been the slowest among all of the major industry categories since at least 1987, when the current estimates begin.[1] Table 1 shows that productivity growth was actually *negative* on average for the construction industry over the 1987 to 2019 period, whereas it averaged at least 1 percent per year in all other major industries.[2] Moreover, Fig. 1 shows construction productivity growth was consistently low during this whole period. While the chronic issue of low productivity growth in construction is not new (Stokes and Kemble, 1981; Allen, 1985), this topic has recently been the focus of new research (Goolsbee and Syverson, 2023; D'Amico et al., 2024). One reason for this renewed interest is that low productivity growth has implications for housing affordability, as increases in productivity could have allowed for the construction of more, higher-quality structures at a lower cost, helping to mitigate the growing imbalance between housing supply and housing demand over this period.

This paper has two main contributions to the literature on construction productivity. First, we question whether productivity growth has actually been so low for the past three decades. The absence of any productivity growth sounds implausible given the variety of labor-saving innovations in the industry such as nail guns (Sichel, 2022), more pre-fabricated inputs (Haas et al., 2000; Teicholz, 2013), and the vast improvements in information technology (e.g. architectural design software) since the 1980s. The accuracy of the official statistics is questionable because the measurement of construction productivity requires a number of assumptions, some of which could understate actual productivity growth. One important example is the possibility that unobserved improvements in structure quality (e.g. energy efficiency, quality of interior finishes, etc.) have biased growth in the construction deflator upward, thereby biasing growth in the estimates of real output downward. We perform a detailed analysis of many possible sources of bias—mainly but not exclusively related to unobserved

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[1] Estimates of productivity growth by industry can be found at https://www.bls.gov/productivity/.

[2] We do not discuss data post-2019 because of concerns about measurement issues 2020–2022. The response rate for the construction-put-in-place survey fell in 2020, creating an increase in imputed data used to construct nonresidential construction spending. Moreover, real output growth in nonresidential construction was likely biased down in 2021 and 2022 due to measurement issues related to high cost pressures for inputs used in construction (Brandsaas et al., 2023). Productivity data are currently available through 2023. The published estimates for the construction sector fell by 0.3pp per year from 2019 to 2023, so the recent data continue the trend of low productivity growth.

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Table 1
Average productivity growth by major Industry, 1987 to 2019.

	Percent Change Annual Rate
Construction	−0.4
Services	1.2
Transportation	1.3
Agriculture	1.3
Mining	1.6
Nondurable Manufacturing	1.7
Finance, Insurance and Real Estate	2.0
Utilities	2.2
Durable Manufacturing	2.9
Trade	3.2
Information	4.7

Source. Bureau of Labor Statistics, Office of Productivity and Technology.

improvements in structure quality—and find that measurement error is unlikely to be large enough to overturn the conclusion that productivity growth in the construction sector has indeed been quite low. These results suggest that labor-saving innovations have been either modest or largely offset by other factors that have increased the costs of construction.

Our second contribution is to produce new state and metro-level estimates of productivity growth in new single-family residential construction from 1980 to 2019. These estimates are new in the literature, partly because producing them is not trivial, due to both data limitations and volatility in regional data. These estimates suggest that single-family productivity growth has likely been weak in much of the U.S. and has contracted sharply in some locations. Using these estimates we document new stylized facts about differences in productivity growth across locations and that shed light on some possible reasons why construction productivity growth has been so low.

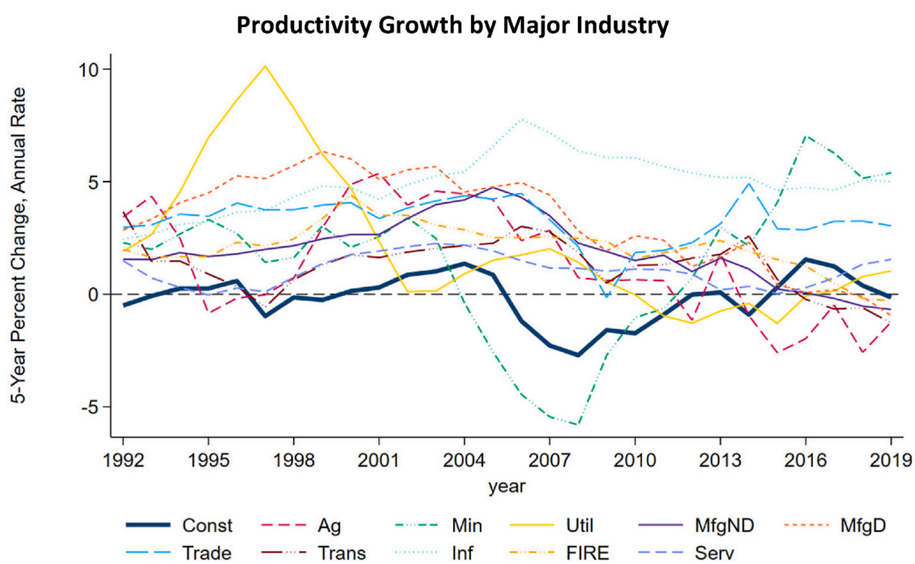

Fig. 1. Productivity growth by major industry.
Source. Bureau of Labor Statistics, Office of Productivity and Technology.

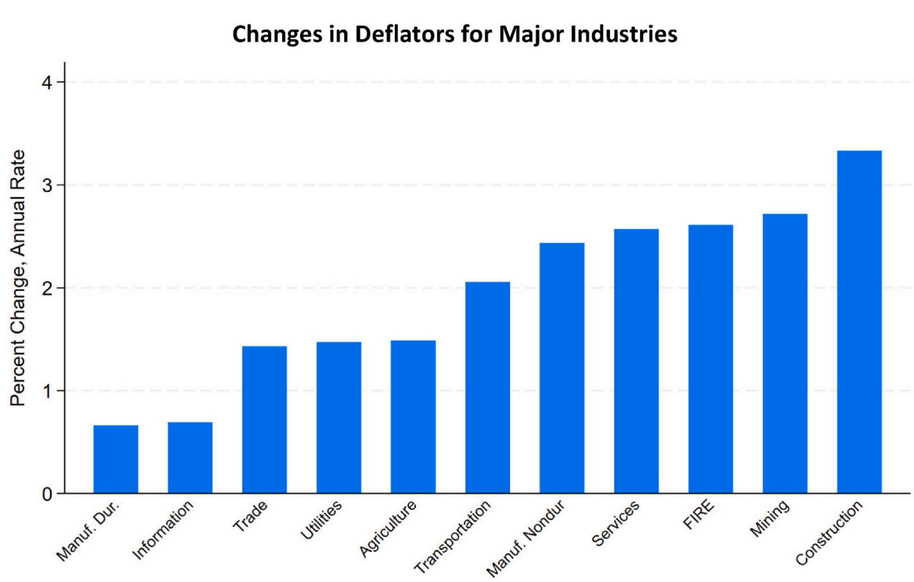

Fig. 2. Changes in deflators for major industries.
Source. Bureau of Labor Statistics, Office of Productivity and Technology.

The paper begins with a detailed description of how construction productivity is measured in the official statistics: as the quantity of structures produced divided by labor input, where the quantity of structures is calculated as the total nominal value of structures built in a variety of subsectors divided by price deflators specific to those subsectors. Fig. 2 shows that on average, the deflators for the construction industry have risen at a much faster pace than those used to deflate nominal output in other industries. Hence, either the price of producing structures really has increased at a much higher rate than the price of producing other goods and services over the past 30 years, or the construction-sector price deflators have been biased upward by a growing amount over time.

There is reason to suspect a role for deflator mismeasurement because a proper deflator should measure the change in the price of structures holding quality constant, but quality is a function of many characteristics, some which are harder to measure than others. For example, the analysis in Goolsbee and Syverson (2023) controls for quality changes by accounting for changes in housing size, but this adjustment alone could be insufficient, as it does not account for other aspects of quality such as number of bedrooms and bathrooms, energy efficiency, and quality of craftmanship that may be hard to record as data but are appreciable to owners and property inspectors. As we discuss below, the price deflator methodology employed by the Census does account for characteristics like size and number of bedrooms, but it does not account for other qualities that have likely improved over time.[3]

Given the potential importance of unobserved quality, we first quantify the bias from this source using three different approaches. Our first approach uses detailed industry construction cost data from R.S. Means to estimate the change in construction costs for specific housing types. This method is much less susceptible to unobserved quality bias than the Census Bureau's method because we can hold many more features of a housing unit fixed, such as the type of roof and the material used for kitchen countertops. The construction costs that we generate under this approach rise by about the same amount as the deflator used for new single-family construction, suggesting that the influence of unobserved quality increases on this deflator has been negligible. Our second approach measures aspects of structure quality that are observable to us but not used in the Census Bureau's calculations. We obtain three such measures: an assessment of structure quality from property tax assessors, a rating of structure quality from the resident of the home, and an estimate of energy efficiency. We estimate that improvements in energy efficiency have boosted structure values by only about 0.2 percentage point per year from the late 1980s to the late 2010s. The tax assessors' and residents' quality ratings have not changed much at all over time, likely because these measures are better suited for cross-sectional comparisons of quality rather than for changes over long periods of time. Using the cross-sectional correlation between quality and house value and the generous assumption that all homes built in the 1980s were low quality and all homes built in the 2010s were high quality, we estimate that unmeasured quality improvements could have boosted structure prices by about 0.5 percentage point per year. Our final approach is the application of an econometric technique for assessing the magnitude of unobserved variable bias (Oster, 2019). It is based on how observed structure characteristics like unit size and number of bathrooms are correlated with the change in structure values over time, as well as on an assumption about how unobserved structure characteristics might be correlated with changes in structure value. This technique suggests that unobserved quality improvements have biased the growth rate of the single-family deflator upward by no more than 0.8 percentage point per year from 1987 to 2019.

In sum, our three different approaches suggest that unobserved structure quality has biased up the single-family deflator by an amount ranging from zero to 0.8 percentage point per year. After accounting for the fraction of nominal construction output that is deflated by this price index and making assumptions about the effect of unobserved quality on deflators used for other sectors of construction, we calculate that the resulting bias to productivity growth in the aggregate construction sector is no more than 0.5 percentage point per year. We also discuss other potential sources of bias to measured productivity growth and conclude that the magnitude of these other sources is probably small as well. In conclusion, it does seem that that productivity growth has been quite low in the construction industry, even if it has not been as low as implied by the official statistics.

Having established that construction productivity growth has truly been quite low, the second goal of this paper is to provide new stylized facts about how productivity growth has varied across the country. Reliable regional estimates of construction productivity growth are generally not available, and so we construct our own measures.[4] We focus on the new single-family construction sector since data on output for this sector is available, unlike other sectors of construction. Specifically, we create new estimates of productivity growth by state and metropolitan area from 1980 to 2019 using data on single-family permit issuance, the average size of new homes, and the number of construction workers.

The regional estimates suggest productivity growth has been quite low throughout much of the United States, but still with a fair amount of geographic heterogeneity. For example, at the low end some states experienced productivity declines of about 3 percent per year, while at the high end some states experienced productivity growth of about 1 percent per year. Some of the states with the lowest productivity growth are small and relatively densely-populated like Connecticut, Rhode Island and Vermont. Other states with relatively strict regulatory constraints on new construction, like Massachusetts, New York and California also had fairly low productivity growth. Meanwhile states with relatively high productivity growth include West Virginia, South Carolina and Montana.

We next turn to metropolitan area estimates and estimate regressions of productivity growth on local attributes that could be related to structure costs and hence productivity growth. One of the main findings is of a negative association between productivity growth and measures of housing supply regulations. To measure the latter, we mainly rely on the Wharton Residential Land Use Regulatory Indexes, but we also find a negative association with other measures of housing supply constraints. This finding complements findings in D'Amico et al. (2024), who find a correlation between regulation, firm size, and the *level* of productivity. The correlation between productivity growth and regulation that we find is generally stronger than that documented in Sveikauskas et al. (2016), likely because our results are based on a long-run estimate of productivity growth while their estimates are based on higher-frequency correlations, which are likely to be noisier given the high cyclicality and volatility of productivity growth at the regional level. An additional contribution of our analysis is that we dig into the types of regulation that matter for productivity growth. We find that delays in permit approval are most strongly and robustly correlated with productivity growth. Other aspects of the regulatory environment matter as well, including restrictions on the number of permits allowed and impact fees. Beyond regulation, we also find a positive association between productivity growth and the fraction of construction taking place outside of the urban core (further away from the city hall), perhaps as construction projects in areas that are less built-up tend to be larger and hence exploit economies of scale. By contrast we find that productivity growth is not related to initial metro size or initial metro density, suggesting that there is scope for productivity growth even in large, dense cities.

[3] For example, structures now are likely much more energy efficient, using better insulation and more efficient heating and cooling systems. They are also more fire-resistant as they are more likely to use grounded electrical outlets. And they use higher-quality materials, such as reinforced concrete for foundations.

[4] In particular, the BEA publishes state-level nominal output indexes that are deflated using a *national* construction price index, which thus assumes away differences across areas in construction costs.

Our research is not the first attempt to examine slow productivity growth in the construction sector. Some previous research suggests that productivity growth may have been higher than the official statistics suggest. For example, Goodrum et al. (2002) analyze data on the labor hours needed to complete 200 different construction-sector work activities in 1976 and 1998 and find that productivity increased materially for most activities, with an average increase of 31 percent. Also, Sveikauskas et al. (2016) and Sveikauskas et al. (2018) argue that some construction sectors like multifamily and industrial have experienced more robust productivity gains. And Allen (1985) found that slow productivity growth from 1968 to 1978 could be explained by mismeasurement of the nonresidential construction deflators and a shift towards single-family construction.[5] By contrast, Goolsbee and Syverson (2023) argue that productivity growth in the single-family sector has likely been minimal since the 1970s, given the roughly flat trajectory of aggregate square footage of new single-family homes per employee. D'Amico et al. (2024) show that small firms are more common in residential construction than in manufacturing, and argue this difference could partly explain stagnant productivity in construction since small firms are less able to exploit economies of scale. Our paper complements this earlier work by showing that productivity growth may have been restrained by regulation and shifts in the location of construction, even as some labor-saving improvements may have been pushing in the opposite direction.

The remainder of the paper proceeds as follows. Section 2 provides an overview of how productivity in the construction sector is measured. The price index used as the deflator for new single-family construction has a very large influence on aggregate construction, and so this section provides details on how this price index is calculated. Section 3 provides evidence on the potential role for measurement error in the single-family deflator and also discusses other measurement issues. Section 4 presents the estimates of construction productivity growth by state and metropolitan area. Section 5 concludes and discusses other possible reasons why construction productivity growth has been so low for so long.

2. Measurement of productivity in the construction sector

2.1. Measurement of nominal output and real output

The BLS measures productivity in the construction sector by aggregating real output of 22 subsectors and dividing by an estimate of labor input for the entire industry.[6] The residential subsectors are new single-family construction, new multifamily construction and improvements. The nonresidential subsectors span a wide range of structures such as offices, warehouses, manufacturing structures like factories, power and communication infrastructure, and highways. The nominal shares of the 15 largest subsectors are reported in Appendix Table 1. Following the methodology used in the National Income and Product Accounts (NIPA), real output for each subsector is calculated by dividing nominal output by a deflator that is specific to that subsector. Nominal output for each subsector is based on construction spending from the Census Bureau's Value of Construction Put In Place program.[7] For new single-family residential construction, spending is estimated from the sales prices of newly-built single-family homes and assumptions about how the construction of a unit is spread over time from start to completion. For residential improvements, nominal spending is estimated from homeowner expenditures in the Consumer Expenditure Survey. For multifamily and nonresidential construction, nominal spending is from a survey that asks builders to estimate the nominal value of structures put in place each month.

Table 2
Deflators used in the construction sector.

	Nominal Output Share 1987–2019
Price index for new single-family homes under construction	46.5
Used for the new single-family sector	31.6
Used for residential improvements	6.6
Used for nonresidential sectors	8.3
Price index for new multifamily units under construction	2.3
BEA multifamily price index	2.5
Nonresidential Producer Price Indexes	
Warehouse PPI	3.1
Office PPI	2.5
Industrial PPI	2.7
New school PPI	0.9
Health care PPI	0.8
Home maintenance PPI (input cost index)	6.6
ECI for construction workers (input cost index)	6.6
Turner building cost index	8.3
BEA nonresidential price indexes	8.1
Handy-Whitman cost indexes (input cost index)	6.9
AUS telephone cost index (input cost index)	2.5

Source. Authors' calculations based on nominal output data from the Bureau of Economic Analysis and summaries of NIPA methodology from various years.

The price deflators used to convert nominal output to real output are drawn from a variety of sources. The price deflator for new single-family construction is the price index for new single-family homes under construction produced by the Census Bureau, which we will refer to henceforth as the "single-family price index." As we will describe in more detail in section 2.2, this index estimates the constant-quality price of new single-family structures based on the sales prices and characteristics of new single-family homes. For data since 2005, the deflator for new multifamily construction is the price index for new multifamily units under construction produced by the Census Bureau, calculated using a similar method as the single-family price index. From the late 1970s to 2004, the multifamily deflator was a price index developed by the BEA for the purpose of deflating nominal construction spending (de Leeuw, 1993). The deflator for residential improvements is an average of the single-family price index, the PPI for inputs to residential maintenance and repair, and the Employment Cost Index for the construction industry. Meanwhile the deflators for the nonresidential sectors differ by sector and time period. Some nonresidential sectors, such as office and health care, use a Producer Price Index (PPI) for new buildings in that specific sector. These sector-specific PPIs were developed in the 2000s and the starting dates differ a bit for each sector. For years between 1997 and the start data of each PPI, the BEA uses a sector-specific cost index that it developed from a construction cost estimator (Grimm, 2003). Prior to 1997, the deflators used for all nonresidential sectors are an unweighted average of the single-family price index and the Building Cost Index produced by the Turner Construction Company. For some nonresidential sectors, like lodging, there is no sector-specific PPI and an unweighted average of the single-family price index and the Turner Building Cost Index is used for the entire time period from 1987 to the present.

Table 2 lists all of the price indexes that are used as inputs to the deflators and reports the average share of nominal construction activity for which each is used over our 1987–2019 sample period. The single-family price index has the largest influence on aggregate construction, both because of the large share of new single-family construction and because this price index is used to deflate other sectors as well. In total, any bias in the single-family price index will affect nearly half of

[5] His findings are less relevant today, however, due to changes in nonresidential price index methodology and since single-family construction has not continued to be a growing share of total construction.

[6] Measuring productivity for each subsector separately is complicated by classification issues with labor input, as some workers in the construction industry may operate in more than one subsector.

[7] The productivity statistics use a concept of output called "sectoral output," which is defined as the total amount of goods and services produced in an industry for sale either to consumers or to businesses outside that industry. Because the value of inputs is not subtracted from output, accurate measurement does not require accurate measurement of the sector's inputs.

aggregate output in the construction industry. In Section 3 we will discuss how each of the other price indexes might also be affected by unobserved quality improvements. We will also discuss other potential sources of bias that will be relevant to various subsets of the price indexes listed in Table 2.

2.2. Methodology for the price deflator for new single-family construction

Since much of our analysis will focus on measurement issues pertaining to the price index for new single-family homes under construction, it is helpful to describe how it is computed in more detail. Full details of the methodology can be found on the Census website.[8] Musgrave (1969) describes the development of this method.

The Census Bureau computes the single-family price index using sales prices and characteristics of new homes sold. The first step is a set of hedonic regressions, modeling structure value as a function of various housing unit characteristics.[9] These characteristics include structure square footage, number of bedrooms, number of bathrooms, presence of a basement deck, patio, or garage, type of exterior wall material, and type of heating/air conditioning. These characteristics are often included in hedonic pricing models (Sirmans et al., 2006). Regressions are run separately for each time period and for five separate market strata: single-family attached homes and single-family detached homes in each of the four Census regions. The next step is to calculate two price indexes using the coefficient estimates from these regressions: a Laspeyres index and a Paasche index. The Laspeyres index is a weighted average of the estimated coefficients for each housing unit characteristic, with the weights based on the housing unit characteristics in 2005. The Paasche index is similar but uses the current period housing characteristics as the fixed weights. Finally, the price of single-family homes under construction is the geometric mean of the Laspeyres and Paasche indexes (i.e. a Fisher Ideal index).

The dependent variable in the hedonic regressions is an estimate of structure value. For homes that are built by contractors, structure value is computed as the amount paid to the contractor. However, for homes that are built for sale, structure value is not easily observable. The Census Bureau multiplies the home's sales price by a fixed factor (0.84) to subtract out the value of the project attributable to land as well as some other non-structure costs like the value of moveable appliances.[10]

The Census Bureau's methodology will generate an unbiased estimate of changes in structure costs if it controls for all aspects of structure quality that are correlated with house value and that have changed over time. However, not all aspects of structure quality are included in their analysis. Some examples of omitted structure characteristics include the energy efficiency of windows and doors, the types of interior finishes such as flooring and kitchen countertops, and the durability of the materials used. In the analysis below we will refer to "unobserved quality" as all features of the structure that are correlated with structure value but not included in the Census Bureau's methodology for calculating the price index for single-family homes under construction.

3. Bias from unobserved quality and other sources of bias

This section starts by examining the potential for changes in unobserved structure quality to bias estimates of growth in the Census Bureau's price index for new single-family homes under construction. We take three approaches: the creation of an alternate price index that holds many more housing characteristics fixed than the Census Bureau's methodology; an analysis of aspects of quality that we can observe in other data sources but that are not included in the Census Bureau's methodology; and an econometric method for estimating the magnitude of unobserved variable bias. Next, we discuss the scope for unobserved quality to bias the price deflators used for sectors of construction other than new single-family homes, as well as potential sources of bias other than unobserved structure quality. Finally, this section concludes by summarizing the maximum possible bias owing to all of the issues discussed in this section.

Table 3
Construction cost estimates from R.S. Means.

	Cost in 1987	Cost in 2019	Percent Change (annual rate)
1-story home			
Economy wood siding (800sf, 1 bath)	51,010	157,089	3.6
Average wood siding (1200 sf, 1 bath)	77,908	220,808	3.3
Custom brick veneer (1800sf, 2½ baths)	162,899	443,288	3.2
Luxury solid brick (2400sf, 2½ baths)	267,022	622,518	2.7
2-story home			
Economy wood siding (18000sf, 2 baths)	90,653	254,738	3.3
Average wood siding (2200sf, 2 baths)	114,930	321,208	3.3
Custom brick veneer (2800sf, 3½ baths)	202,876	548,146	3.2
Luxury solid brick (3600sf, 3½ baths)	327,282	790,914	2.8

Note. Economy and average homes are assumed to have an asphalt roof, a 1-car garage, an open porch and breezeway, and laminate kitchen countertops. Custom and luxury homes have a cedar shake roof, a 2-car garage, an enclosed porch and breezeway, and marble kitchen countertops. All 1-story homes have a 30-gallon gas water heater. For 2-story homes, the economy and average homes have a 30-gallon gas water heater while the custom and luxury homes have a 50-gallon gas water heater. Economy homes have 2 kitchen cabinets and 6 linear feet of countertops. Average, custom and luxury homes have 3, 4 and 5 cabinets and 14, 20 and 25 linear feet of countertops, respectively. The custom and luxury homes have a burglar alarm. All homes have air conditioning as well as a broom closet, smoke detector, dishwasher, garbage disposal, refrigerator, range, oven, microwave, washing machine, and dryer.

3.1. An alternate price index to measure construction costs

One way to assess the potential bias of the price index for new single-family homes under construction is to create an alternate measure of construction costs that holds many more aspects of structure quality fixed over time than the Census Bureau's price index does. If increases in this alternate measure of construction costs were much smaller than the increases in the Census Bureau's single-family price index, we might conclude that unobserved quality has biased up the Census Bureau's price index. To create this alternate price index, we use information from a company named R.S. Means that estimates the cost of building various types of residential structures (RSMeans, 1987, 2019). These estimates are used by builders and contractors to develop cost estimates for their construction projects, and therefore should be quite reliable. The cost estimates are created by adding up the cost of materials and installation for all of the individual components of a structure and then adding in costs for overhead, architectural fees, and other general costs.

The advantage of using R.S Means estimates to study changes in construction costs is that R.S. Means allows the user to specify many detailed attributes of the structure. For example, one can specify that a home has a laminate kitchen countertop, and therefore one can compare the cost of homes with laminate kitchen countertops at different points in time. By contrast, a general shift from laminate kitchen countertops to granite countertops would increase the average sales price of new homes and bias the Census Bureau's single-family price index upward because type of countertop is not included in the Census Bureau's regression. Nevertheless, the RS Means estimate is not entirely free from bias. Continuing with the

[8] https://www.census.gov/construction/cpi/pdf/descpi_uc.pdf.

[9] See Sirmans, Macpherson and Zietz (2005) for a review of studies using hedonic models of house prices.

[10] See more information here: https://www.census.gov/construction/c30/methodology.html. For contractor-built homes, the Census Bureau inflates sale amounts by a factor of 1.1 to account for other expenses related to lot development. Contractor-built houses are weighted to also represent owner-built houses.

example of countertop quality, the RS Means estimate would be biased if the quality of laminate countertops has changed over time.

R.S. Means provides cost estimates for a variety of home types (1-story, split level, 2 story, etc.) and four quality levels of each type: economy, average, custom and luxury. We calculate the construction costs for 1-story homes and 2-story homes at each of these quality levels, yielding a total of 8 cost estimates at each point in time. As shown in Table 3, we allow unit size, number of bathrooms, type of exterior and roof, type and length of kitchen countertops, and many other unit characteristics to differ by level of quality. The costs of the characteristics also vary by quality. For example, the cost per linear foot of a laminate countertop is higher for an average quality home than for an economy quality home, presumably reflecting the use of a higher quality material.

R.S. Means also contains information about the amount of time required to complete various tasks and the total cost to complete these tasks. Goodrum et al. (2002) analyze data from R.S. Means and other cost-estimating firms on the labor hours needed to complete 200 different construction-sector work activities in 1976 and 1998 and find that productivity increased materially for many activities, with an average increase of 31 percent. Though this task-level analysis is interesting, the set of tasks undertaken to build a structure has changed over time. If new tasks tend to be lower productivity than existing tasks, then these new tasks would mute the productivity gains from the existing tasks. RS Means does not describe exactly which sets of tasks are required to build a specific type of structure, so it is not possible to examine how the set of tasks has changed. Moreover, some aspects of the construction process, such as measures that increase worker safety, may have changed in a way that increases costs even for a given set of tasks. Hence, in our analysis we prefer to look at cost changes over time for a completed structure, as these cost estimates are more comprehensive than task-based estimates.

Table 3 reports the estimated construction costs for each unit type in 1987 and 2019. The cost increases for all 8 housing types range from 2.7 to 3.6 percent per year, with the unweighted average equal to 3.2 percent. Meanwhile, the Census Bureau's single-family price index rose by 3.2 percent per year over this period. The result that the R.S. Means cost estimates do not show substantially smaller increases than the Census Bureau's price index suggests that the Census Bureau's omission of the many housing unit characteristics included in R.S. Means has not led to a material bias. While it is true that the R.S. Means estimates do not hold all housing characteristics fixed, the fact that holding many important characteristics fixed does not lead to a much lower estimate of cost increase suggests that the role of unobserved quality change is small.

3.2. Observed measures of quality

3.2.1. Tax assessors' and residents' ratings of structure quality

For the purposes of assessing the value of residential property, tax assessors in many jurisdictions report the quality of the structure. The excerpt below, taken from the real estate assessment website of Fairfax County, Virginia, provides an example of the factors that affect the assessor's quality evaluations[11]:

"The Average category covers many standard tract-built houses. These are built to at least minimum building code standards and the quality of materials and workmanship is acceptable. Good category houses are typically found in better quality tract developments or can be designed for an individual owner. The shape of the structure is generally somewhat more complex than the Average category and good quality standard materials are used throughout. The Excellent category covers properties in higher end subdivisions or standard custom houses. Excellent properties have a higher level of design and materials when compared to Good. Luxury properties are typically individually designed custom houses and exhibit very high standards of design, materials, finish, and workmanship."

Thus, these quality ratings will capture many elements of structure quality that are not otherwise recorded in the data. These quality assessments are included in CoreLogic's Residential Real Estate database, which contains the property characteristics from tax assessment records for 99 % of the US housing stock. The categories of ratings vary across jurisdictions. Appendix Table 2 reports the frequency of all the ratings that appear in the CoreLogic dataset. We group the responses "excellent", "luxury", "above average" and "good" into an indicator for high quality and the remaining non-missing responses into an indicator for medium/low quality.

We examine the correlation of this measure of structure quality with house prices by regressing the sales prices of new homes on an indicator for high structure quality and the housing unit characteristics included in the Census Bureau's methodology. To this end, we use the sales prices of new homes from the deeds transactions in CoreLogic's Residential Real Estate database, which includes transactions from 2000 to 2019. New homes are identified using a new construction indicator calculated by CoreLogic based on owner transfer records where CoreLogic has identified the seller as a builder.[12] We also require that new homes have a year of first sale no more than three years after the year built. In our

Table 4
Effect of structure quality on Ln(Home value).

	CoreLogic	American Housing Survey	
	(1)	(2)	(3)
Built in 2019 (relative to 2000)	0.569	–	–
	(0.018)		
Tax assessor rating = high quality	0.164	–	–
	(0.026)		
Ta assessor quality rating missing	0.064	–	–
	(0.024)		
Built 2000-19 (relative to 1970-89)	–	0.956	0.938
		(0.006)	(0.006)
Resident quality rating = 10 (relative to 7 or less)	–	0.159	0.153
		(0.009)	(0.009)
Dishwasher	–	–	0.237
			(0.009)
Washing machine	–	–	0.130
			(0.027)
Dryer	–	–	0.015
			(0.019)
Years	2000–2019	1985–2019	1985–2019
Housing characteristics	Yes	Yes	Yes
Division FE	Yes	No	No
Region FE	No	Yes	Yes
Number observations	3,398,815	35,298	35,298
Adjusted R2	0.59	0.68	0.68

Source. CoreLogic Residential Real Estate database and American Housing Survey National Samples 1985, 1987, 1989, 2015, 2017, 2019. CoreLogic sample includes newly-built single-family detached homes and the dependent variable is the home's sales price "High quality" are homes designated by the property tax assessor as "luxury", "excellent", "above average" or "good." Standard errors in column 1 are clustered by county. AHS sample restricted to single-family detached homes built 1970–1989 and appearing in the 1985-89 samples or built 2000-19 and appearing in the 2015-19 samples. The dependent variable in AHS is the resident's estimate of home value. The resident's quality rating is on a scale from 1 to 10, but few respondents rate their home quality below 7 (see Appendix Table 3). In CoreLogic the housing characteristics are unit square footage, number of bedrooms, indicators for fireplace, garage, basement, and various types of exteriors. In the AHS the housing characteristics are indicators for unit square footage, number of bedrooms, number of bathrooms and presence of central air conditioning, a fireplace, a garage and a basement. Indicators for appliances are three separate indicators for the presence of a clothes washer, a dryer and a dishwasher.

[11] https://icare.fairfaxcounty.gov/ffxcare/content/desc.htm.

[12] This measurement of new construction based on information identifying the seller as a builder is consistent with the recommendations in Coulson et al. (2019), who show that estimates of the new home premium can vary meaningfully when new homes are identified solely based on age since some recently built homes could include "flips." Our main estimates are robust to excluding properties first sold one or more years after the property was built.

sample, 91 percent of the new homes were first sold within a year of the year they were built. Because structure quality is only available for 39 percent of the sample, we also include an indicator for homes where quality is missing.[13]

As shown in the first column of Table 4, the price of homes with high structure quality is 0.16 log points, or about 18 percent higher than the price of lower-quality homes conditional on the other characteristics that the Census Bureau uses to calculate constant-quality new home prices.[14] Therefore this measure of structure quality does indeed seem to capture an important housing attribute that is missing from the Census Bureau's methodology. What matters for our purpose is how this aspect of quality has changed over time. However, the CoreLogic data cannot speak directly to changes in structure quality from 1987 to 2019, both because we only have data starting in 2000 and because we suspect that the assessor's measure of quality may be relative to other homes in the same year rather than an absolute measure of quality. 46 percent of the homes built in 2000–2004, the first five years of this sample, were high quality, compared with 52 percent in 2014–2019.

Nevertheless, we can use a back-of-the envelope calculation to estimate the largest possible effect that these results imply for bias in the single-family price index. Specifically, if we assume that no new homes were high-quality in 1987 and all new homes were high quality in 2019, the cumulative change in the single-family price index would be biased upward by almost 20 percent, which translates to an annualized growth rate of about 0.5 percentage point per year.

Next we examine a similar measure of quality: a resident's rating of the quality of their home. This rating is reported in the American Housing Survey (AHS), which is a nationally representative survey of housing units with a primary goal of measuring the size, composition and quality of the US housing stock. For this analysis, we use AHS data on newly-built single-family detached homes covering two time periods: an "early" period, which includes data on homes built between 1970 and 1989 as observed in the 1985, 1987 and 1989 National samples, and a "recent" period, which includes data on homes built between 2000 and 2019 as observed in the 2015, 2017 and 2019 National samples.

The AHS asks the resident to rate the quality of their home as a place to live on a scale from 1 to 10. Since the AHS asks a separate question about neighborhood quality, we are reasonably confident that the home quality rating reflects structure quality and not local amenities. In this sample the resident's rating of housing quality is generally in the top third of the range and did not change much between the two sample periods (see Appendix Table 3). Just like the tax assessor measure, we suspect that this rating reflects an assessment of the quality of the home relative to other homes in the same time period rather than relative to homes in an earlier time period. Even so, we can use the data to estimate the cross-sectional correlation between quality and home value conditional on other housing unit characteristics.

We regress the natural logarithm of house value (as reported by the survey respondent) on a set of housing unit characteristics, indicators for Census region, an indicator for homes built in the "recent" period, and indicators for different quality ratings. Although the set of housing unit characteristics is not as complete as the set used by the Census Bureau for calculating the single-family price index, we still obtain a good approximation of the cumulative price increase from the early period to the recent period. Specifically, controlling for housing characteristics the value of homes in the recent period is 169 percent higher than the value of homes in the early period (not shown). The single-family price index rose by 153 percent between these two periods, a very similar amount. Column 2 of Table 4 shows that homes with the highest quality rating are about 0.16 log points (17 percent) higher value than those with a rating of 7 or below. Therefore, this analysis supplies supporting evidence that conditional on the housing characteristics used by the Census Bureau, high-quality new homes are roughly 20 percent higher value than low-quality new homes. As with the CoreLogic data, this analysis cannot speak directly to changes in quality over time. But a back-of-the-envelope calculation similar to the one using the CoreLogic estimate would generate a similar result.

3.2.2. *Energy efficiency*

Another aspect of housing quality that we examine in the AHS data is energy efficiency. Many improvements in housing quality over the past 40 years are intended to improve energy efficiency. Some examples include double-paned windows, better insulation, and more efficient heating and cooling systems. Although these improvements are difficult to measure individually, we can get a sense of the cumulative changes in energy efficiency of new homes by comparing the total energy use of new homes built in the 1970s and 1980s to that of new homes built in the 2000s and 2010s in the American Housing Survey.

For this exercise we calculate total expenditures on utilities as the sum of annual expenditures on electricity, natural gas, heating oil, water and other fuels. We deflate these nominal expenditures by the Consumer Price Index for utilities in order to obtain an estimate of the quantity of energy used for each home. Then we regress the energy use for each house on indicators for unit square footage, indicators for Census region, and an indicator for homes built in the recent period. The coefficient on the indicator for homes built in the recent period shows how energy use has changed over time after conditioning on changes in the size and geographic location of housing units.[15]

As reported in Table 5, the energy use of homes built in the 2000s and 2010s was almost 25 percent lower (column 1) or $740 (column 2) per year lower than that of homes built 1970s and 1980s. While this dollar amount is not insignificant, it is only about 4 percent of the annual rental expenditures of the homes in the recent sample. To compare the energy savings with average value of the structure, we estimate cumulative savings over the life of the home by dividing the annual energy savings by a cap rate of 5.3 percent, which is the ratio of rental income to property value reported in Jorda et al. (2019) for all U.S. residential property from 1870 to 2015. Next we calculate average structure value of the homes in our sample by multiplying the average home value in the recent sample by (1-0.41), since Davis et al. (2021) estimate that the share of house value attributable to land is 0.41.[16] These calculations suggest that energy savings over the life of a home are about 7 percent of average structure value. Given that this improvement in energy efficiency occurred over a 30-year period, this aspect of quality boosted structure value by only 0.23 percent per year. Estimates are even smaller if we use a cap rate derived from the 2019 annual reports of large single-family rental corporations, for which we calculate cap rates above

[13] Quality ratings appear to be missing in many cases because many counties do not record structure quality. Specifically, quality tends to be missing for all housing units in a county or available for most housing units in a county. Results are robust to dropping observations with missing quality, limiting the sample to counties where less than 25 percent of the observations are missing quality, and including county fixed effects.

[14] We find that the high-quality premium is similar in high-cost and low-cost areas, as well as in the first five and last five years of our sample period. The high-quality premium is also robust to including state and metro area fixed effects in the regression. Results available upon request.

[15] It is important to control for unit size because new homes have become larger over time and larger homes use more energy. Ideally it would be nice to control for more detailed geographic information since weather patterns, and therefore the need to heat and cool homes, can vary materially within Census region. However, this information is not available in the public-use data.

[16] https://www.fhfa.gov/PolicyProgramsResearch/Research/Pages/wp1901.aspx. As we will discuss below, this estimate is for all homes less than 10 years old, not only newly-built homes. The land share is probably lower for new homes since lot sizes have fallen over time. A lower land share would raise our estimated structure value and therefore lead to an even smaller estimate of the improvements in energy efficiency relative to structure value.

Table 5
Energy use of newly-built homes.

	Ln(Energy Use)	Energy Use
Built 2000–2019	−0.223	−742
	(0.004)	(14)
Unit square footage		
1000 to 1499 sf	0.223	477
	(0.012)	(38)
1500 to 1999 sf	0.332	788
	(0.012)	(37)
2000 to 2499 sf	0.419	1062
	(0.012)	(38)
2500 to 2999 sf	0.498	1344
	(0.012)	(40)
3000 to 3999 sf	0.599	1735
	(0.012)	(40)
≥4000 sf	0.685	2103
	(0.013)	(43)
Region		
Midwest	−0.150	−622
	(0.008)	(27)
South	−0.129	−520
	(0.008)	(24)
West	−0.226	−795
	(0.008)	(26)
Constant	7.877	3245
	(0.012)	(40)
Number of observations	40,722	40,722
Adj. R2	0.158	0.167

Source. American Housing Survey National Samples 1985, 1987, 1989, 2015, 2017, 2019. Sample restricted to single-family detached homes built 1970–1989 and appearing in the 1985-89 samples, or built 2000-19 and appearing in the 2015-19 samples. Energy use defined as total annual expenditures on electricity, natural gas, heating oil, water and other fuels, deflated by the Consumer Price Index for Utilities.

9 percent (calculations available upon request).

3.2.3. Other measures of quality

A third aspect of structure quality that we can observe in the AHS data is whether the home has various types of appliances: a dishwasher, a washing machine, and a clothes dryer. In principle, moveable appliances like these should not be included in structure value. In fact, part of the Census Bureau's time-invariant adjustment to sales prices is to subtract the value of appliances. However, since the adjustment is time-invariant, the price index for new single-family homes will be biased if the ratio of total value of appliances to total structure value has changed over time. Moreover, the presence of these appliances could be correlated with other aspects of structure quality. For example, homes with a dishwasher could be more likely to have higher quality kitchen countertops and cabinets. In the AHS, the fraction of new homes with dishwashers increased from 0.73 in the 1980s to 0.93 in the 2010s, while the fraction of homes with dryers rose from 0.88 to 0.96. These increases, while not very large, could signal that moveable appliances, or possibly other unobserved housing attributes that are correlated with these appliances, have become a larger fraction of home value. We assess this possibility by including indicators for each of these appliances in the regression described above. As shown in column 3 of Table 4, the coefficient estimate on the indicator for homes built in the recent period barely changes, suggesting that the contribution of such appliances to total home value has not changed over time. In support of this conclusion, a survey of homebuilders found that appliances were only a small share of total structure cost and that this share did not increase from 1998 to 2019.[17] We conclude that appliances have not increased as a share of total home value from the 1980s to the 2010s, and therefore have not led to a material bias in the single-family price index.

[17] https://www.nahb.org/-/media/8F04D7F6EAA34DBF8867D7C3385D2977.ashx.

We can also assess changes in structure quality over time using supplemental information provided by the R.S. Means company. In conjunction with providing estimates of the cost of building specific types of structures, they describe the general characteristics of the structures whose costs they assess. In Appendix Table 4 we summarize the descriptions of average-quality new homes in 1987 and 2019. Many elements of new single-family homes have remained the same over this 32-year period. The average new home is still built with a concrete foundation and framed with 2x4 studs and ½" plywood sheathing. It has asphalt shingles on the roof, ½" drywall for the interior walls, and similar flooring. That said, some elements of homes built in 2019 are higher quality. Foundations in 2019 were made of reinforced concrete and insulated, whereas foundations in 1987 were not. The average quality new home in 2019 included a 40-gallon electric water heater, whereas the typical water heater in 1987 was only 30 gallons and gas-fired. Electric water heaters tend to be cheaper and more energy efficient than gas, so this shift reflects a clear quality improvement. Overall, this evidence suggests that building quality has increased a bit over time, but the changes do not seem dramatic. We find similar results for luxury-quality homes (not reported).

3.3. Econometric bounds on the contribution of unobserved quality

As a final way to assess the magnitude of measurement error attributable to unobserved quality, we turn to an econometric technique developed by Oster (2019). This technique is useful for placing bounds on the magnitude of coefficient bias for scenarios in which observed controls are an incomplete proxy for omitted variables. The Oster (2019) estimator uses as inputs observables (how the coefficient of interest and model R-squared change when the observed controls are included) and two assumptions about unobservables. These assumptions are: 1) the maximum R-squared if all relevant explanatory variables were observed and 2) the influence of remaining unobservables relative to the influence of the controls we do observe. We adapt this method to our case, where the coefficient of interest is a time period indicator (i.e. the change in structure price conditional on observed characteristics).

Oster (2019) shows a consistent estimate of the coefficient of interest (β*) can be approximated using the following formula.

$$\beta^* \approx \tilde{\beta} - \delta\left[\mathring{\beta} - \tilde{\beta}\right]\frac{R_{\max} - \tilde{R}}{\tilde{R} - \mathring{R}}.$$

where $\tilde{\beta}$ and $\tilde{R}$ are the coefficient estimate and R-squared from the model with full controls, $\mathring{\beta}$ and $\mathring{R}$ coefficient and R-squared from the baseline model, δ relates the importance of unobservables relative to the importance of observables, and Rmax is the maximum R-squared when all possible controls (observed and unobserved) are included.

As a rule of thumb, Oster (2019) suggests bounding values of Rmax $= 1.3^* \tilde{R}$ and of $\delta = 1$. These values are calibrated by re-analyzing estimates from randomized experiments, which provide unbiased coefficient estimates by design. The second assumption implies that the remaining unobserved characteristics are as important as the observables. In our case, we think $\delta = 1$ is a reasonable bounding assumption, as it implies that various aspects of unobserved quality like interior finishes are as important to home values as the observables like square footage and number of bathrooms.

We begin with the AHS data since the data cover the full time period of interest. Table 6 shows that in a regression with only region indicators, the coefficient on the indicator for homes built in the recent period is 1.19. When the full set of Census variables are included, this coefficient decreases to 0.99 and the R-squared increases by 0.18. Thus, the observed measures of quality reduce the estimated increase in home value over this 30-year period by 0.2 log point. With Rmax $= 1.3^* \tilde{R}$ and $\delta = 1$, the lower bound for the unbiased coefficient on the indicator for

Table 6
Estimated bias from unobserved quality following Oster (2019).

	Coefficient on Time Period Indicator	R^2	Implied Structure Price Growth Rate (annual rate)
Regression estimates in AHS data			
Baseline	1.191	0.48	4.05
Census controls	0.989	0.66	3.35
Implied unbiased coefficient	0.767	0.86	2.59
Regression estimates in CoreLogic data			
Baseline	0.637	0.27	3.41
Census controls	0.563	0.59	3.01
Implied unbiased coefficient	0.521	0.77	2.79

Note. Baseline regression includes U.S. Census region indicator variables as controls. The 1985-89 AHS sample includes homes built from 1970 to 1989 and the 2015-19 AHS sample includes homes built from 2000 to 2019; the time period indicator is equal to one for properties built after the 2000s and zero otherwise. The CoreLogic dataset covers the period from 2000 to 2019; the time period coefficient reported is for the year 2019 (2000 is the omitted year). The implied unbiased coefficient assumes that $\delta = 1$ and that the R^2 of the regression including all unobserved variables would equal 1.3 times the R^2 of the regression with Census controls. See text for more details.

homes built in the recent period would be 0.77. Converting the coefficient estimates to annualized growth rates, we find the constant-quality price of structures would have risen at an annual rate of 2.6 percent, rather than the estimated 3.4 percent when only the Census controls are included. In other words, this calculation suggests that unobserved increases in quality have biased the rate of increase of structure prices by up to 0.8 percentage points per year.

Next we conduct the same econometric exercise using the CoreLogic data described in section 3.2. The results in Table 6 show that the unobserved quality improvements may have biased the rate of increase by up to 0.2 percentage points this year. This estimate is smaller than in the AHS data because the time period coefficient falls by less when the observed measures of quality are included and because the R-squared increases by more.

Although we cannot test the appropriateness of the bounding assumptions directly, two types of evidence suggest that δ is unlikely to be larger than 1. First, we can look at the correlation of the resident's or tax assessor's assessment of structure quality with house value, since these variables are observable measures of quality that are excluded from the Census Bureau's analysis. These correlations are smaller than the correlation of unit size with house value, and either the same size as or smaller than the correlations of many other housing attributes with house value (see Appendix Table 5). Therefore, assuming that the correlation between unobserved characteristics with house prices is as large as the correlation between observed characteristics and house prices seems like a reasonable upper bound. Second, we note that the only way that δ could be larger than one, or even equal to one, is if the unobserved measures of quality increased by much more than the observed measures of quality. This seems unlikely to us given the large increases in observed quality: in the AHS the fraction of new single-family homes larger than 2500 square feet increased by more than 50 percent from 27 percent in the 1980s to 44 percent in the 2010s. And the fraction with at least 3 bathrooms tripled from 11 percent to 35 percent.

To summarize our results on bias to the single-family price index from unobserved structure quality, our estimates range from very small (when comparing the single-family price index to alternate cost estimates from RS Means) to 0.8 percentage point per year (when using the econometric method). We will use the estimate of 0.8pp in the spirit of calculating the largest possible amount of measurement error.

3.4. Quality bias in nonresidential sectors and other sources of bias

So far, we have focused on the potential for unobserved quality to bias growth of the price index for new single-family homes under construction. What about other deflators used for other sectors of construction? Since the price index for new multifamily units under construction is calculated using a very similar methodology as the single-family price index, the bias in this deflator could be similar.[18] We suspect that unobserved structure quality is likely to have a negligible influence on the PPIs for new nonresidential buildings because they are based on changes in the costs of very specific inputs. For a similar reason we suspect that the PPI for inputs to residential maintenance and repair will not be influenced by changes in the quality of construction materials. We also think that the ECI for construction workers should not be influenced by changes in structure quality since it measures only labor costs. The influence of unobserved structure quality on the BEA's cost indexes—the nonresidential indexes used between 1997 and the introduction of the PPIs and used for the multifamily index used before 2005—is probably smaller than that for single-family price index because these indexes were created based on the estimated cost of labor and materials for specific structure types, not based on building sales prices. However, since the inputs used for these indexes may not have been as detailed as the inputs used in the PPIs, there could be some scope for increases in input quality to boost these indexes. Therefore, we will assume that the bias related to unobserved structure quality for these indexes is half of the bias that we assume for the single-family price index. The quality bias in the other price indexes used as deflators—the Handy Whitman index, the AUS telephone index, and the Turner Building Cost Index—is unclear, as we do not have much information on their methodologies. Since they are also based on input costs rather than property sales prices, we will also assume that the bias from unobserved quality in these indexes is half as large as for the single-family price index.

Next we assess the potential for sources of bias beyond unobserved structure quality. One issue is that structure value is not observed directly for most homes under construction, but rather is assumed to be a constant fraction of total house value. This assumption would lead to an upward bias in the single-family deflator if the share of land had, in fact, risen over time. Prior research has found that the share of house value attributable to land has risen since the 1980s as land prices have risen more than structure prices (Case, 2007; Davis and Heathcote, 2007; Davis and Palumbo, 2008; Davis et al., 2021). However, most of this research has measured the average land share for all existing residential structures in the US. Buyers of new homes may react to higher land prices by substituting towards smaller lots (Molloy et al., 2022) or to areas where land prices are lower, reducing the land share for newly built homes. Davis et al. (2021) measure the land share for homes that are less than 10 years old and find that the average land share only increased from 38 percent in 2012 to 41 percent in 2019. Moreover, this increase was concentrated in a small number of counties where land prices are high and new construction is less common. If we take their estimates of land shares by county and calculate a weighted average of the change in land share using single-family construction as weights, we find that the land share did not increase at all from 2012 to 2019. Although this analysis covers only a short sample period, a survey

[18] Specifically, the Census Bureau also creates this index from a sample of property sales prices and the characteristics of the buildings. Eriksen and Orlando (2022) use the RS Means cost estimator to calculate the construction cost of two multifamily building types from 2012 to 2020. They find much smaller increases in construction costs (less than 2 percent per year) than the increase in the Census Bureau's multifamily price index (5 percent per year). This result suggests that increases in building quality have biased up the multifamily price index. That said, Eriksen and Orlando's calculations assume that management and design overhead are a fixed percentage of building cost; increases in these costs might also have caused the multifamily price index to increase by more than their estimates.

conducted by the NAHB found that the ratio of finished lot costs to sales price for new single-family homes was actually lower in 2019 than it was in 1998 (the first available year).[19] Not only do we suspect that land shares for new single-family homes may not have risen that much from 1987 to 2019, but the bias to measurement of real construction output is mitigated by the fact that the estimate of nominal construction expenditures for new single-family homes uses the same assumption of a constant land share. Therefore any bias would be present in the numerator and denominator of the calculation for real single-family output and would cancel out. The bias from rising land shares in the single-family price index would only matter for other sectors of construction that use this price index in their deflator, since these other sectors measure nominal construction spending from structure values and do not use any assumptions about land shares.

One final measurement issue is that the deflators for some sectors are based on input prices rather than output prices. This will overstate the increase in the final cost of the structure because any productivity improvement should allow a structure to be produced at a lower cost, even if all of the input costs have not changed. Pieper (1991) finds little bias from this issue based on comparing productivity estimates for the period 1963–1982 using three different methodologies and finding similar growth rates. Another reason to suspect that this bias is small is that the growth rates of the ECI for construction workers and the PPI for residential maintenance and repair—two price indexes that measure input costs and are used as deflators—were only 0.5pp and 0.2pp higher, respectively, than the growth rate of the single-family price index from 1987 to 2019 (after adjusting the single-family price index downward for bias owing to unobserved structure quality). Since these indexes combined deflate 13 percent of total nominal construction expenditures, the bias to aggregate productivity growth would only be 0.05pp per year. We cannot conduct a similar analysis for the sectors of nonresidential construction that use the Handy Whitman or AUS telephone cost indexes because we do not have access to these price indexes, nor do we have any alternative measures of output prices to compare them to. If we assume that the bias for these sectors is similar to the bias that we calculated based on the ECI for construction workers and the PPI for residential maintenance and repair, then we would find an additional bias of 0.03pp per year.

3.5. *Implications for aggregate construction sector productivity*

The implication for productivity growth in the aggregate construction sector depends on what portion of the construction sector is affected by each type of bias discussed above. Based on the fraction of nominal output associated with each deflator, our calculation that omitted quality could bias up the single-family price index by 0.8pp per year at most, and our assumptions about the role of omitted quality in other construction sector deflators, we estimate that omitted quality could have biased downward total construction productivity growth by 0.5pp per year. The other sources of measurement error discussed above may have contributed an additional 0.1pp per year (see Table 7). Cumulatively these factors add up to less than ¾ percentage point per year, even though the calculations are based on fairly generous assumptions. We have based our calculations on generous assumptions in order to determine the largest possible role for measurement error in explaining low productivity growth. More modest assumptions would, of course, reduce the magnitude of our estimates and make the case for measurement error even weaker.

Adding the cumulative bias to reported productivity growth, we estimate that productivity was essentially flat in the construction sector from 1987 to 2019 (see Fig. 3). From one perspective, this could be considered a material difference from the published data because the level of bias-adjusted productivity in 2019 was 21 percent higher than the published level. From another perspective, the bias-adjusted

Table 7
Contributions to bias in aggregate construction sector productivity growth.

	Percentage Points Annual Rate
Unobserved structure quality	
Reduces SF and MF price indexes by 0.8pp per year	0.39
Reduces some other nonres price indexes by 0.4pp per year	0.11
SF and MF price indexes include land prices	0.00
Price indexes for some sectors based on input prices	0.08
Total	0.58
Published productivity growth	−0.45
Productivity growth adjusted for total bias	0.13

Source. Author calculations described in text.

estimate dos not change the qualitative result that productivity growth in this sector has been quite low. Fig. 3 illustrates that our bias-adjusted estimate of productivity growth in the construction sector remains much lower than in other industries.

4. Regional evidence on productivity growth

In this section, we first describe how we calculate new estimates of productivity growth in the new single-family construction sector from 1980 to 2019 for states and metropolitan areas. Next, we explore what local characteristics are associated with productivity growth, such as initial housing costs, the proximity of new construction to the downtown area, and physical barriers to construction.

4.1. *Productivity growth across states and metropolitan areas*

Because the Bureau of Labor Statistics does not publish estimates of construction productivity by geography, we calculate our own estimates. For the numerator of our productivity estimates, we calculate the total quantity of housing structure produced in a year as the number of single-family housing units permitted in that year multiplied by the average square footage of homes built in that year. We focus on the production of new single-family homes because we do not have data on real quantities for other types of structures. The permit data are from the Census Bureau's Residential Construction branch and the square footage data are from CoreLogic's tax assessor data.

For the denominator of our productivity estimates, we calculate labor input as the total number of employees in the construction industry because the available data on employment by industry do not allow for clear estimates of the number of people working specifically on new residential construction.[20] For the state-level data, estimates are similar when based on the number of workers in "construction of buildings" (NAICS 236) or the number of residential construction workers calculated from a set of 6-digit NAICS sectors related to residential construction.[21] Specifically, the correlations of our baseline measure of productivity growth with measures that use these two alternate employment definitions are 0.89 and 0.87, respectively. These employment measures are based on establishment-level data, which

[19] https://www.nahb.org/-/media/8F04D7F6EAA34DBF8867D7C3385D2977.ashx.

[20] Identifying all workers in new single-family construction is difficult because many construction firms employ specialty trade contractors. In the NAICS classification, specialty trade contractors can be separated into residential and nonresidential sectors. But the residential specialty trade contractors will include people working on remodeling as well as new construction. In the SIC classification, specialty trade contractors cannot be disaggregated into residential and nonresidential.

[21] Data on employment by industry and state are from the QCEW, which has annual data by NAICS starting in 1990. For each state, we extend the estimate of workers in "construction of buildings" back to 1980 using estimates from SIC category 1521 (single-family housing construction) and SIC category 1531 (operative builders). For the 10 years of overlap between the SIC and NAICS data, the correlation of state-level employment growth rates is 0.9.

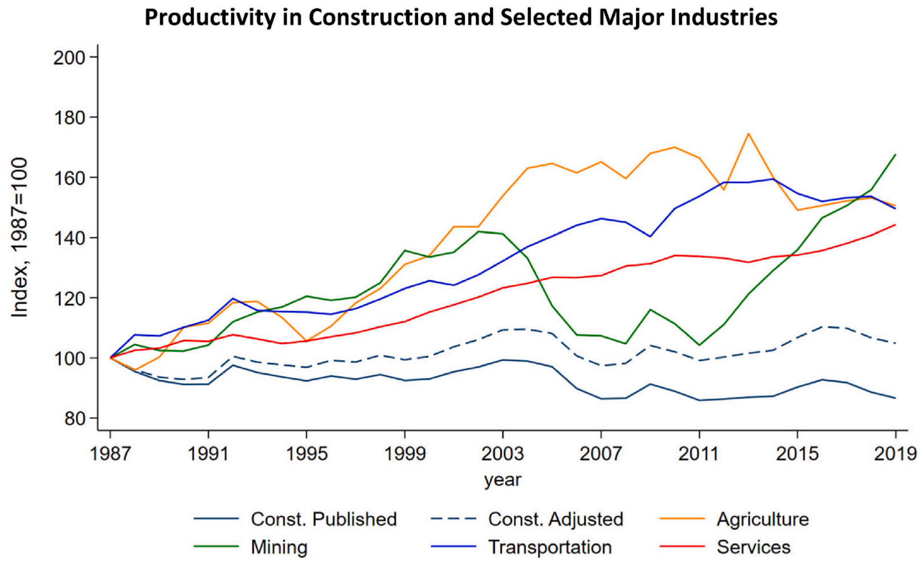

Fig. 3. Productivity in Construction and Selected Major Industries
Note. Source of the published productivity statistics is the Bureau of Labor Statistics, Office of Productivity and Technology. The adjusted construction estimates multiply the published estimates by a time trend that increases by 0.6 percent per year, our estimate of total bias shown in Table 7.

seems appropriate for state-level estimates.[22] However, for smaller areas like counties or metropolitan areas, it seems likely that a non-trivial amount of construction work could take place outside the location of the establishment. Therefore, for the metro-level employment estimates we use the number of construction workers in the Decennial Census and American Community Survey, which record the number of workers living in a given location. It seems more likely that construction workers work on projects in the metropolitan area where they reside.

The permit data and state-level employment data are annual so we are able to calculate annual productivity estimates by state. Our metro-level estimates cover 1980, 1990, 2000, 2010 and 2019. The sample period for both types of geographies start in 1980 because that is the first available year of the permit data.[23]

Just as with the national productivity growth estimates, our estimates of local productivity growth are likely biased downward because they do not account for improvements in the quality of homes beyond unit square footage. Therefore, we multiply our estimates by a trend that increases by 0.8 percent per year, the largest-possible magnitude of the bias for single-family homes found in section 3. Because this adjustment is the same for all locations, it does not affect the regression results reported below. Ideally, we would adjust the productivity estimates based on the magnitude of changes in non-size related housing characteristics for each location. But we do not have reliable data on changes in these other structure characteristics by state or metropolitan area. If changes in these other structure characteristics are not correlated with structure size but are correlated with location characteristics like housing supply regulation, the correlations that we report in this section could be biased. Appendix Table 6 shows that some measures like number of bedrooms and number of bathrooms are strongly correlated with size, while other characteristics like presence of central air conditioning or a porch are weakly correlated with size. We leave this issue as a possible limitation of our productivity growth estimates and hope that further research can develop more comprehensive measures of structure output at the local level.

Because productivity is cyclical and noisy, calculating the average growth rate from the first year of the sample to the last year of the sample could be an imperfect measure of the long-run trend in local productivity. Instead, we regress the natural logarithm of annual productivity in each location on a time trend. The coefficient on the time trend provides an estimate of the average productivity growth rate in the state that is more robust to the start and endpoints of the time series.

The average permit-weighted estimate of productivity growth in our state-level and metro-level samples are −0.6 and −0.7 percent per year, respectively. These estimates are somewhat lower than average growth of aggregate (bias-adjusted) productivity from 1987 to 2019, which we estimate to have been about 0.1 percent per year.[24] It is plausible that productivity growth in the single-family sector has been lower than other types of construction because the projects and firms tend to be smaller. Indeed, Sveikauskas et al. (2018) find that single-family productivity growth was lower than multifamily productivity growth from 1987 to 2016. Another possibility is our estimates of productivity growth may be biased down by more than the aggregate estimates because we do not account for improvements in the quality of homes beyond unit square footage, whereas the aggregate estimates account for changes in some other aspects of structure quality.

Fig. 4 show the estimates of productivity growth for each state. The estimates vary notably by state, with productivity growth around −3 percent per year at the low end and around 2 percent per year at the high end. About 70 percent of the states have an estimate of productivity growth near or below zero. In that sense, new single-family productivity growth appears to have been low throughout much of the United States.

The figure shows that the states with the lowest productivity growth are Connecticut, Rhode Island and Vermont, small states that tend to be relatively densely populated. Massachusetts, New York and California—states with relatively strict regulatory constraints on new construction—also have fairly low productivity growth. Meanwhile states with relatively high productivity growth include West Virginia, South Carolina and Montana.

[22] We exclude the District of Columbia because establishments located in DC likely work on projects in Virginia and Maryland.

[23] When we average the metropolitan area estimates by state (using housing unit weights for metropolitan areas in multiple states), the correlation with state-level productivity growth is 0.87. We find this strong correlation reassuring given that the metropolitan area estimates use a different source for construction employment and are based on decadal data rather than annual data.

[24] We find a similar estimate of aggregate productivity growth when we use the coefficient on a linear trend rather than calculating average annualized growth from 1987 to 2019.

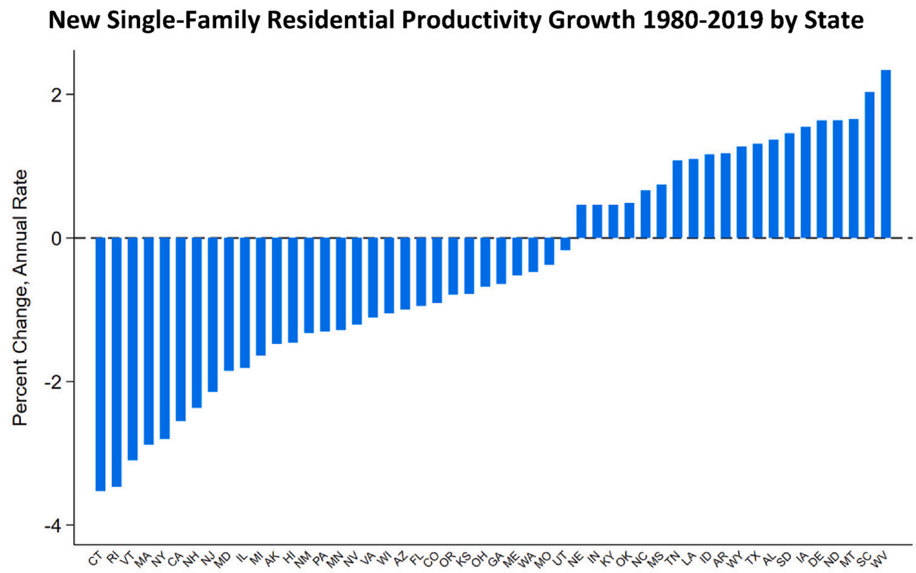

Fig. 4. New Single-Family Residential Productivity Growth 1980–2019 by State
Note. Productivity is defined as new single-family permits multiplied by average structure size of units built in that year divided by the total number of construction workers. The numerator is multiplied by a trend that increases by 0.8 percent per year to account for the maximum bias of single-family construction found in section 3. Growth is measured by regressing ln(productivity) on a linear time trend.

4.2. *Correlation of productivity growth with local characteristics*

To examine local attributes that are related to productivity growth, we turn to the metropolitan area estimates. Table 8 reports results from a regression of productivity growth on various local characteristics. We focus on characteristics that seem like they could plausibly be related to construction costs, and therefore productivity growth. All attributes are standardized to have a mean equal to zero and standard deviation equal to 1. In addition, some specifications include region fixed effects.

The first column of Table 8 shows results for about 300 metro areas, which is the full sample of metro areas for which we were able to estimate productivity growth. Productivity growth is negatively associated with median housing values in 1980, perhaps because more expensive areas tend to have higher housing supply constraints. Relatedly, productivity growth also tends to be weakly lower in areas where buildable area is constrained by a higher share of water to total land and water area.

We also examine whether the density of new construction is related to productivity growth in two different ways. First, we measure average density in 1980 as housing units per square kilometer. Second, we measure the fraction of single-family construction that took place in suburban or exurban locations, defined as the fraction of single-family units built 1980 to 2019 that are far from the city hall, where “far” is defined as more than the median distance between the city hall and all single-family homes built 1930 to 1979.[25] This fraction is positively related to productivity growth, indicating that productivity growth has been higher on average in areas where more construction has taken place outside the urban core. Meanwhile, average density in the metro area is unrelated to productivity growth, perhaps because density varies widely within metro areas. We also do not find a correlation between productivity growth and initial metro size, measured as the log of housing units in 1980. The standard error is small enough that we can reject that the coefficient on initial city size is less than −0.3 with a p-value of 0.06. We find a similar result when we measure city size using land area. Finally, productivity growth is positively associated with growth in the housing stock.[26] This relationship could reflect the fact that locations with higher productivity growth have been able to grow

Table 8
Correlation of metro-level productivity growth 1980–2019 with various local characteristics.

	(1)	(2)	(3)	(4)
Ln(housing units in 1980)	−0.109	−0.082	−0.049	–
	(0.119)	(0.122)	(0.123)	
Ln(housing units per square mile in 1980)	0.195	0.057	−0.068	–
	(0.136)	(0.159)	(0.164)	
Ln(housing units 2019/ housing units 1980)	0.434	0.295	0.278	0.311
	(0.107)	(0.125)	(0.143)	(0.123)
Fraction of suburban and exurban construction	0.195	0.179	0.268	0.243
	(0.103)	(0.104)	(0.110)	(0.107)
Fraction water area	−0.149	−0.150	−0.171	−0.200
	(0.112)	(0.116)	(0.116)	(0.113)
Ln(median house value 1980)	−0.544	−0.413	−0.107	–
	(0.121)	(0.162)	(0.187)	
Wharton regulation index	–	–	−0.337	−0.422
			(0.175)	(0.151)
Midwest region	–	0.402	0.155	0.026
		(0.364)	(0.396)	(0.361)
South region	–	0.716	0.786	0.706
		(0.350)	(0.370)	(0.346)
West region	–	0.093	−0.492	−0.614
		(0.431)	(0.446)	(0.359)
Adjusted R2	0.14	0.14	0.23	0.24
Observations	289	289	212	212

Note. The dependent variable is the coefficient from regressing ln(productivity) on a time trend, multiplied by 100. All independent variables except the region fixed effects are standardized to have a mean equal to zero and standard deviation equal to one. Fraction of suburban and exurban construction is defined as the fraction of single-family units built 1980 to 2019 that are far from the city hall, where “far” is defined as more than the median distance between the city hall and all single-family homes built 1930 to 1979.

[25] The location of city hall is mainly from Holian (2019). We add a few locations that are missing from that dataset by searching for the city hall location on the internet. We measure housing unit location by year built using tax assessor data from CoreLogic.

[26] This association is not mechanical for at least two reasons. Areas with stronger gains in housing units may also have faster construction employment growth, and so might not have stronger productivity growth on average. Also, depreciation including teardowns will lead to differences between the number of permits issued and changes in the net housing stock.

Table 9
Correlations of various measures of housing supply regulation with construction productivity growth.

	Metro-Level Regressions						State-Level Regressions					
Wharton (1988)	−0.25											
	(0.14)											
Wharton (2006)		−0.56					−1.18					
		(0.09)					(0.16)					
Wharton (2018)			−0.27					−0.49				
			(0.12)					(0.22)				
Saks regulation index (1970s and 1980s)				−0.48								
				(0.17)								
Bartik et al. 1st Principal Component (2024)					−0.35				−0.94			
					(0.11)				(0.18)			
Bartik et al. 2nd Principal Component (2024)						−0.17				−0.91		
						(0.10)				(0.18)		
AIP (1976)											−0.76	
											(0.20)	
Zoning court cases per capita (1980–2010)												−0.58
												(0.21)
R^2	0.02	0.12	0.02	0.10	0.03	0.01	0.54	0.08	0.35	0.33	0.22	0.12
Number observations	142	255	238	66	266	266	48	49	50	50	50	50

Note. Each column reports coefficient estimates from a bivariate regression of productivity growth on the measure of regulation named in the row. The 1988 Wharton survey is described in Linneman et al. (1990). The 2006 Wharton survey is described in Gyourko et al. (2008). The 2018 Wharton survey is described in Gyourko et al. (2021). The Saks regulation index combines 6 different sources of regulatory constraints from the 1970s and 1980s (Saks, 2008). The AIP measure is from a survey conducted by the American Institute of Planners (1976). Zoning court cases per capita are from Ganong and Shoag (2017). The Bartik et al. (2024) measures are the first and second principal components from regulations measured using large language models to machine learning algorithms and recent local statutes and administrative documents. Estimates are provided for individual municipalities and townships; we aggregate to metropolitan areas and state using the average number of housing units 2019–2023 as weights. They interpret the first principal component as reflecting the complexity of the regulatory environment and the second as reflecting exclusionary zoning.

more. It could also reflect the possibility that locations with more teardowns have a lower net increase in the housing stock, and the cost of teardowns could have risen faster than the cost of building on vacant land. Column 2 of the table shows these results are robust to controlling for Census region indicators.[27] Interestingly, even conditional on these attributes, productivity growth has been notably higher in the South.

The models reported in columns 3 and 4 include the Wharton Residential Land Use Regulation Index. We average the results from two waves of the survey that were conducted in 2006 and 2018 because each survey measures the true amount of regulation with noise. We find productivity growth is negatively associated with the Wharton regulation index, as shown in columns 3 and 4. Moreover, including this variable reduces the correlation between house value and productivity growth, suggesting that the correlation with house value mainly reflected regulatory constraints. These results complement the findings in D'Amico et al. (2024), who find a correlation between regulation, firm size, and the *level* of productivity. Similarly, Sveikauskas et al. (2016) find a small negative correlation between state-level changes in regulation and construction productivity growth. We suspect that we find a larger correlation with regulation with regulation than they do because annual changes in their measure of regulation are noisy.

Table 9 shows that a range of measures of regulation tend to be negatively correlated with productivity growth at the metro and state level. The correlations tend to be stronger at the state level than at the metro level, perhaps because regulation and productivity growth are both measured with more noise at the metro level. The 2006 wave of the Wharton survey, which is the one used by D'Amico et al. (2024), has the strongest correlation with productivity growth among the various regulatory measures.

To dig a little deeper into how regulation may reduce productivity growth, Table 10 shows the correlation of productivity growth at the metropolitan level with each of the components of the Wharton survey. The strongest and most robust correlation is with approval delays, which capture average review times for a range of types of residential projects including by-right projects (permitted under current rules), not-by right projects (requiring exemptions to current rules) and subdivision approvals. According to the version of the Wharton survey conducted in the late 1980s, permit approval times were low across the US (Linneman et al., 1990). Hence, it seems that increases in regulatory delays have reduced productivity growth. Supply restrictions—limits on the number of permits issued or on the size of multifamily buildings—also tend to be negatively correlated with productivity growth, perhaps because these limits prevent builders from taking advantage of economies of scale. Impact fees, which raise the cost of construction projects, also tend to be negatively correlated with productivity growth. Moreover, areas where a larger number of local entities (such as zoning boards, planning commissions, and environmental review boards) are needed to approve a by-right building project tend to have lower productivity growth. In addition to lengthening approval timelines, the need for a large number of approvals can reduce the likelihood that a project is approved, thereby reducing the amount of work that a construction firm can accomplish. Finally, locations where the state legislature is more involved in influencing residential building activity or growth management also tend to have lower productivity growth. This result may be surprising because states should have some incentive to encourage development in at least some parts of the state. However, it could be that state involvement further complicates the approval process or ends up requiring higher-cost designs.

Returning to Table 8, the final column shows that dropping the variables that are unrelated to productivity growth, the 7 remaining variables explain 24 percent of the heterogeneity in productivity growth across metro areas. While this percentage is not immaterial, much of the geographic variation remains unexplained.

5. Discussion and conclusions

In sum, our findings suggest that the mismeasurement of construction-sector deflators has likely biased down estimates of construction productivity growth by ¾ percentage points per year, at most. Though this bias is not negligible, it is modest enough that we do not

[27] Labor input is defined as the total number of annual hours worked of all people in the industry. Any possible mismeasurement of labor quality would result in mismeasurement of total factor productivity, not labor productivity.

Table 10
Correlations of various types of housing supply regulation with construction productivity growth.

	2006	2018	Average of 2006 and 2018
Local political pressure	−0.12	0.08	−0.13
	(0.10)	(0.11)	(0.14)
State political involvement	−0.53	−0.13	−0.55
	(0.10)	(0.12)	(0.14)
Court involvement	0.07	−0.06	0.04
	(0.10)	(0.12)	(0.17)
Local zoning approval	0.10	0.16	0.33
	(0.10)	(0.11)	(0.17)
Local project approval	−0.25	−0.10	−0.36
	(0.10)	(0.11)	(0.15)
Local assembly	−0.16	0.17	−0.06
	(0.09)	(0.11)	(0.14)
Supply restrictions	−0.41	−0.26	−0.40
	(0.11)	(0.09)	(0.12)
Density restriction	−0.05	−0.19	−0.20
	(0.10)	(0.11)	(0.14)
Open space	−0.26	−0.06	−0.29
	(0.10)	(0.11)	(0.14)
Impact fees	−0.19	−0.29	−0.33
	(0.10)	(0.10)	(0.14)
Approval delay	−0.57	−0.45	−0.68
	(0.10)	(0.10)	(0.12)
Affordable housing	–	−0.41	–
		(0.11)	

Note. Each row shows the results of a separate regression of metro-level productivity growth on the type of regulation named in the row. See Gyourko et al. (2021) for a full description of each type of regulation. The first column reports results using the 2006 Wharton survey (sample size is 255), the second column reports results using the 2018 Wharton survey (sample size ranges from 242 to 245) and the third column reports results averaging the results from the two surveys (sample size ranges from 221 to 224). The affordable housing component was not asked in the 2006 survey. All types of regulation are standardized to have a mean of zero and standard deviation of one.

overturn the conclusion that construction productivity growth has indeed been quite low—still near zero—and much lower than productivity growth in other sectors. All things considered, it seems unlikely that the mismeasurement of construction productivity growth itself has had an effect on housing policy or on the construction-sector labor market. Moreover, because the construction sector's share of nominal aggregate output averaged only 11 percent over our sample period, the implications of this bias for aggregate productivity growth are negligible.

Beyond the deflators, we doubt that mismeasurement of other components of construction productivity has led to material downward bias. Specifically, we do not have any particular reason to think that nominal output growth would be biased down by a large amount. And mismeasurement of labor input may have been biasing productivity growth *upward,* since one large source of measurement error in labor input is an undercount of undocumented workers.[27] This undercount may easily have become larger from the 1980s to the 2010s as the unauthorized immigrant population expanded.[28] With labor input having grown by a larger amount than measured, measured growth in labor input would be biased downward, leading to an upward bias in productivity growth. Goolsbee and Syverson (2023) also find little role for labor input in explaining low growth in construction-sector productivity.

Further evidence supporting low productivity growth can be found in statistics measuring the average length of time from start to completion of single-family homes.[29] This timeline increased from 6.2 months in the mid-1980s to 7.0 months in 2019, suggesting that any time-saving productivity improvements have been more than offset by delays elsewhere in the construction process.[30]

Low productivity growth in the construction sector is not unique to the United States. A study by McKinsey shows that construction productivity growth from 1995 to 2015 was less than 1 percent per year in 22 out of the 38 countries that they examined and it was negative in 12 of these countries (McKinsey Global Institute, 2017; Exhibit E2;). Countries with low productivity growth include developed countries like the US, France and Spain as well as less-developed countries like Malaysia and Columbia. The common international experience of low productivity growth bolsters the conclusion that low growth is not due to measurement error.

The fact that construction productivity growth has truly been low for at least the past three decades has many important implications. For one, the rising cost of housing has reduced housing affordability, which has likely influenced household formation decisions as well as other household spending decisions. And because housing cost increases have not been uniform across the country, differential changes in housing affordability may have caused workers to make different location choices (see e.g. Hsieh and Moretti, 2019; Ganong and Shoag, 2017). Stagnant construction productivity has also likely had material effects on wages, labor supply and labor demand in the construction industry.

Due to the extensive implications of low productivity growth in the construction sector, it is important for researchers to explore why productivity growth has been so low. The state-level and metro-level estimates of residential productivity growth that we create and present in this paper provide suggestive evidence in this direction. We show that productivity growth has been lower in areas with more land use regulation. D'Amico et al. (2024) show that regulation of construction projects reduces developers' investment in technology, average revenues and average revenues per employee. More generally, these regulations can increase the cost of construction by creating delays in the construction process, increasing overhead costs, and requiring higher-cost designs. Indeed, we find that permit approval times are the component of the regulation index that is most strongly correlated with productivity growth. Millar et al. (2016) find that time-to-plan for nonresidential construction projects has lengthened by more in metropolitan areas with more restrictive land use regulation. And Brooks and Liscow (2023) find that increases in interstate infrastructure costs have been associated with an increase in land use litigation.

Beyond regulation, our results show that productivity growth has been lower in areas with more construction in the urban core rather than suburban or exurban communities. Building in the urban core can be more costly because the density of existing structures is higher. It is difficult to take advantage of gains to scale on small parcels of land where only one or two homes can fit compared with large developments of hundreds of new homes. Moreover, construction in the urban core is more likely to be a teardown, which adds to the cost relative to building on vacant land. To illustrate that more construction today takes place in denser areas than in the past, we calculate the pre-existing population density where new homes were being built in the early 1990s and compare with the population density in areas where new homes were built in the late 2010s. Fig. 5 shows the distribution of population density for each cohort of homes. Indeed, new homes built between 2016 and 2019 were more likely constructed in tracts with a population density above 3000 persons per square mile, while new homes built between 1991 and 1994 were more likely to be built in tracts with less than 100 persons per square mile.

[28] The Pew Research Center estimates that the unauthorized immigrant population tripled from 1990 to 2017. https://www.pewresearch.org/fact-tank/2021/04/13/key-facts-about-the-changing-u-s-unauthorized-immigrant-population/.

[29] https://www.census.gov/construction/nrc/data/time.html.

[30] Using the Census Survey of Construction microdata files, we still find a lengthening of construction timelines from 1999 to 2019 after controlling for structure size and location.

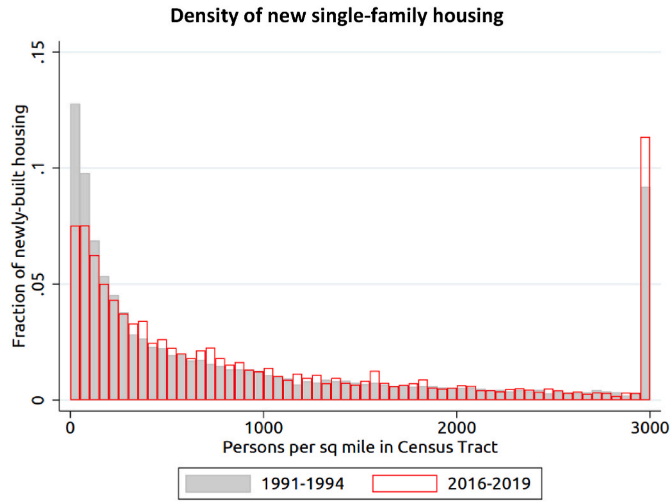

Fig. 5. Density of new single-family housing.
Source. IPUMS NHGIS time series tables (Manson et al., 2022), CoreLogic RRE, and authors' calculations. Sample of newly built housing restricted to single-family detached. Population density is measured in 1990 for 1991–1994 new housing and in 2010 for 2016–2019 new housing. Census tracts with more than 3000 persons per square mile are topcoded to 3000.

Finally, it is worth highlighting one of the null results of our analysis: productivity growth has not been lower in larger metropolitan areas than smaller metropolitan areas. This result is important because it suggests that city size itself does not become a drag on future productivity growth as cities grow. In other words, there is no evidence that productivity growth is low in larger cities because they have become fully built-out.

While the cross-sectional analysis in our paper is informative, about ¾ of the heterogeneity in productivity growth across locations remains unexplained by the geographic characteristics that we examine. Other factors are clearly important for explaining the variation in productivity growth across space, and these factors also might shed light on why aggregate productivity growth has been so low. For example, it would be valuable for future research to directly examine the construction costs of building teardowns one at a time relative to building multiple homes in larger subdivisions. Relatedly, future research should also examine the potential drag on productivity growth from the rising share of home improvements in total construction spending, as it seems plausible that renovation is more costly than new construction.

Another important area for future research is the potential role that modular or manufactured homes could play in boosting construction productivity. These types of homes allow for much more output per worker because they take advantage of factory-production methods and returns to scale. Even though the technology to produce this type of housing has existed for many decades, it is still not common, perhaps owing to building codes and other regulations (Schmitz, 2020). More

Appendix Table 1
Construction Subsector Output Shares

	Share of Nominal Construction Output 1987–2019
Residential	
New single-family	31.4
Improvements	19.7
New multifamily	4.8
Nonresidential	
Power	6.9
Office	6.7
Industrial	6.5
Health care	4.1
Lodging	2.6
Shopping malls	2.6
Telephone	2.5
Warehouse	1.8
Education	1.8
Amusement	1.6
Food establishments	1.2
Land transportation	1.0
Other	4.9

Source. Authors' calculations based on nominal output data from the Bureau of Economic Analysis.

Appendix Table 2
Property Tax Assessor's Designation of Structure Quality

Quality	Percent of Observations
Poor	0.01
Below Average	0.58
Low	0.22
Economical	0.03
Average	17.44
Fair	0.73
Good	11.69
Above Average	5.26
Excellent	2.19
Luxury	0.35
Missing	61.51

Source. CoreLogic Residential Real Estate database. Sample includes newly-built single-family detached homes from 2000 to 2019.

Appendix Table 3
Distribution of Resident's Rating of Home Quality

	Homes built 1970–1989	Homes built 2000–2019
Rating = 1 to 6	6.6	3.5
Rating = 7	7.6	6.9
Rating = 8	21.2	22.0
Rating = 9	16.7	18.7
Rating = 10	48.0	49.0

Source. American Housing Survey National Samples 1985, 1987, 1989, 2015, 2017, 2019. Sample restricted to single-family detached homes built 1970–1989 and appearing in the 1985-89 samples, or built 2000-19 and appearing in the 2015-19 samples.

Appendix Table 4
Housing Quality Descriptions from RS Means

	Average Quality 1987	Average Quality 2019
Foundations	• Concrete footing 8″ deep x 18″ wide • 8″ cast in place concrete 4′ deep • 4″ concrete slab on 4″ crushed stone base	• Concrete footing 8″ deep x 18″ wide • 8″ reinforced concrete foundation wall 4′ deep, dampproofed and insulated • 4″ concrete slab on 4″ crushed stone base and polyethylene vapor barrier
Framing	• 2x4 studs 16″ O.C. • ½" plywood sheathing • 2x6 rafters 16″ O.C • 2x6 ceiling joints 16″ O.C • ½" wafer board subfloor on 1x2 wood sleepers 16″ O.C.	• 2x4 studs 16″ O.C. • ½" plywood sheathing • 2x6 rafters 16″ O.C • 2x6 ceiling joists • ½" plywood subfloor on 1x2 wood sleepers 16″ O.C.
Exterior walls	• Beveled wood siding, #15 felt building paper • Brick veneer on wood frame with 4″ average quality brick • Stucco on wood frame with 1″ stucco finish • Solid masonry 6″ concrete block load bearing wall with insulation and brick/ stone exterior	• Beveled wood siding, #15 felt building paper • Brick veneer on wood frame with 4″ average quality brick • Stucco on wood frame with 1″ stucco finish • Solid masonry 6″ concrete block load bearing wall with insulation and brick/ stone exterior
Roofing	• 240# asphalt shingles • #15 felt building paper • Aluminum gutters, downspouts, and flashings	• 25-year asphalt shingles • #15 felt building paper • Aluminum gutters, downspouts, drip edge and flashings
Windows	Wood double hung	Double hung
Exterior doors	3 flush solid core wood exterior doors, storms and screens	3 flush solid core wood exterior doors with storms
Interior walls	½" taped and finished drywall Primed and 1 coat paint	½" taped and finished drywall Primed and 2 coats paint
Flooring	• 40 % finished hardwood • 40 % carpet with underlayment • 15 % vinyl tile with underlayment • 5 % ceramic tile with underlayment	• 40 % finished hardwood • 40 % carpet with ½" underlayment • 15 % vinyl tile with ½" underlayment • 5 % ceramic tile with ½" underlayment
Interior doors	23 hollow core doors	Hollow core and louvered
Heating	Gas or oil-fired warm air furnace	Gas fired warm air heat
Electrical	• 200 AMP service • Romex wiring • Incandescent lighting fixtures, switches receptacles	• 100 AMP service • Romex wiring • Incandescent lighting fixtures, switches, receptacles
Kitchen cabinets	14 LF wall and base with plastic laminate countertop and sink	14 LF wall and base with plastic laminate countertop and sink
Water heater	30-gallon gas fired	40-gallon electric

Source. R.S. Means Company "Square Foot Costs", volumes 1987 and 2019.

Appendix Table 5
Correlation of Housing Unit Characteristics with Ln(House Value)

	AHS		CoreLogic	
	1985–89	2015–19	2001–05	2015–19
Characteristics included in Census regression:				
Unit size	0.45	0.52	0.59	0.41
Number bedrooms	0.36	0.35	0.33	0.23
Number bathrooms	0.46	0.48	0.51	0.37
Fireplace	0.40	0.27	0.13	0.08
Garage	0.29	0.21	0.03	−0.03
Porch	0.18	0.06	–	–
Basement	0.11	0.14	0.01	0.08
Central air conditioning	0.17	0.05	−0.06	−0.20
Characteristics not included in Census regression:				
Resident rating of unit quality	0.20	0.13	–	–
Tax assessor rating of unit quality	–	–	0.42	0.31

Note. Each row shows the bivariate correlation between home values and the variable named in the row. The 1985-89 AHS sample includes homes built from 1970 to 1989 and the 2005-19 AHS sample includes homes built from 2000 to 2019. In the AHS data unit size has nine discrete values and resident rating has 5 discrete values. The tax assessor rating equals 1 for ratings of "good", "above average", "excellent" or luxury." In the CoreLogic data the correlations reported are with ln(square footage) and the tax assessor rating equals 1 for ratings of "good", "above average", "excellent" or "luxury."

Appendix Table 6
Correlation of Housing Unit Characteristics with Unit Square Footage

	AHS		CoreLogic	
	1985–89	2015–19	2001–05	2015–19
Number bedrooms	0.46	0.59	0.58	0.59
Number bathrooms	0.46	0.67	0.68	0.70
Fireplace	0.36	0.36	0.23	0.08
Garage	0.24	0.25	0.07	0.06
Porch	0.16	0.08	–	–
Basement	0.36	0.28	0.01	0.01
Central air conditioning	0.18	0.18	0.12	0.05
Resident rating of unit quality	0.20	0.16	–	–
Tax assessor rating of unit quality	–	–	0.39	0.26

Note. Each row shows the bivariate correlation between square footage and the variable named in the row. The 1985-89 AHS sample includes homes built from 1970 to 1989 and the 2015-19 AHS sample includes homes built from 2000 to 2019. In the AHS data unit square footage has 9 discrete values and resident rating has 5 discrete values. In the CoreLogic data the correlations reported are with ln(square footage) and the tax assessor rating equals 1 for ratings of "good", "above average", "excellent" or "luxury."

generally, construction is still a very labor-intensive industry with low investment in intellectual property. Productivity growth in the education services industry—another sector that has a very low capital-to-labor ratio—has also been very low over the past 3½ decades. Future work should explore these and other possible explanations for why productivity growth in the construction sector has been so low.

CRediT authorship contribution statement

Daniel Garcia: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Raven Molloy:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

Data availability

Data will be made available on request.

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SIZE MATTERS: WHY CONSTRUCTION PRODUCTIVITY IS SO WEAK

2025

Size matters: Why construction productivity is so weak (2025)

ISBN: 0 85801 365 7

CEDA's objective in publishing this report is to encourage constructive debate and discussion on matters of national economic importance. Persons who rely upon the material published do so at their own risk.

ABOUT THIS PUBLICATION

Size matters: Why construction productivity is so weak explores the factors driving the three-decade long decline in the productivity of Australia's construction sector and focuses on the lack of scale in construction as a key barrier to this multifaceted problem. By proposing measures to lift stagnant national productivity growth – in particular in construction – and address Australia's housing crisis, this report contributes to two focus areas of CEDA's Progress 2050 vision for a better future for the next generation of Australians: productivity, investment & innovation and wellbeing, security & participation.

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HILDA Data Use: This paper uses unit record data from Household, Income and Labour Dynamics in Australia Survey [HILDA] conducted by the Australian Government Department of Social Services (DSS). The findings and views reported in this paper, however, are those of the authors and should not be attributed to the Australian Government, DSS, or any of DSS' contractors or partners. DOI: 10.26193/J4NSZO

Size matters:

WHY CONSTRUCTION PRODUCTIVITY IS SO WEAK

DWELLINGS BUILT PER CONSTRUCTION WORKER **DECLINED BY ROUGHLY 50%** SINCE THE 1970s

IN SYDNEY, APPLICATIONS TO BUILD AN APARTMENT BLOCK HAVE BALLOONED IN SIZE

1967
12 PAGES LONG

2025
HUNDREDS OF PAGES LONG

THEY NOW REQUIRE STRUCTURAL, ENVIRONMENTAL, TRAFFIC AND OFTEN HERITAGE ASSESSMENT, MAKING THEM HUNDREDS OF PAGES LONG

CONSTRUCTION FIRMS WITH 200+ EMPLOYEES **GENERATE 85% MORE REVENUE PER EMPLOYEE** THAN CONSTRUCTION FIRMS WITH 5-19 EMPLOYEES

If construction firms matched the size distribution of manufacturing firms

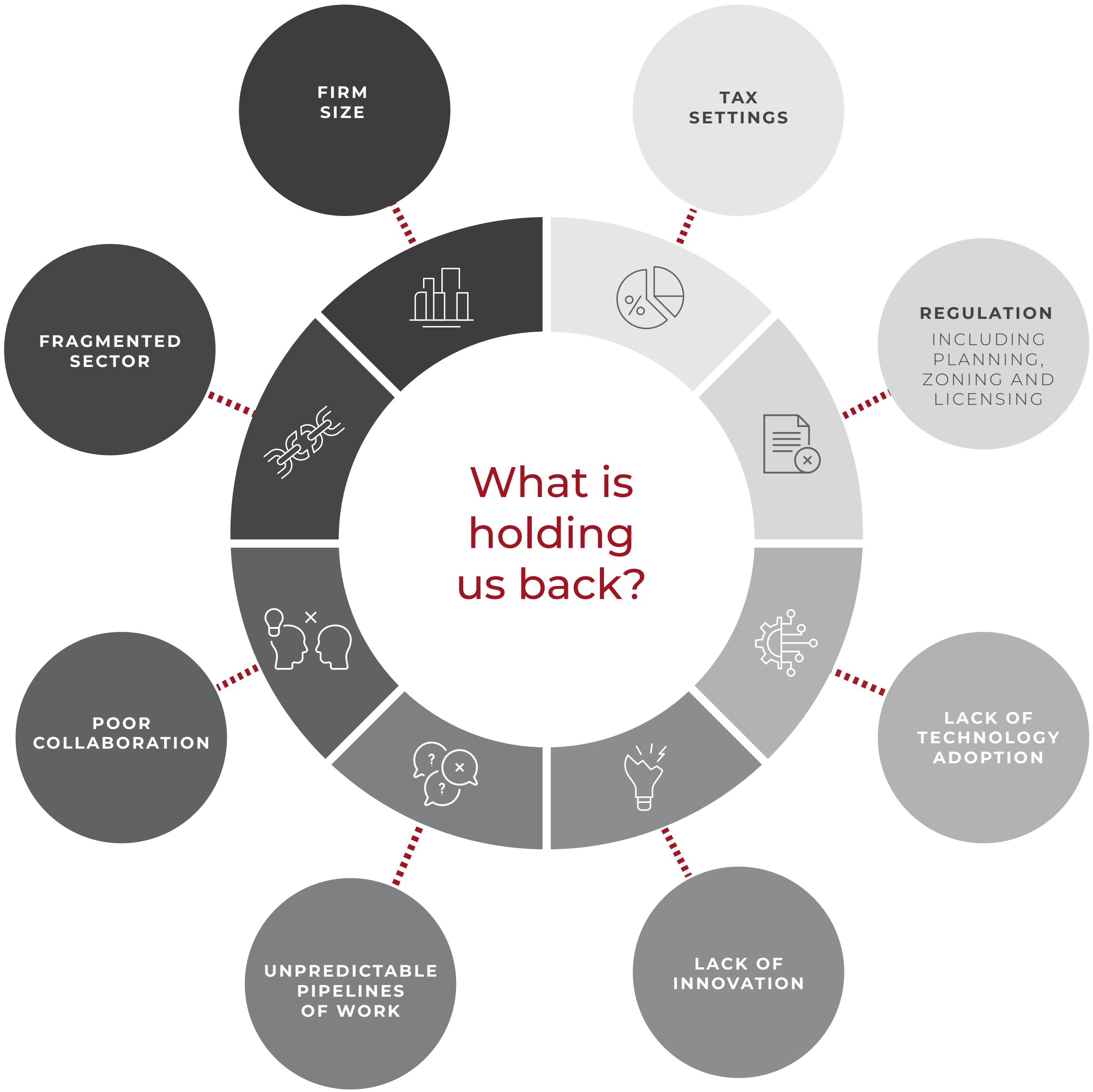
the construction industry would produce

12 per cent or $54 billion more revenue

without any additional labour

equivalent to gaining an extra 150,000 construction workers

Factors contributing to weak construction productivity



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CONTENTS

INTRODUCTION: CONSTRUCTION IS CRITICAL TO ALL AUSTRALIANS BUT IS FAILING TO DELIVER

The construction sector is one of our largest industries and is vital to the functioning of our economy. It plays a critical role in meeting Australians' housing needs, delivering the nation's infrastructure pipeline and making the energy transition. These goals are important not only for Australians today, but also for generations to come. Our economic prosperity relies on our ability to get things built, but we are losing this ability. Without improvement in this sector we will not be able to deliver on a strong economy and a strong social compact.

Put simply, productivity means producing more of something (an output) with the same or fewer resources (inputs). It is about working smarter, not harder.

By all measures, construction has been underperforming in the productivity stakes. Construction's size and interconnectedness mean it has a significant impact on the national economy and is a key driver of Australia's broader productivity weakness.[1]

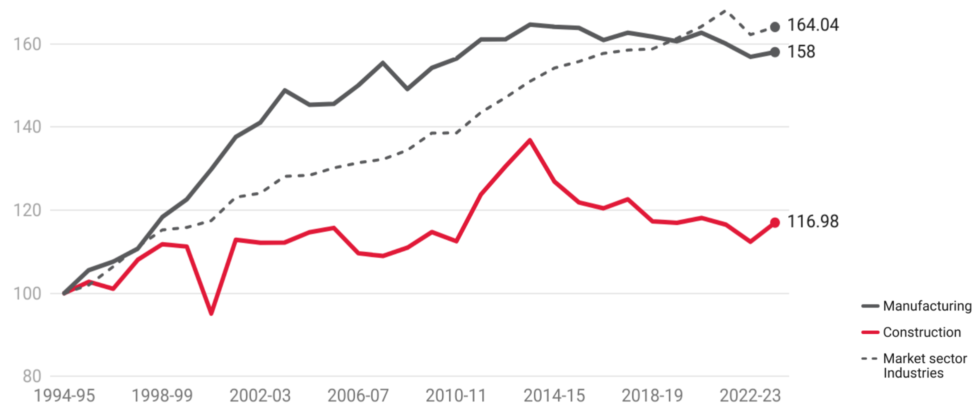
Labour productivity in construction (measured as output per hour worked) grew by just 17 per cent over the 29 years from 1994/95 to 2023/24 (Figure 1). In contrast, labour productivity grew by 64 per cent in the 'market-sector' industries, and 58 per cent in manufacturing over the same period.

Multifactor productivity in construction has been broadly unchanged from 1994/95 to 2023/24 (Figure 2). It grew by almost 20 per cent in market-sector industries and 23 per cent in manufacturing over the same period.[2]

Construction productivity underperforms

Figure 1 - Labour productivity

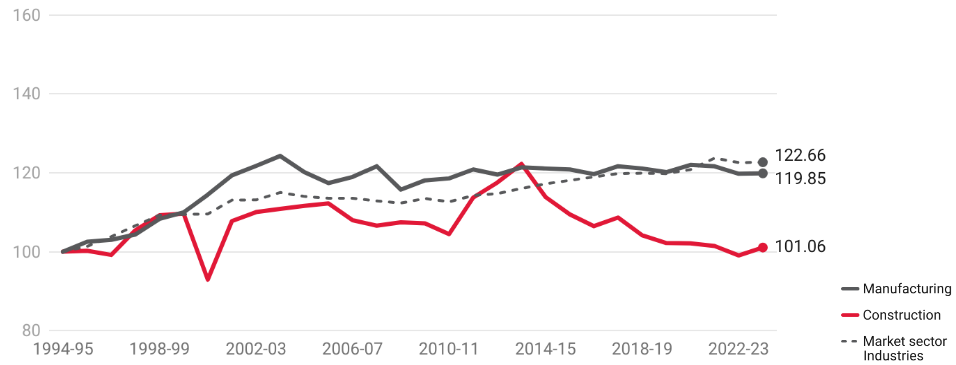
ABS estimates of labour productivity hours worked basis; 1994 =100.



Source: Australian Bureau of Statistics, 5260.0.55.002 Estimates of Industry Multifactor Productivity, Australia, table 6.

Figure 2 - Multifactor productivity

ABS estimates of multifactor productivity hours worked basis; 1994 =100.



Source: Australian Bureau of Statistics, 5260.0.55.002 Estimates of Industry Multifactor Productivity, Australia, table 1.

Productivity has been particularly weak in the building of houses and apartments. Our analysis shows that dwellings built per construction worker have declined by roughly 50 per cent since the 1970s (Figure 3).

These measures do not account for changes in the size and quality of buildings, which have both improved over time. The Productivity Commission has found that, even when adjusting for size and quality improvements, construction labour productivity per hour worked has declined by around 12 per cent since 1994, and still significantly underperformed the wider economy, which experienced labour productivity growth of around 49 per cent over the same period.

Construction's productivity performance has been one of the weakest of all sectors in the economy – it is one of only three market-sector industries to have *subtracted* from overall multifactor productivity growth in recent decades.[3] Boosting productivity in construction will be vital to solving Australia's housing crisis, rejuvenating weak business investment and supporting a strong economy.

We are not alone in this challenge - many other advanced economies have also experienced weak construction productivity over the past 30 years, including the United Kingdom, the United States and Canada.[4]

The construction productivity problem is complicated and there is no single driver of poor performance. Analysis by CEDA and others, as well as discussions with key stakeholders, suggest it has not been driven by some commonly cited culprits, including: a lack of new technologies;[5] measurement issues; quality improvements; growth in the white-collar workforce;[6] or industrial relations and conditions in enterprise-bargaining agreements.[7]

Instead, a range of other factors have contributed, including: complex, slow approvals; lack of innovation; lack of scale; workforce issues; and policy settings.[8] Inefficiency (rather than a lack of technical progress) also appears to be part of the problem.[9, 10]

Figure 3 - We are building half as many homes per worker as in the 1970s

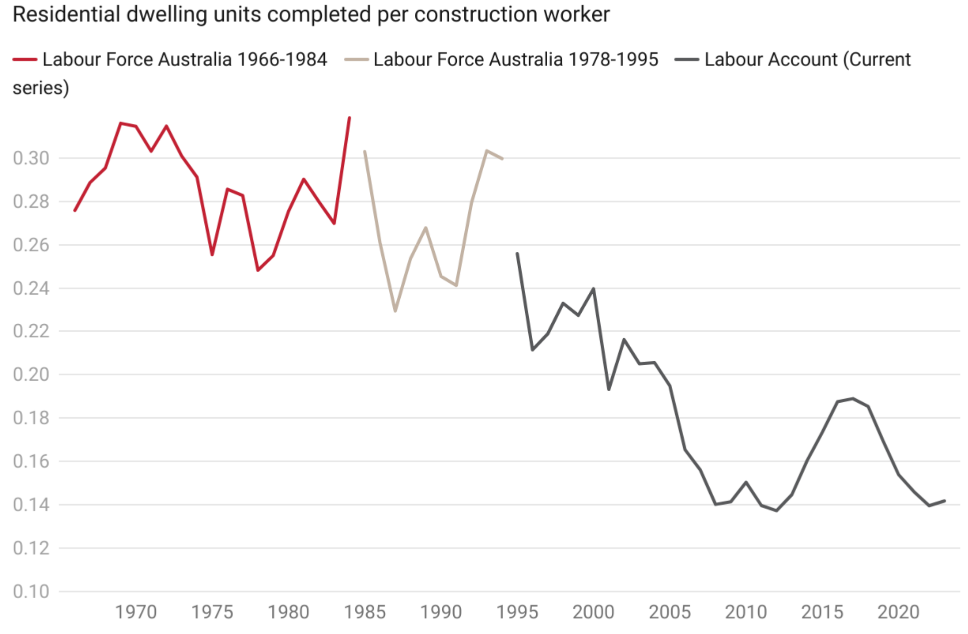


Chart: CEDA analysis of ABS data | Source: Labour Force Australia 1966-1984, Labour Force Australia 1978-1995, Labour Force Account (Current series)

Our analysis shows a key driver of this multifaceted challenge is that Australia's building industry is dominated by very small firms due to its structure, complex regulations and broader tax settings.

This report focuses on the lack of scale in the sector, an area that hasn't previously received much attention. The construction sector is currently suffering from labour shortages, which is holding back progress on critical infrastructure and housing. It is imperative that we address productivity in the sector to allow us to deliver the infrastructure Australia needs.

CONSTRUCTION IS NOW DOMINATED BY SMALL FIRMS

Construction is one of the least concentrated industries in Australia, made up mainly of small firms and individual subcontractors. Aside from the few very large or highly specialised firms, the number of firms in the industry is far greater than what is needed to deliver effective competition. Our analysis shows this is contributing to the productivity problem.

There are currently 410,602 construction firms in Australia, of which 98.5 per cent are small businesses with fewer than 20 employees.[11] Ninety-one per cent of construction firms are microbusinesses with fewer than five employees,[12] up significantly from 43 per cent in 1988/89.[13] Construction has a much higher share of microbusinesses than comparable industries (Figure 4).

In Australia, firms with fewer than 20 employees account for 53 per cent of total construction sector revenue. Many of these small firms are "construction services" providers, which includes a diverse network of tradespeople and subcontractors. Their large share of construction revenue and employment, and high degree of interconnectedness with the rest of the sector, means that small construction firms are critical to the sector's overall productivity.

Figure 4 - Most construction firms are microbusinesses

Percentage of employing firms by number of employees

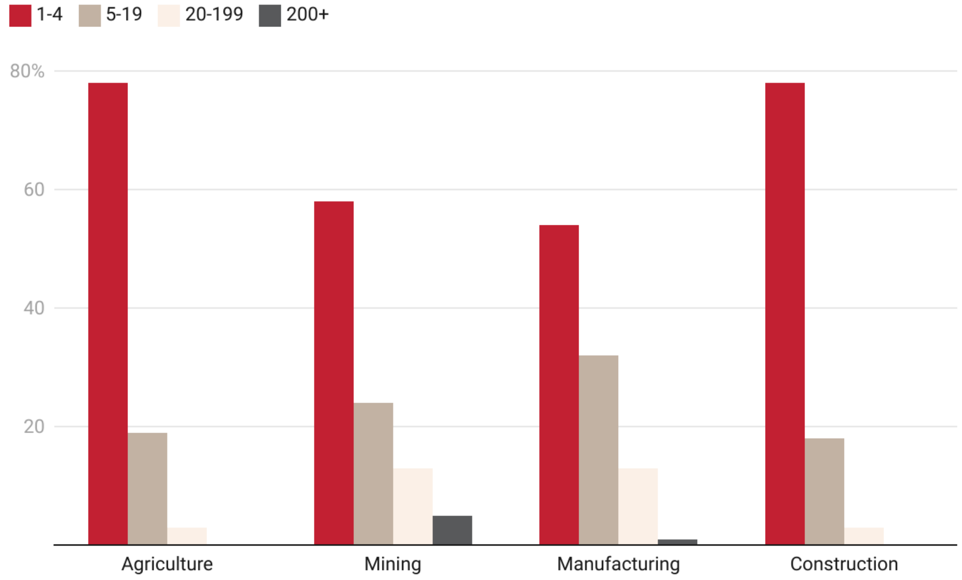


Chart: CEDA analysis of ABS data | Source: 8165.0 Counts of Australian Businesses, including Entries and Exits, June 2020 to June 2024

SMALLER CONSTRUCTION FIRMS ARE LESS PRODUCTIVE

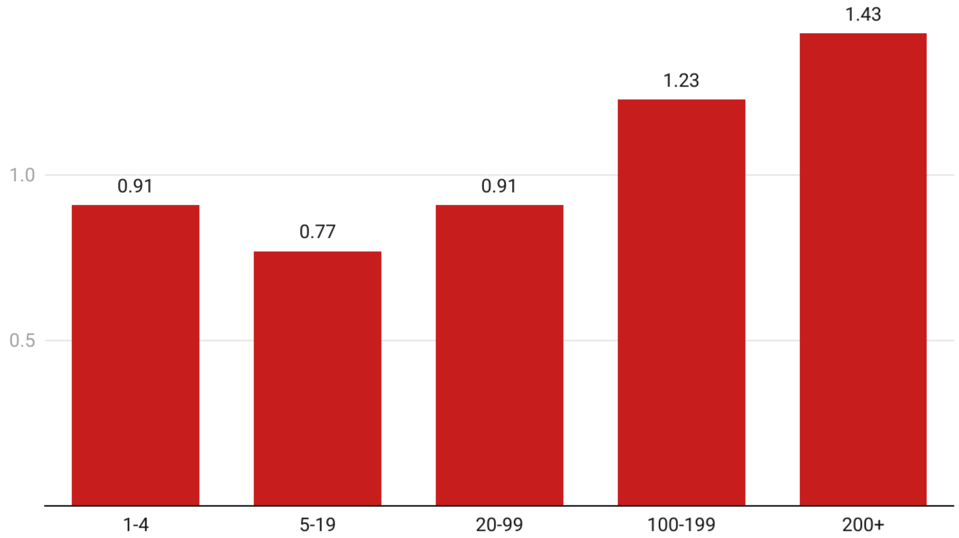
We analysed previously unreleased ABS data that looked at revenue per employee in construction firms ranging in size from zero to 200+ employees. While we are unable to measure firm-level productivity, revenue per employee acts as a reasonable proxy for labour productivity.[14] Our analysis shows larger Australian construction firms produce more per employee than smaller ones.

We found that Australian construction firms with 200 or more employees generate 86 per cent more revenue per worker than Australian construction firms with 5 to 19 employees (Figure 5).

If firms in the Australian construction industry matched the size distribution of firms in the manufacturing industry, the construction industry would produce 12 per cent, or $54 billion, more revenue per year without requiring any additional labour. This is equivalent to gaining an extra 150,000 construction workers. In a sector currently suffering from labour shortages that are holding back progress, this sort of increase would make substantial inroads in the ability to deliver on critical infrastructure and housing works.

Figure 5 - Construction workers generate more revenue in larger firms

Average revenue per employee, by number of employees



Sample of construction industry businesses, linked PAYG and business activity data

Chart: CEDA analysis of ABS data | Source: ABS data commissioned by CEDA

Smaller firms are less able to achieve economies of scale and scope. Consultation with CEDA members and other industry experts has confirmed that the construction industry tends to be fragmented, insular and lacking incentives to adopt new ways of doing things.

While there are some large, highly innovative firms in the sector, overall it is dominated by small businesses with more traditional ways of working. They have less capacity to innovate, to invest in equipment and technology, and to devote to training and capability building, which are all important drivers of productivity growth.

The link between firm size and productivity likely works in both directions – naturally more productive construction firms do more building, while firms that anticipate taking on more projects also invest more in technology.[15] Differences in business models between large and small construction firms may account for part of this difference – for example, larger firms often function as project managers, outsourcing much of the physical work to subcontractors, and larger firms tend to dominate high density and civil engineering projects.

Our results align with overseas experience - researchers have found a strong connection between firm size and productivity in US residential construction, where firms with 500 or more employees produce six times as many units per employee than firms with fewer than 20 employees, and firms with 100 to 499 employees are twice as productive. They estimate that US residential construction could be as much as 91 per cent more productive if its size distribution matched US manufacturing.

CEDA workshop participants identified poor management capabilities as the most important factor holding back technology and digital adoption in construction.

ABS data backs this up, showing that small construction firms have weaker management capabilities than equivalent-sized firms in other industries. In 2021/22 less than 7 per cent of construction firms had a written strategic plan, 8 per cent used key performance indicators, 21 per cent had reviewed their business model and just 12 per cent actively sought digital technologies to improve business processes. These scores were all 10 percentage points lower than the aggregate Australian business sector, and 2 to 5 percentage points lower than for all businesses with 0-4 people.

WHY ARE THERE SO MANY SMALL CONSTRUCTION FIRMS?

Construction firms have stayed small because the structure of the industry and regulations encourage them to remain so.

Construction is highly segmented and demand is highly cyclical. Downturns in demand can disadvantage businesses that invest in productivity-enhancing assets like machinery, equipment and new technologies. They are therefore more likely to maintain cost flexibility by relying on labour instead of capital inputs, and to favour subcontracting as a more flexible source of labour than direct employment.

While subcontracting may be the right approach for a given business or project, at an economy-wide level it means more work is done by smaller, less productive firms. And as subcontracting fragments the industry, this has likely increased the time and effort spent on procurement, contract negotiations, supervision and regulation, and dispute resolution. Our consultation has identified reworks and disputes as a major source of inefficiency in the sector.

Our analysis of ABS data found that in Australia, more residential construction output also comes from bigger firms in areas with faster dwelling growth – showing the strong demand pipeline allowing firms to invest and grow (Figure 6).

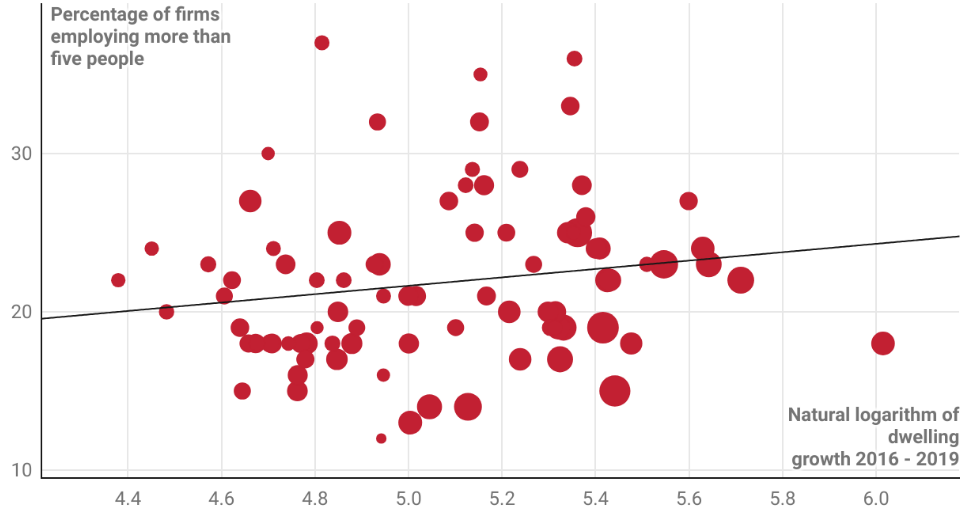
Certainty and repeatability can increase productivity. Innovation typically comes with up-front financial and learning-by-doing costs, which can make new approaches unviable on an individual project basis, where customers and upstream suppliers are more likely to focus on cost and time savings rather than experimenting with new methods or technologies.

The success of Victoria's Level Crossing Removal Program is a case in point. This infrastructure program in Melbourne elevated rail lines above roads. The goal in 2018 was to remove 85 crossings by 2025 with a budget of $16.3 billion (average cost $191.8 million per crossing).[16] The goal was achieved earlier than anticipated and following efficiency improvements

Figure 6 - Areas with greater housing supply have bigger firms

Residential completions, census data industry employment

Dwelling completions between 2016 and 2019 at SA4. Percentage of construction firms within SA4 employing five or more people. Slope .0265, R Squared .029



Point size based on SA4 population

Chart: CEDA analysis of ABS data | Source: Small Area Dwelling Completions, Counts of Australian Businesses, including Entries and Exits

was expanded to remove 110 crossing by 2030 with a budget of $19.8 billion (average cost $180 million per crossing).[17]

The demand certainty created by this program enabled the firms delivering the infrastructure to invest in new building methods and process innovations.[18] In addition, industry stakeholders say a key factor in the program's success was the tight integration between client and contractors, where the procurement and contracting framework forced innovation to occur.

TAX SETTINGS AND REGULATIONS KEEP FIRMS SMALL

The construction sector is governed by a complex set of regulations across all three levels of government. While regulations are important to ensure minimum safety and quality standards, excessive regulation hinders productivity, including by limiting firm size.

Tax incentives encourage construction firms to remain small

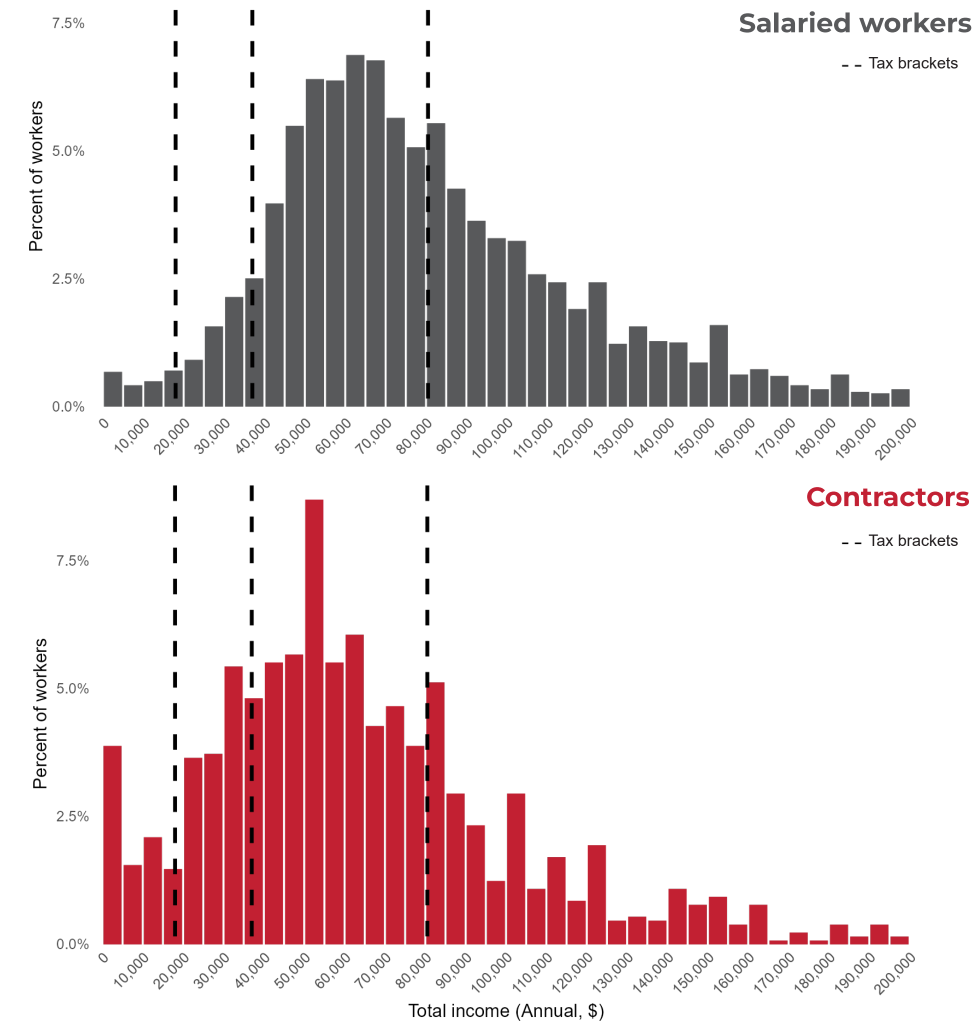
Being self-employed can result in paying less tax than a salaried employee earning the same pre-tax income. Self-employed businesses typically operate as a private company or sole trader.

Our analysis of HILDA income data for people working at least 30 hours per week shows around 8.5 per cent of independent contractors in the construction sector disclose income under the tax-free threshold of $18,200, and therefore pay no tax, compared with just 2 per cent of salaried construction workers (Figure 7). 2.2 per cent of the contractors disclose no income at all, compared with 0.44 per cent of salaried workers.

Self-employed businesses operating as sole traders are taxed at the same marginal tax rates as employees. However, independent contractors must declare and assess their own tax obligations. Self-employed people are more responsive to changes in tax rates and are more likely to report their income just under thresholds where marginal tax rates increase, often called "bunching".[19]

These results are not unexpected given the structure of our taxation system. Employees or salaried workers typically make ongoing personal income tax contributions deducted from each salary payment with rising thresholds based on income. In contrast, private companies are taxed at a flat rate of 25 per cent for small and medium businesses (with revenue of less than $50 million) and 30 per cent for larger businesses.

Figure 7 - Contractors are more likely to report very low incomes



Source: CEDA analysis of HILDA Release 22.0 - Construction workers who work 30 or more hours per week.

A high-income construction worker earning $148,000 per year would pay 26 per cent tax as a salaried worker. As a contractor, they could structure their income with a discretionary trust and a 'bucket' company and pay just 18 per cent tax – a difference of $12,400 in annual-take home pay after tax.[20] Additionally, in trust structures, a high-income individual can distribute income across household members, who may pay even lower tax rates. Or, in rare cases, contractors can simply misrepresent their income and avoid tax altogether.

Other tax settings also favour smaller construction firms. For example, the instant asset write-off currently allows businesses with turnover of less than $10 million to claim an immediate tax deduction on vehicles and other business assets.[21] There are therefore significant incentives for construction workers to be self-employed under a private company arrangement to minimise their tax bill.

It's not just individual tax settings that are discouraging scale. Taxes charged at different rates based on firm size can also discourage productive firms from growing, particularly payroll tax. For example, in South Australia, where the tax-free threshold for payroll tax was raised from $600,000 to $1.5 million in 2019, firms that would otherwise generate revenue in excess of $1.5 million adjusted their behaviour to remain just under the tax-free threshold.[22] At the national level, around 60,000 companies in construction pay the lower federal company tax rate of 25 per cent rate for small and medium businesses rather than the large business rate of 30 per cent, which is the second most by industry.[23]

Australia's land-use regulation is complex and decentralised

Australia has a complex combination of local, state and federal rules around land-use that often differ across local geographic areas. Australia has the most decentralised system of land-use planning in the OECD.[24]

Over time, the work required to lodge development applications and comply with planning and construction rules has increased significantly. For example, the development application to build a three-storey block of apartments in Sydney in 1967 was 12 pages long.[25] Today an equivalent building would require extensive structural, environmental, traffic and often heritage assessment, meaning applications are many hundreds if not thousands of pages long.[26]

This can prevent new firms from entering the local market and prevent productive firms from growing.[27] Where there is more regulation or it adds greater uncertainty to large housing projects, firms are more likely to prefer smaller projects that are better suited to smaller, less productive firms.[28] This exacerbates geographic segmentation, makes it harder for firms to grow and reduces the incentive to invest in technology.

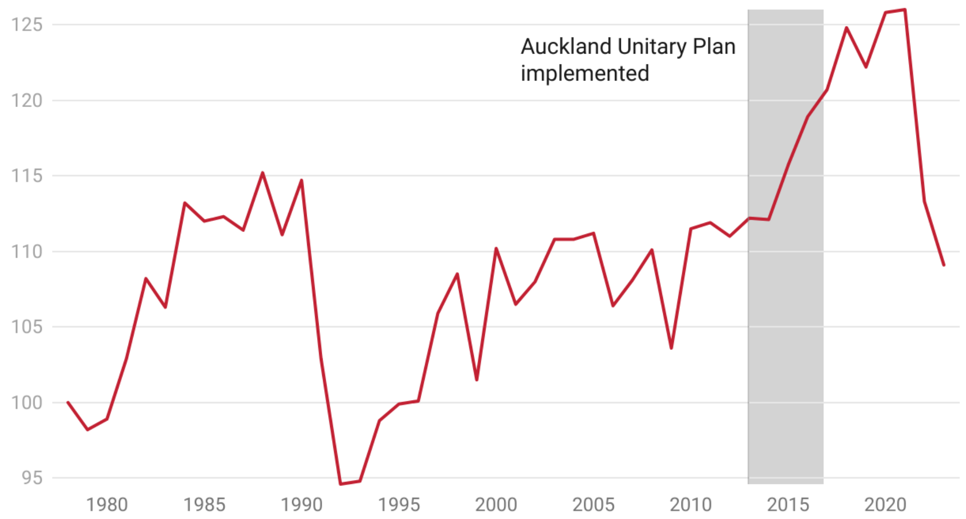
In the US, researchers found the decline in homes built per construction worker after 1970 occurred just as land-use regulations tightened.[29] They found that more regulated US cities had higher construction costs and smaller, less productive residential builders.[30]

This area is ripe for reform. Our consultations revealed broad agreement that land-use regulation is a barrier to firm size in Australia.

Experience in New Zealand suggests reducing these regulations can help to boost productivity. The Auckland Unitary Plan removed many different zoning restrictions, allowing for higher-density development across the city. The "up-zoning" of Auckland started in 2013 with the introduction of "Special Housing Areas".[31] It was implemented across three-quarters of Auckland in 2016, and more than tripled approvals for dwellings within six years.[32] It coincided with a significant increase in multifactor productivity in NZ construction (Figure 8).[33]

Figure 8 - NZ construction productivity accelerated after zoning reform

New Zealand construction sector multifactor productivity; 1978 = 100



Source: Stats NZ

Other regulations

Other regulations may also be holding back firm size and productivity. This includes **state-based occupational licensing**, which sets legal requirements to practice an occupation such as being a plumber, painter or electrician. Construction licensing has become more stringent in recent years,[34] which can be detrimental to productivity growth because it makes businesses less dynamic, reduces business entries and exits, and makes it harder for the most productive businesses to grow.[35] The Federal Government's new plan to introduce national licensing for electricians is a much-needed first step in the right direction.[36]

Two reasons commonly put forward for licensing are consumer and/ or public safety and service quality. Despite widespread licensing in the sector, however, it has been plagued by problems with non-compliant cladding, water ingress, structurally unsound roofs and poor fire safety.[37]

As CEDA has previously argued, while safety must be guarded, there are better ways to protect consumers, such as closer regulatory oversight, including on-site inspections of building works. Professional indemnity insurance is also important. Licensing of low-risk trades such as painting and decorating should be abandoned, and remaining licences should be nationally consistent.

Regulation can enhance productivity if targeted correctly. Governments at all levels must recognise that, despite good intentions, poorly designed and onerous regulations can have big opportunity costs and unintended consequences. More coordination is needed to improve this. Stronger directives from federal and state governments could also help.

CONCLUSION AND POLICY DIRECTIONS

Productivity in the construction industry has been stagnant for three decades. While many factors have contributed to this outcome, a critical driver is the dominance of small firms. Currently, 98.5 per cent of Australian construction firms have fewer than 20 employees. Smaller building companies are less productive than bigger firms because they can't achieve the same productivity gains from economies of scale and scope, innovation and investment.

Our analysis of previously unreleased ABS data shows Australian construction firms with 200 or more employees generate 86 per cent more revenue than those with 5 to 19 employees. If Australian construction firms matched the size distribution of firms in the manufacturing industry, construction would produce 12 per cent, or $54 billion, more revenue per year without requiring any additional labour. This is equivalent to gaining an extra 150,000 construction workers.

The dominance of small firms is the result of the cyclical and segmented nature of the industry, combined with the shift to subcontracting that took place in the early 1980s and late 1990s.

Current regulatory settings are keeping builders small:

- Tax incentives favour independent contractors, who are four times more likely to disclose income under the tax-free threshold than salaried construction workers. Other tax settings, such as the instant asset write-off and payroll tax thresholds, also favour smaller construction firms.
- Australia has the most decentralised system of land-use regulation in the OECD, which exacerbates geographic segmentation and makes it harder for firms to expand into new areas.
- Complex, and in some cases increasingly stringent, state-based occupational licensing rules also make it harder for the most productive businesses to expand interstate.

Many drivers of productivity, such as technology adoption, require scale and certainty. As volatility and regulation in the sector grows, so too does the complexity and risk involved in delivering construction projects. This prevents productive firms from growing.

To encourage scale, governments should:

1. Make local and state government regulations more streamlined and consistent.
2. Help to smooth out variability in demand by creating a more consistent, predictable pipeline of construction work through their infrastructure and social housing programs.
3. Better align the relative tax rates for individuals and small and large businesses as part of broader reform of the entire tax system.

Australia has been slow to deliver on critical infrastructure projects and has not built enough homes to keep up with demand. Sydney is now the second most expensive housing market in the world, while Adelaide is sixth and Melbourne is ninth.[38]

All levels of government must tackle this challenge. We must ensure that basic policy foundations such as regulations and tax don't stand in the way of targeted measures to build more homes.

To help us build smarter, not just harder, we must focus on policies to lift productivity in construction.

This work has benefited from insights gathered from two workshops (around 15 attendees in total), as well as broad consultation with around 15 other CEDA members and key stakeholders, including industry participants, academics, state and federal government agencies and industry bodies. We are sincerely grateful for all contributions and insights received.

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The impact of upzoning on housing construction in Auckland☆

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ABSTRACT

There is a growing debate about whether upzoning is an effective policy response to housing shortages and unaffordable housing. This paper provides empirical evidence to further inform debate by examining the various impacts of recently implemented zoning reforms on housing construction in Auckland, the largest metropolitan area in New Zealand. In 2016, the city upzoned approximately three quarters of its residential land to facilitate construction of more intensive housing. We use a quasi-experimental approach to analyze the short-run impacts of the reform on construction, allowing for potential shifts in construction from non-upzoned to upzoned areas (displacement effects) that would, if unaccounted for, lead to an overestimation of treatment effects. We find strong evidence that upzoning stimulated construction. Treatment effects remain statistically significant even under implausibly large displacement effects that would necessitate more than a four-fold increase in the trend rate of construction in control areas under the counterfactual of no-upzoning. Our findings support the argument that upzoning can stimulate housing supply and suggest that further work to identify factors that mediate the efficacy of upzoning in achieving wider objectives of the policy would assist policymakers in the design of zoning reforms in the future.

1. Introduction

Housing has become prohibitively expensive in many of the world's major cities, precipitating serious and widespread housing affordability crises (Wetzstein, 2017). A growing coalition of researchers argue that part of the solution is to "upzone" cities by relaxing land use regulations (LURs) to allow construction of more intensive housing, such as townhouses, terrace housing and apartment buildings (Glaeser and Gyourko, 2003; Freeman and Schuetz, 2017; Manville et al., 2019). Policymakers have begun to listen to these supply-side solutions and, in response, several metropolitan and gubernatorial authorities have pursued zoning reform in recent years (National Public Radio, 2019).

These policy reforms are underpinned by the argument that LURs increase house prices by restricting housing supply (Glaeser et al., 2005; Quigley and Raphael, 2005; Quigley and Rosenthal, 2005; Ihlanfeldt, 2007; Zabel and Dalton, 2011; Gyourko and Molloy, 2015). Relaxing those regulations through upzoning, it is argued, enables new more intensive development, thereby increasing housing supply and putting downward pressure on prices. However, these arguments are not universally accepted and many commentators remain skeptical of the capacity for these market-led policies to deliver affordable and inclusive housing (Rodríguez-Pose and Storper, 2020; Wetzstein, 2021). Instead it is suggested that government intervention is needed to tackle the problem through means such as state-led construction (Wetzstein, 2021; Favilukis et al., 2023), the repurposing of public space (Wetzstein, 2021; Freemark, 2021), and policies that limit demand (Wetzstein, 2021).

Unfortunately our understanding of the manifold impact of upzoning is presently limited by an acute lack of empirical research on the subject (Schill, 2005; Freeman and Schuetz, 2017; Freemark, 2019). Only a handful of studies have offered empirical evidence of the effects of a relaxation of LURs (Atkinson-Palombo, 2010; Freemark, 2019; Gray and Millsap, 2020; Limb and Murray, 2022; Peng, 2023), and these have tended to concentrate on small-scale policy changes, often involving transit-oriented rezoning, not the large-scale policy reforms currently being implemented in many US cities.[1] The limited empirical work that is available has findings that often contravene the

☆ We thank Auckland Council for providing the building permit and urban extent datasets, and Land Information New Zealand for providing the land parcel dataset. This research was funded by the Royal Society of New Zealand under Marsden Fund Grant UOA2013. Phillips also acknowledges research support from the NSF under Grant no. SES 18-50860 and a Kelly Fellowship at the University of Auckland. We thank two anonymous referees and the Editor for their many helpful suggestions.

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[1] Gray and Millsap (2020) is an exception, showing that the 1998 reduction in minimum lot sizes in Houston preceded an increased concentration of development activity in middle-income, less dense, under-built neighborhoods.

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outcomes anticipated by proponents of supply-side regulatory reforms. For example, Freemark (2019) found that transit-oriented upzoning in Chicago failed to encourage construction, calling into question the fundamental premise of the supply-side argument (Rodríguez-Pose and Storper, 2020). Meanwhile, Limb and Murray (2022) argue that transit-oriented upzoning in Brisbane, Australia, generated no significant increase in housing construction.

The lack of empirical evidence on the effects of large-scale upzoning is largely due to the fact that, until very recently, no city has systematically upzoned large shares of land as a mechanism to promote affordability (Freeman and Schuetz, 2017, p. 229). In 2016, however, the city of Auckland, New Zealand, implemented large-scale zoning reforms under the Auckland Unitary Plan (AUP). Motivated in part by housing affordability concerns (Auckland Unitary Plan Independent Hearings Panel, 2016), the plan upzoned approximately three-quarters of residential land, and trebled the number of dwellings that could be built (Greenaway-McGrevy et al., 2021), providing researchers with a unique opportunity to study large-scale upzoning reform of the kind that was hitherto lacking.

The present paper examines impact of upzoning on housing construction in Auckland to provide further evidence on whether zoning reforms can fulfill the fundamental premise of the supply-side policy response, namely, that upzoning increases housing supply. A difference-in-differences (DID) framework is adopted that exploits geographic variation in the incidence of upzoning to estimate causal effects through the comparison of outcomes in upzoned residential areas with outcomes in non-upzoned residential areas. Our dataset consists of geocoded building permits that are matched to planning maps that detail the geographic incidence and intensity of upzoning.[2] Because the empirical design exploits temporal changes in zoning rules via a policy intervention, it has the capacity to mitigate many of the concerns stemming from the endogeneity of regulations that afflict studies which rely only on spatial variation in LURs (Gyourko and Molloy, 2015). By exploiting time series and spatial variation in LURs, we are able to allow for a wider set of time-invariant confounders since their impact on outcomes is differenced out in the DID procedure. The approach is concordant with other work where changes in the geographic variation in zoning has been used in quasi-experimental designs to examine casual impacts (Thorson, 1997; Cunningham, 2006; Zhou et al., 2008; Kahn et al., 2010; Freemark, 2019).

Our empirical strategy pays particular attention to the possibility that housing construction in upzoned areas displaced housing that would have otherwise been constructed in non-upzoned areas.[3] These displacement effects would manifest as negative spillovers from treatment areas to control areas, violating the stable unit treatment value assumption (SUTVA) in the Neyman-Rubin causal framework, and generating an overstatement of conventional treatment effects that are based on simple comparisons of outcomes in treatment and control groups. Present techniques for addressing spatial spillover effects require the spillovers to be localized, in the sense that the magnitude of the spillover between geographically distant areas is assumed to be negligible (Clarke, 2017; Butts, 2021; Huber and Steinmayr, 2021). As we demonstrate below, the evidence suggests that upzoning in Auckland reallocated permits over large distances (from distant areas with more vacant land to near areas with less vacant land), meaning that methods that model spillovers under the assumption that they are highly localized and dissipate with distance are untenable in our setting. We therefore develop an approach to accommodating spillover effects that does not rely on spillovers dissipating with distance.

We adapt the set identification approach suggested by Rambachan and Roth (2023) (hereafter "RR") for remediating violations of the standard parallel trends assumption that is required under the DID framework. RR extrapolate pre-treatment trends to generate a set of counterfactual outcomes in the treatment group. In the present paper we repurpose this strategy by using pre-treatment trends in the *control* group to extrapolate a set of counterfactual outcomes that are used to bound the magnitude of the spillover effect. The intuition underpinning both the RR strategy and our strategy is the idea that observed trends immediately prior to the policy intervention are informative of the counterfactual scenario. Adapting the RR method to our application yields a confidence set of treatment effects that is robust to spillover effects and amenable to inference.

The empirical findings using this methodology reveal strong statistical evidence that upzoning increased housing construction. Our preferred model specification shows a statistically significant increase in permits even under counterfactual sets that span approximately four times the extrapolated linear trend in the control group. For example, a linear trend fitted to pre-treatment observations in the control group implies that 1116 additional permits in non-upzoned areas in 2021 under the counterfactual of no upzoning. We find that the estimated treatment effect for 2021 remains statistically significant even when we allow an additional 4469 permits in the counterfactual set of outcomes. Put differently, counterfactual scenarios that allow more than a four-fold increase in permits over the pre-treatment trend (since $4 \approx 4.005 = 4469/1116$) would be needed in order for the estimated treatment effects to become statistically insignificant. There is no policy change concurrent to the upzoning policy that could plausibly generate such a substantial increase in construction.

We also use the extrapolated counterfactual trend in control areas to generate a point estimate of the number of additional permits enabled through upzoning. To do so, we restrict the counterfactual set to the extrapolated linear trend, so that the set collapses to a point. This approach implies that 21,808 additional dwellings were permitted over the five years following the zoning reform, corresponding to approximately 4.11% of the dwelling stock of the Auckland region.[4]

Our results have implications for ongoing debates about the efficacy of upzoning. In particular, the findings support the view that large-scale upzoning can encourage construction. This is particularly important in the light of recent work by Freemark (2019) and Limb and Murray (2022), who find that zoning changes had minimal impact on housing construction in Chicago and Brisbane, respectively. Further work examining potential mediating factors that enabled increased construction will hopefully help explain why the policy was more effective in Auckland, and assist policymakers in tailoring rezoning and housing policies to facilitate construction elsewhere.

The remainder of the paper is organized as follows. Section two provides the background institutional context and timeline of the key events in the city of Auckland and Section three describes the dataset used in our empirical work. Section four presents the empirical DID model. Section five describes and applies our methodology for dealing with potential spillover effects. Section six concludes.

2. Institutional background

This section provides some background demographic and administrative features of Auckland city with information concerning relevant policies and processes preceding the relaxation of Land Use Regulations (LURs) under the Auckland Unitary Plan (AUP). It also shows how the policy informs our empirical design.

[2] Throughout the paper, "permits" refers to permitted housing units or, in the New Zealand parlance, "consented dwellings".

[3] Spatial displacement effects go by varying terms in the urban literature. Neumark and Simpson (2015) characterize displacement effects from place-based policies as negative spillovers, while Redding and Turner (2015) refer to "reorganization" effects in response to transport policies.

[4] Note this is not an estimated increase in dwelling stock. Unfortunately we do not have precise measures of dwellings demolished when properties are redeveloped because demolition permits are only required for buildings that are less than three storeys.

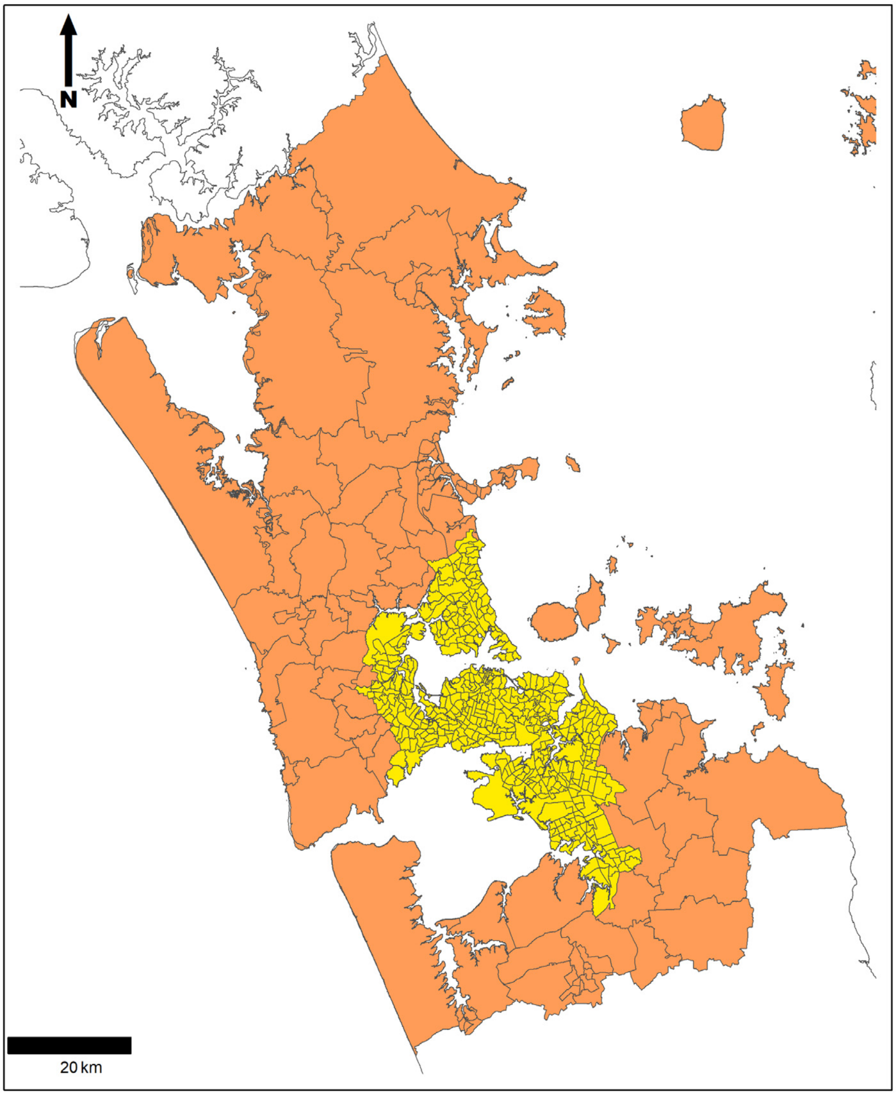

Fig. 1. Auckland region. *Notes:* Auckland region (shaded) decomposed into Statistical Area geographic units. Urban core shaded yellow in the center. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Auckland is the largest city in New Zealand with a population of approximately 1.57 million within the greater metropolitan region (as of the 2018 census). Prior to 2010, the metropolitan region comprised seven different city and district councils. Since 2010, the entire metropolitan area, as well as several towns, populated islands, and a large amount of the rural land beyond the fringes of its outermost suburbs, has been under the jurisdiction of a single local government, the Auckland Council. Centered on a long isthmus of land between two harbors, this jurisdiction extends over 4894 km^2 of land area.

Figure 1 illustrates the Auckland region, decomposed into Statistical Areas (SAs), which, as discussed below, are used as the geographic unit of analysis in our work. The shaded areas are the Auckland Council region. The lighter shaded area in the center is what we refer to as the "urban core".[5]

In March 2013, the Auckland Council announced the "draft" version of the AUP. The draft version of the plan went through several rounds of consultations, reviews and revisions before the final version became operational on 15 November 2016. Each version of the AUP contained new LURs that would potentially change restrictions on the extent of site development. In most areas these regulations were relaxed in order to enable residential intensification and greater population density, including multi-family housing such as terrace housing and apartments. These proposed changes could be viewed online, so that any interested member of the public could observe the specific LURs proposed for a given parcel of land. This meant that it was relatively simple for developers to observe the new land use regulations and to commence planning prior to the policy becoming operational.

The amount of development allowed on a given site is restricted by the LURs of its assigned planning zone. In this study we focus on four residential zones introduced under the AUP, listed in declining levels of permissible site development: Terrace Housing and Apartments (THA); Mixed Housing Urban (MHU); Mixed Housing Suburban (MHS); and Single House (SH). Thus THA allows the most site development, and SH allows the least. Table 1 summarizes the various LURs for each of the four residential zones considered. These regulations include site coverage ratios, height restrictions, setbacks and building envelopes, among others. For example, five storeys and a maximum site coverage of 50% is allowed in THA, whereas only two storeys and 35% site coverage is allowed in SH.[6]

[5] For the urban core, we use statistical areas inside or overlapping the "Major Urban Area" of the greater metropolitan region, as defined by Statistics New Zealand.

[6] There are two additional zones in the AUP that are classified as "Residential": "Large Lot" and "Rural and Coastal Settlement". We exclude these areas from our analysis as they are an intermediate, semi-rural zone between outright rural and urban housing areas. We also omit residential land on the islands in the Hauraki Gulf, which have their own unique zoning under the AUP.

Table 1
Summary of land use regulations by residential zone under the Auckland unitary plan.

Regulation	Terrace housing and apartments zone	Mixed housing urban zone	Mixed housing suburban zone	Single house zone
Max. height	16 m (five to seven storeys)	11 to 12 m (three storeys)	8 to 9 m (two storeys)	8 to 9 m (two storeys)
Height in relation to boundary	3 m vertical + 45° recession plane	3 m vertical + 45° recession plane	2.5 m vertical + 45° recession plane	2.5 m vertical + 45° recession plane
Setback	0 m	1 m	1 m	1 m
Site Coverage	50%	45%	40%	35%
Impervious Area	70%	60%	60%	60%
Min. dwelling size (1 bedroom)	45 m^2	45 m^2	45 m^2	n/a
Max. dwellings (on existing parcels)	does not apply	3	3	1
Min. Lot Size (subdivision)	1200 m^2	300 m^2	400 m^2	600 m^2

Notes: Tabulated restrictions are "as of right" and can be exceeded through resource consent notification. Number of storeys (in parentheses) are obtained from the stated purpose of the height restriction in the regulations. Height in relation to boundary and setbacks apply to side and rear boundaries. Less restrictive height in relation to boundary rules than those tabulated apply to side and rear boundaries within 20m of site frontage. Maximum dwellings per site are the number allowed as of right. Minimum lot sizes per dwelling do not apply to existing residential parcels. Site coverage is the area under the dwelling structure. Impervious area is the area under the dwelling and structures such as concrete driveways that prevent rainwater absorption into soil.

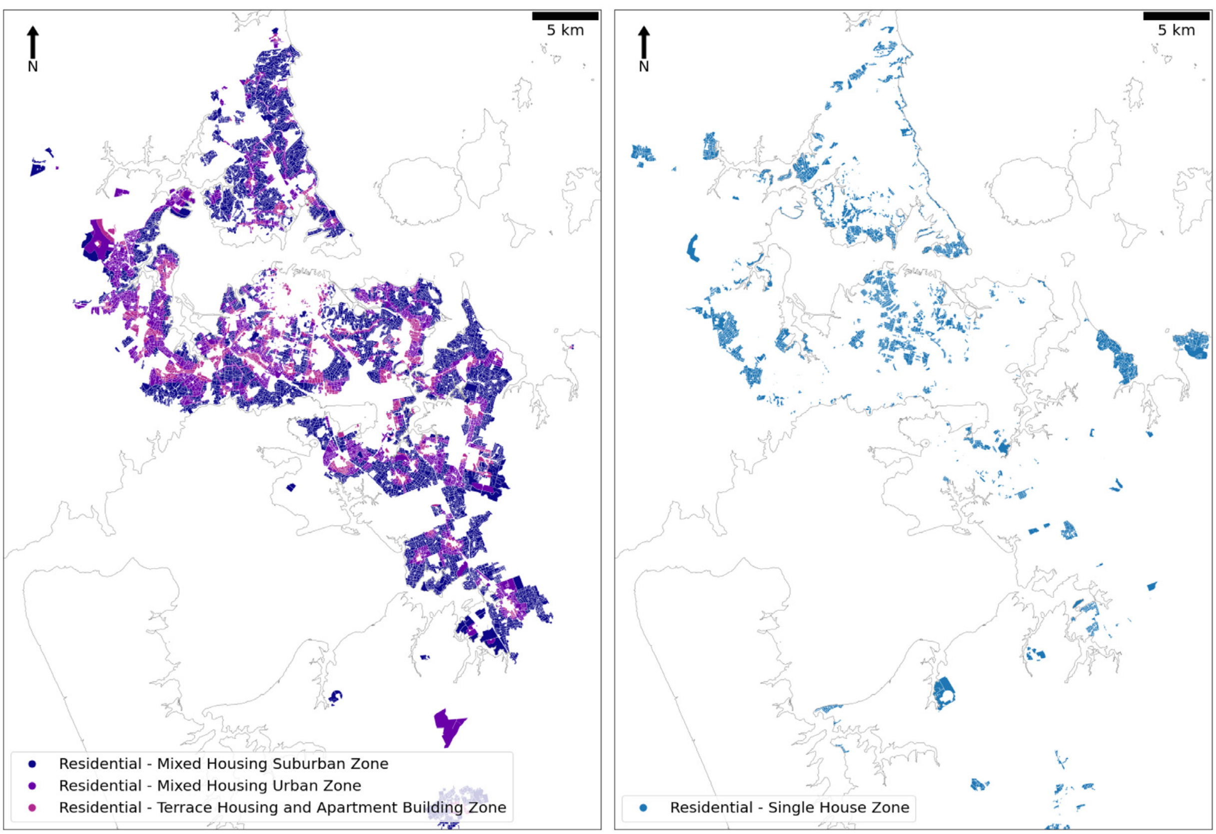

Fig. 2. Residential Zones of inner Auckland introduced under the Auckland Unitary Plan.

Figure 2 depicts the geographic distribution of the four zones. For clarity we zoom in on the central urban area of Auckland. Evidently MHS covers the most area, closely followed by MHU. SH is predominantly located either very close to the central business district (CBD) or at the outskirts of the city. THA covers the least amount of area. Parcels zoned as THA, MHU or MHS collectively comprise 75.1% of residential land, while SH accounts for the remaining 24.9%. Within the urban core of Auckland (the central area in Fig. 1), THA, MHU and MHS account for 84.3% of residential land.[7]

[7] Areas calculated using geocoded dataset of cadastral land parcels, defined as at November 2016.

Our empirical design uses the introduction of the AUP as a quasi-natural experiment in which residential areas that were upzoned to either MHS, MHU or THA are designated as treatment areas, while residential areas that were not upzoned (including SH) are control areas. In order to identify upzoned areas, we compare the LURs that applied before and after the AUP. Prior to the AUP, each of the seven city and district councils set their own zoning regulations, which remained in effect until the AUP became operational in 2016. Upzoned areas are identified by comparing the maximum floor area ratios (FARs) under the previous zone to those that applied under the zone introduced under the AUP. Areas where the FAR increased are classified as upzoned. Although neither the AUP nor the seven city and district plans placed direct restrictions on FARs, all sets of plans imposed site coverage ratios and height limits that cap the maximum allowable FAR on a parcel. Under a plausible mapping of building height to storeys, the FAR is straightforwardly the product of the storey limit and the site coverage ratio. Further details on the classification method are given in the Appendix.[8]

Using this approach, approximately three-quarters (75.2%) of all residential land (SH, MHS, MHU and THA zones combined) is classified as upzoned, including the vast majority (98.7%) of the land designated as either THA, MHU or MHS.[9] Meanwhile, 96.2% of residential land had a FAR no greater than that of SH under the AUP. Thus, while the previous set of regulations did allow for housing intensity that was roughly equivalent to MHS, MHU or THA, these zones were restricted to very small, targeted areas.

Our sample period spans several demand-side policies intended to curb housing demand to promote affordability, including severe restrictions on foreign ownership, disincentives to investor speculation, and macroprudential banking restrictions.[10] Although these policies frequently exempted new builds, there is little reason to think that these policies would differentially impact upzoned areas. Moreover, as we illustrate below, the parallel trends assumption holds remarkably well in our data, affirming that these policies did not have a differential impact. On the supply side, prior to the AUP, "Special Housing Areas" (SpHA) incentivized developers to provide a limited amount of affordable housing in exchange for accelerated processing of building permits. Developers could also use more relaxed planning rules from a preliminary version of the plan (the "Proposed AUP", notified in September 2013). SpHAs were disestablished once the AUP became operational. We exclude permits issued in SpHAs prior to 2017 as a disproportionate share of SpHA permits are in locations that were later upzoned. A robustness check reported in the Appendix demonstrates that our findings are largely unaffected when these permits are included in the analysis.

3. Dataset

Our dataset is based on annual building permits for new dwelling units issued by the Auckland Council from 2010 to 2021.[11] The permits include the number of dwellings. Each observation includes the longitude and latitude of the building site, which have been used to map each permit to its corresponding zone under the Auckland Unitary Plan (AUP).

Figure 3 exhibits aggregate permits in upzoned and non-upzoned residential areas over the 2010 to 2021 period. We also decompose permits into attached and detached dwellings. There is a clear increase in the number of permits in upzoned areas after the policy is implemented (from 2017 onward). The number of attached dwelling permits per year in upzoned areas increases from under 1000 in 2016 to near 10,000 by 2021 – more than a tenfold increase. Over the same period, detached housing increases from just over 2000 permits per year to approximately 4500. By 2019, there were more attached dwelling permits than detached, consistent with the upzoning goal of incentivising more capital intensive structures. In addition, there is a notable fall in detached dwelling permits between 2019 and 2021 in upzoned areas.

Prior to the policy change, permits in subsequently upzoned areas consistently exceeded permits in non-upzoned areas by a relatively constant amount. This pattern is consistent with modeling permits in levels in a difference-in-differences framework, since it implies an absolute

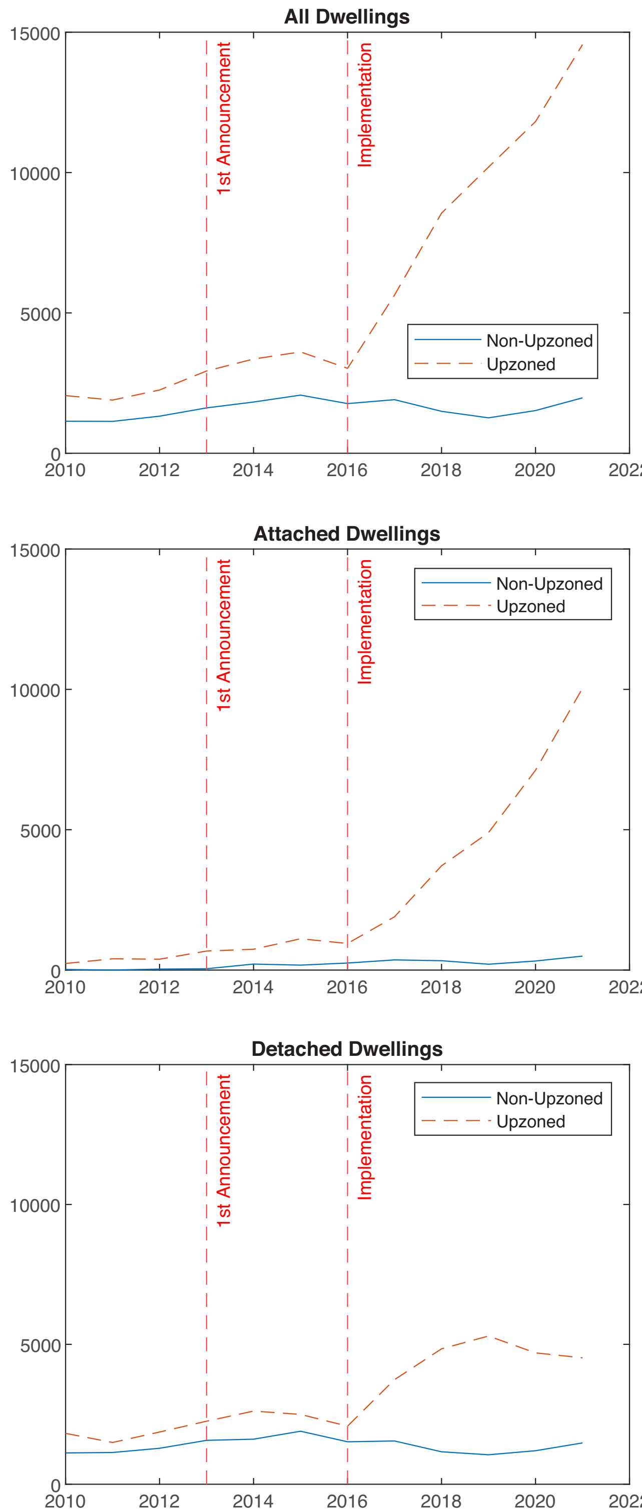

Fig. 3. Dwelling permits, 2010–2021. *Notes:* Dwelling permits issued in upzoned and non-upzoned residential areas.

[8] FARs are often used as a measure of LUR stringency; see Brueckner et al. (2017); Brueckner and Singh (2020) and Tan et al. (2020). By using a FAR, our upzoning identification algorithm is based on increases in maximum floorspace density, rather than restrictions on dwelling density, such as minimum lot sizes (MLS). While the majority of the zones prior to the AUP also had MLS in addition to height and site coverage restrictions, MLS do not apply to extant residential parcels under the AUP. MLS on extant parcels were therefore an additional restriction that only applied prior to the AUP, which means that our upzoning classification method may understate the amount of upzoned land.

[9] We also consider empirical designs in which THA, MHU and MHS are simply classified as the treatment group and SH areas are the control group, and where downzoned areas are excluded from the analysis. Our results and findings do not substantively change.

[10] Loan to value ratios on new residential mortgages were introduced in 2013; a limited capital gains tax was introduced in 2015; and legislation preventing foreign ownership (excepting Australia and Singapore) in 2018. See Greenaway-McGrevy and Phillips (2021) for additional details.

[11] Permits for extensions to existing dwellings are not included in our analysis.

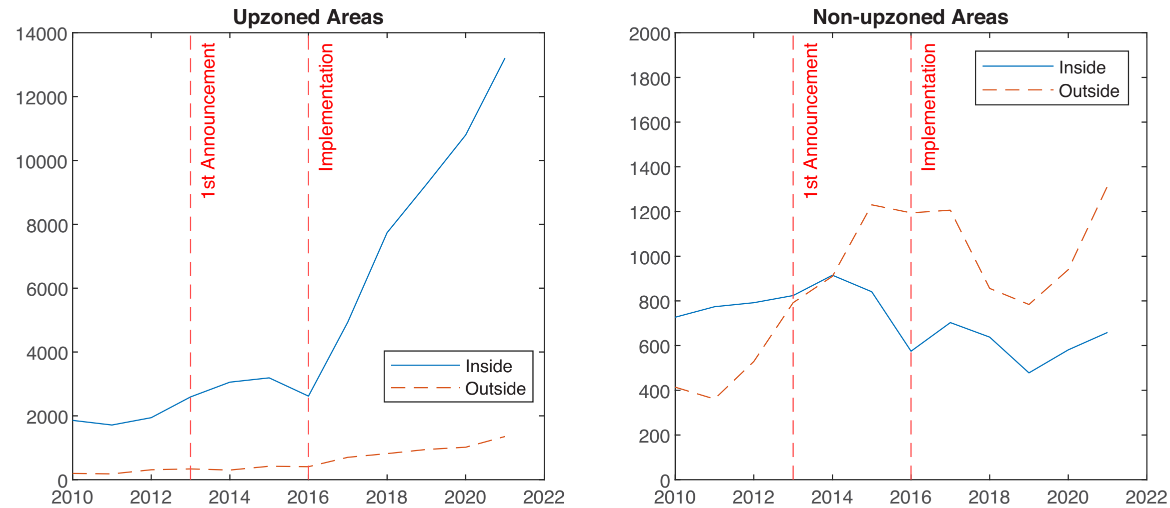

Fig. 4. Dwelling permits inside and outside the urban core, 2010–2021. *Notes:* Urban core depicted in Fig. 1.

difference in the level of the two series under the counterfactual (Kahn-Lang and Lang, 2020).

There is a notable decrease in the number of permits in non-upzoned areas after 2015. Permits follow a steady upward trend until 2015. Thereafter there is a discrete shift as permits trend downwards. This break in trend is statistically significant (refer to the Appendix for details). These outcomes are consistent with a negative spillover effect, as construction that would otherwise have occurred in non-upzoned areas may have been relocated to upzoned areas as a result of the policy. The outcome is mainly driven by a decline in detached dwelling permits, which lends further support to the negative spillover interpretation of the switch in trend in 2015.

Economic theories of urban development suggest that upzoning will encourage construction in desirable locations where zoning regulation was previously binding, such as areas close to job locations. The canonical Alonso-Muth-Mills (AMM) spatial equilibrium model of the monocentric city predicts that a relaxation of Land Use Regulations (LURs) will result in more housing close to the city to the center (Bertaud and Brueckner, 2005). To explore whether this is the case in Auckland, Fig. 4 divides the sample into urban core and non-core areas of Auckland (see Fig. 1 for the geographic delineation of the urban core and non-core areas). Consistent with this prediction, most of the increase in permits in upzoned areas is occurring in the urban core.

Figure 5 breaks down the upzoned areas into constituent Terrace Housing and Apartments (THA), Mixed Housing Urban, (MHU) and Mixed Housing Suburban (MHS) zones. Despite having more restrictive constraints than MHU and THA, it is unsurprising that MHS accounts for most of the increase in permits because it covers the largest geographic area.

4. Empirical model and results

Let $y_{i,j,t}$ denote the number of permits in zone j in area $i = 1, \dots, n$ in period $t = -\underline{T}, \dots, 0, \dots, \overline{T}$, where $\underline{T}$ denotes the number of time series observations prior to the treatment, and $\overline{T}$ denotes the number of time series observations post-treatment. The treatment occurs in period $t = 0$. We use $j = 0$ to indicate the control group (i.e, permits in non-upzoned areas) and $j = 1$ to signify the treatment group (permits in upzoned areas). The causal impact of upzoning is then estimated using a multi-period difference-in-differences (DID) specification of the form

$$y_{i,j,t} = \alpha_{i,j} + \sum_{s=-\underline{T},s\neq 0}^{\overline{T}} \phi_s \mathbf{1}_{s=t} + \sum_{s=-\underline{T},s\neq 0}^{\overline{T}} \beta_s \mathbf{1}_{s=t,j=1} + \varepsilon_{i,j,t} \quad (1)$$

where $\alpha_{i,j}$ are suburb-zone fixed effects, ϕ_s are period fixed effects, and $\mathbf{1}_{s=t}$ are indicators for each time period except the treatment period, $t = 0$. $\mathbf{1}_{s=t,j=1}$ are indicators for each time period (except $t = 0$) interacted with a treatment indicator. Thus $\{\beta_s\}_{s=1}^{\overline{T}}$ represent the treatment effects over time from upzoning. The empirical estimates of these parameters capture the increase in permits in treatment areas relative to control areas in each period after upzoning is implemented. Following convention, estimates of $\{\beta_s\}_{s=-\underline{T}}^{-1}$ will be used to assess the extent to which the parallel trends assumption holds prior to treatment. The period fixed effects ϕ_s measure changes in permits in the control group relative to the implementation period $t = 0$. They also capture common variation in permits across different zones and suburbs that is due to macroeconomic or city-wide shocks and policy changes.

We use “Statistical Areas” (SAs), which are similar to census tracts in the US, as the geographic unit of analysis indexed by i. SAs have a target population of between 2000 and 4000 people in cities (such as Auckland) and were delineated to reflect communities that interact socially and economically. There are 479 SAs in our sample.[12]

One of the strengths of DID is that spatial and time series variation in Land Use Regulations (LURs) can be used to control for a wide set of time invariant confounding factors. Although studies frequently employ spatial discontinuity designs to control for these confounders by assuming they are equally salient on either side of the boundary (Turner et al., 2017; Anagol et al., 2021), these approaches necessarily constrain the geographic area of analysis to areas spanning zone boundaries, making the empirical design ill-suited to aggregating treatment effects without imposing strong assumptions on the saliency of the policy intervention in areas distant to the boundary.

Permits are modeled in levels. As discussed above, levels seem more appropriate given the observed pre-treatment trends in upzoned and non-upzoned areas, which differ over time by a near constant amount until the Auckland Unitary Plan (AUP) is implemented. An additional benefit of modeling outcomes in levels is that it allows us to define counterfactual sets in terms of model parameters. By definition, spillovers

[12] SAs were introduced in 2018, as the previous classification system had not been revised since 1992. The previous statistical geographies no longer reflect current land use and population patterns. The revision was also implemented in order to align the geographic unit standards with international best practice. Population data from the previous census (conducted in 2013) and associated projections were used in the design of the 2018 boundaries. For additional details, see https://www.stats.govt.nz/assets/Uploads/Retirement-of-archive-website-project-files/Methods/Statistical-standard-for-geographic-areas-2018/statistical-standard-for-geographic-areas-2018.pdf [Accessed 1 March 2023]

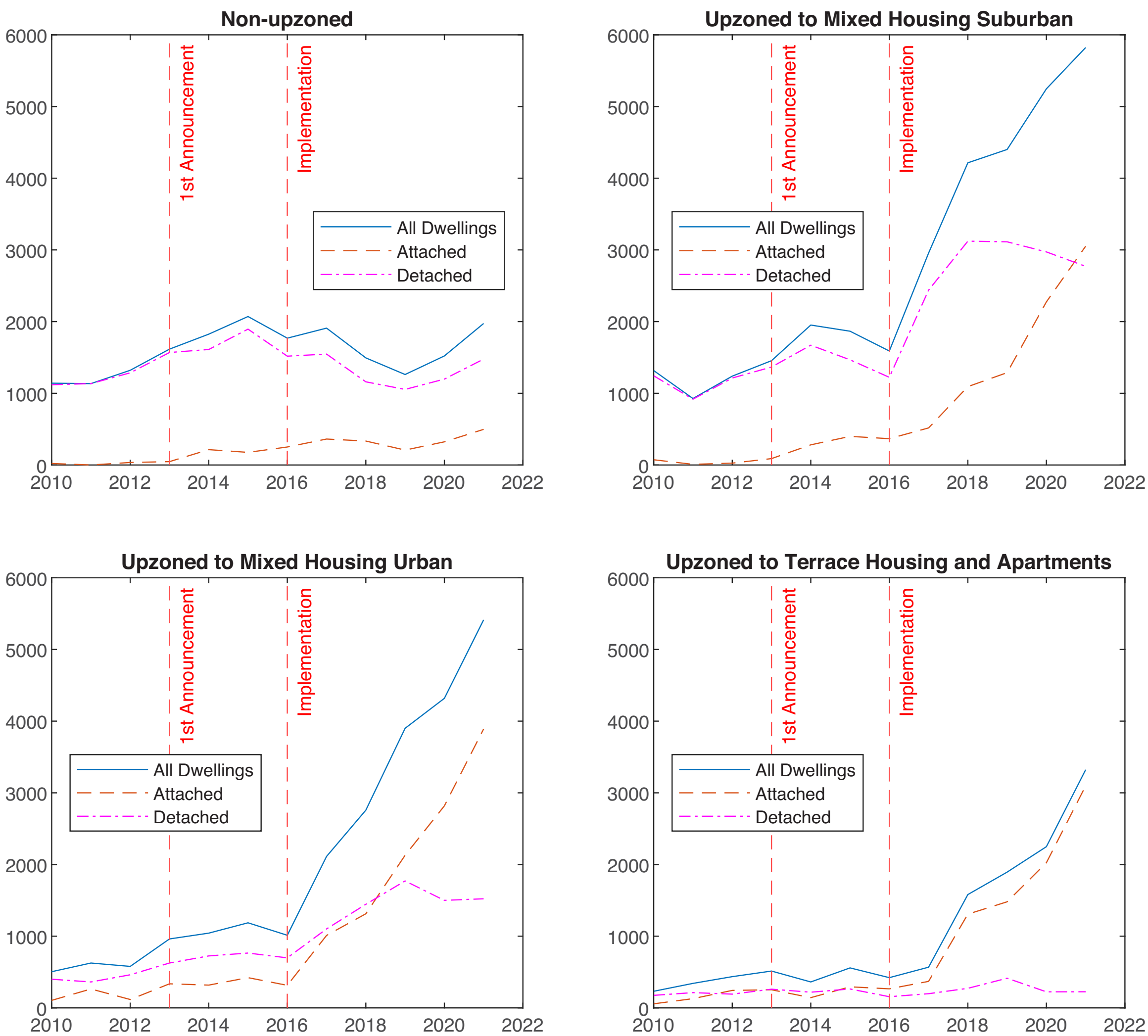

Fig. 5. Dwelling permits by residential zone, 2010–2021. *Notes:* Dwelling permits issued in non-upzoned and upzoned residential areas.

are measured in levels. For example, consider a spillover that generates $\epsilon \in \mathbb{R}^+$ fewer permits in non-upzoned areas – and ϵ more permits in upzoned areas – in the first treatment period. The corrected treatment effect would be $\hat{\beta}_1 - 2\epsilon$ and the corrected period fixed effect would be $\hat{\phi}_1 + \epsilon$. This direct mapping is lost or transformed if permits are instead modeled in logs or another non-linear transformation.

4.1. Selection of the treatment date

We use 2015 as the treatment date.[13] There are two main reasons for this selection.

First, policy interventions can begin to manifest prior to the policy change if agents are notified of the change in advance. This is possible in the case of the AUP because the first version of the plan, with clear notification of the intent for dwelling intensification, was released in 2013, more than three years before the final version became operational (see Section 2 above). Negative spillovers can manifest as a decrease in permits in non-upzoned areas prior to 2016 if developers delay and shift planned construction to upzoned areas. The observed change in trend in non-upzoned areas depicted in Fig. 3 is consistent with a negative spillover: Permits trend upwards until reaching a peak in 2015, a year before policy is implemented in late 2016, before trending downwards to a nadir in 2019.

Second, setting the treatment date to coincide with the pre-intervention peak in non-upzoned permits yields more conservative estimates of treatment effects when accounting for negative spillovers via set identification. This is because the extrapolated linear trend that provides the basis for the set of counterfactual outcomes is steeper (see Section 5 below), resulting in a larger modeled spillover than that obtained under an alternative treatment date.

4.2. Results

Figure 6 shows OLS estimates of the coefficients alongside 95% confidence intervals (standard errors are clustered by SA). Recall that we set the treatment to occur in 2015. The top panel of the Figure displays results for all dwellings, while the middle and bottom panels display results for detached and attached dwellings, respectively.

Evidently there is no apparent trend in the estimated coefficients prior to treatment in any of the three samples, so the parallel trends assumption appears to hold. Further buttressing the DID framework, we find no evidence of anticipation in land prices or sales volumes prior to policy announcement, nor selection into treatment based on specifications that admit neighborhood-specific trends (see the robustness checks provided in Section 5.5.1). We proceed under the assumption that there is no confounding variable generating a difference in trends between treatment and control areas prior to policy implementation.

The response to the zoning change is immediate: The estimated treatment effects increase every year after implementation. By 2021, five

[13] We use other dates in our set of robustness checks.

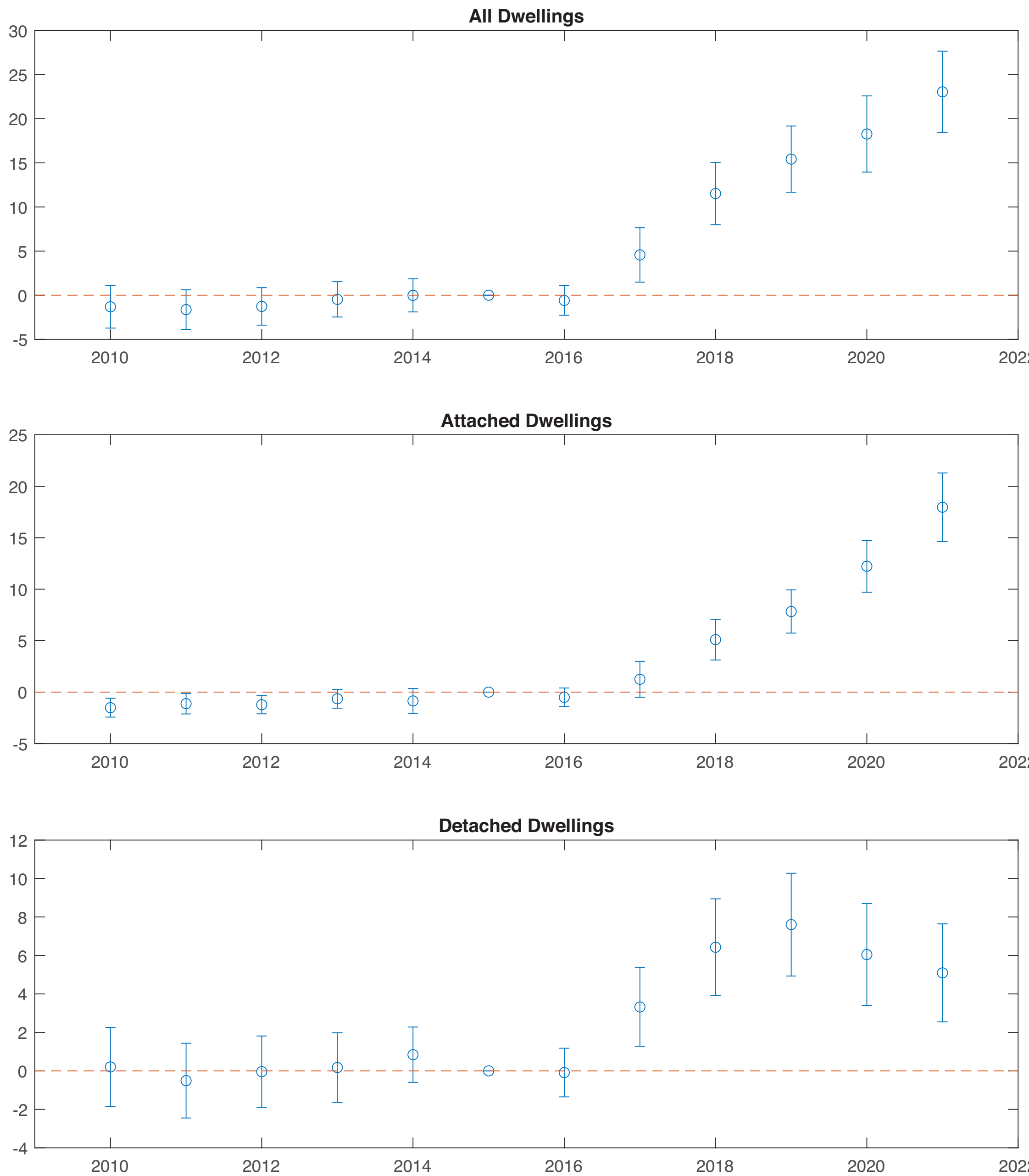

Fig. 6. Estimated treatment effects, 2010–2021. *Notes:* Estimated treatment effects (circles) and 95% confidence intervals (error bars). Treatment date is 2015. Outcome is permits per statistical area.

years after the policy was introduced, some 23.06 additional permits are issued, on average, in upzoned areas compared to non-upzoned areas in each of the 479 SAs. This would correspond to 11,044 permits across the city. Cumulating the corresponding figures for 2016 through 2021 yields 34,614 additional permits in upzoned areas compared to non-upzoned areas. Treatment effects for attached dwellings exceed detached from 2019 onwards. By 2021, the estimated treatment effect for attached is 17.96 permits, while for detached it is 5.09.

4.3. Spillover effects

It is possible that upzoning reallocated construction to upzoned areas that would have otherwise occurred in non-upzoned areas. This negative spillover effect would lead to an overstatement of the treatment effect, since some of the permits in upzoned areas would have been issued in non-upzoned areas under the counterfactual of no policy change.

The time series plots of dwelling permits in Fig. 3 appear to be consistent with a negative spillover effect. There is a mild upward trend in permits built in non-upzoned areas until 2015, one year prior to policy implementation. Thereafter, there is a mild decrease until 2019. Meanwhile, permits in upzoned areas trend upwards from 2016 onwards. This pattern is consistent with a negative spillover effect that shifted construction from non-upzoned to upzoned areas as a result of the policy. The initial upward trend in the control group, and subsequent downturn from 2015 onwards, is most evident in the detached dwellings sample, which is also consistent with a negative spillover.

These patterns are also evident in the estimated period fixed effects (i.e., $\hat{\phi}_s$), which are depicted in Fig. 7. The coefficients measure changes in permits in the control group relative to the treatment period (2015).

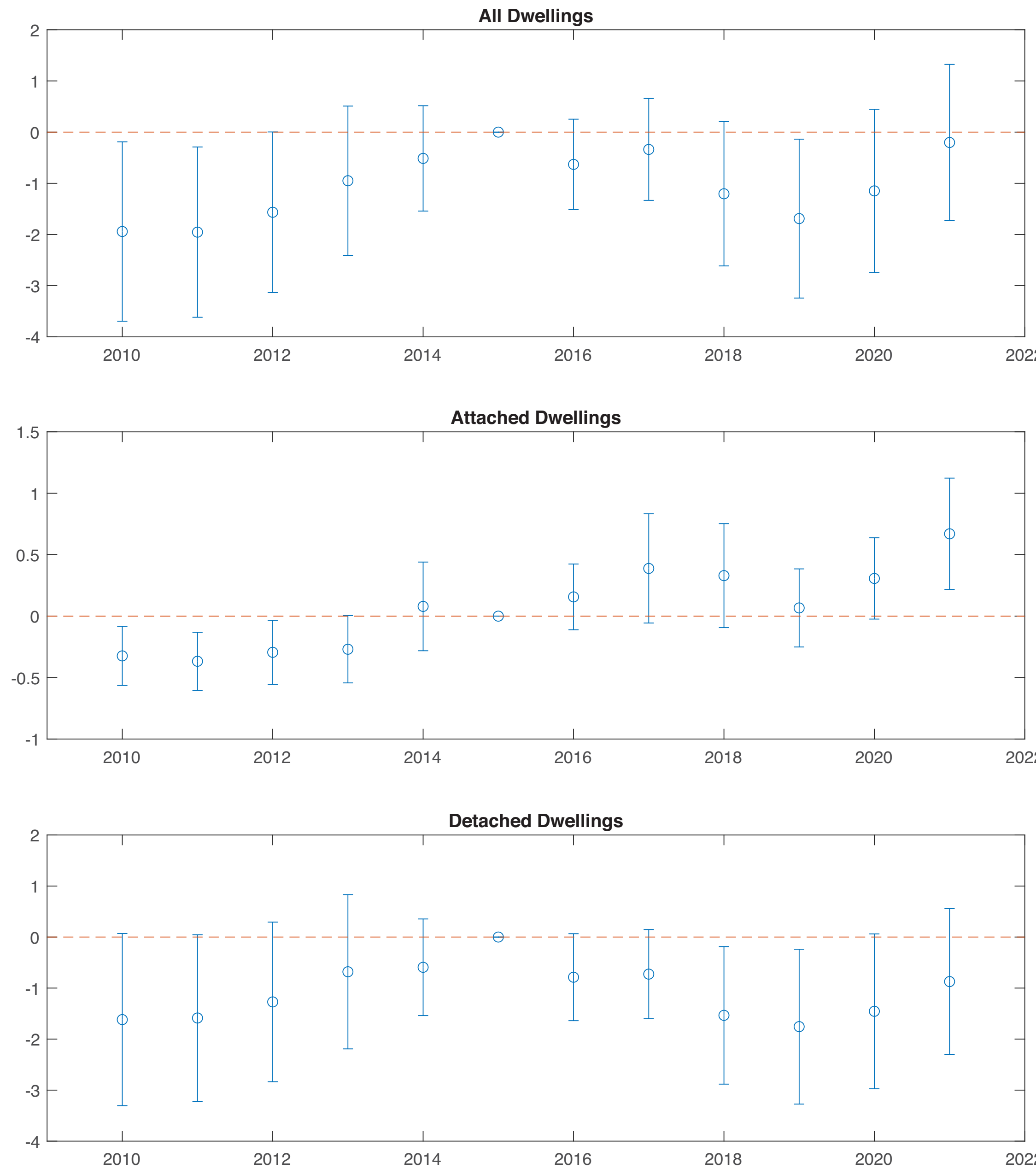

Fig. 7. Estimated period fixed effects, 2010–2021. *Notes:* Estimated period fixed effects (circles) and 95% confidence intervals (error bars). Outcome is permits per statistical area.

In the all dwellings sample, the coefficients trend upwards until 2015. Thereafter, they trend down until 2019.

To examine the potential mechanisms generating spillover effects, we specify a regression function that explains variation in the period fixed effects (PFEs) depicted in Fig. 7. To do so, we use a set of location-specific explanatory variables contained in the vector X_i, and fit the following regression to the data

$$y_{i,j,t} = \alpha_{i,j} + \sum_{s=-\underline{T},s\neq 0}^{\overline{T}} \phi_s \mathbf{1}_{s=t} + \sum_{s=-\underline{T},s\neq 0}^{\overline{T}} \mathbf{1}_{s=t}\gamma_s' X_i + \sum_{s=-\underline{T},s\neq 0}^{\overline{T}} \beta_s \mathbf{1}_{s=t,j=1} + \sum_{s=-\underline{T},s\neq 0}^{\overline{T}} \mathbf{1}_{s=t,j=1}\xi_s' X_i + \varepsilon_{i,j,t},$$

where X_i is a vector of variables specific to Statistical Area (SA) i, comprising: (i) Manhattan distance to the CBD from the SA's centroid; (ii) Manhattan distance to the nearest highway onramp from the centroid; (iii) undeveloped residential land area; and (iv) zoning concentration.

The sequence of parameter vectors $\{\gamma_s\}_{s=-\underline{T}}^{s=\overline{T}}$ captures time series variation in control group permits that can be attributed to cross sectional variation in X_i. If a given variable contained in X_i accounts for the spillover effect, we anticipate the associated sequence of coefficients to mimic the pattern depicted in Fig. 7 – particularly the switch from an upward trend to a downward trend in 2015, which, as discussed above, is consistent with a negative spillover. (i) is included to examine whether this pattern is more prevalent in more distant areas, which would imply that spillovers manifest as a re-allocation of permits from distant exurbs to inner suburbs. (ii) is a conceptually similar variable, but uses highway network access points that facilitate access to all other regions of the city, not just the CBD, as the relevant measure of distance. (iii) is the amount of residential land in the SA that falls outside of the “urban extent" of Auckland (as defined at the time of the zoning reform), which is used as an approximation of developed land.[14] It is included to examine whether the observed patterns in control group permits are more prevalent in locations with more undeveloped land, which would imply that spillovers manifest as a shift from greenfield housing development to redevelopment and infill housing. (iv) is the average minimum distance between upzoned and non-upzoned parcels within the SA,[15] and it is included to examine whether there are local spillovers within the same neighborhood. The larger the measure, the greater the distance, on average, between upzoned and non-upzoned parcels, and thus the greater the concentration of zoning within the statistical area. If there are negative local spillover effects, whereby development is reallocated from non-upzoned to upzoned areas within suburbs, statistical areas with more concentrated zoning are more likely to experience a smaller (in magnitude) post-reform decrease in permits in control (non-upzoned) areas. If there are positive local spillover effects, statistical areas with more concentrated zoning are likely to experience a larger (in magnitude) post-reform decrease in permits in control areas.[16]

Figure 8 presents the point estimates of the PFEs ϕ_s and the elements of γ_s for each of the explanatory variables listed above. Each variable in X_i is standardized (but not demeaned), so the magnitude of each variable's coefficient reflects its explanatory power. The y-axis span is uniform across all variables to facilitate comparability.

The initial upward and subsequent downward trend in the PFEs that is evident in Fig. 7 is gone, and the estimated coefficients are very close to zero, suggesting that our set of variables X_i explains much of the time series variation in permits in non-upzoned areas. Looking to the plots for the explanatory variables, the amount of undeveloped land area has the most explanatory power for the observed patterns in permits in non-upzoned areas over the time period. The pattern in the coefficients mimic those observed in the PFEs exhibited in Fig. 7, steadily increasing through to 2015, before falling to a nadir in 2019. The coefficients for the remaining variables are smaller in magnitude and statistically indistinguishable from zero in all periods.

The evidence is therefore consistent with the spillovers reallocating construction across different suburbs – specifically from relatively undeveloped suburbs to more developed suburbs – rather than within suburbs. In the following section, we present our method for accommodating spillovers that reallocate permits over large distances.

5. Set identification of treatment effects under spillovers

To account for spillover effects we adopt a confidence set identification approach by repurposing methods recently proposed in Rambachan and Roth (2023). First, we specify a set of plausible counterfactual scenarios based on observed pre-treatment trends in the control group. We then test whether outcomes in the treatment group are significantly different from the set of counterfactuals.

Pre-treatment trends are frequently used to infer information about the counterfactual in DID frameworks. For example, RR (2023) propose extrapolating pre-treatment trends in estimated treatment effects to make inferences about counterfactual outcomes. Here, we propose extrapolating trends in control group outcomes to learn about the counterfactual.

Figure 9 superimposes a linear trend on the period fixed effects, which capture outcomes in the control group. The linear trend is only fitted to the pre-treatment sample (2010–2015), and passes through the coefficients in the first period and the treatment period (the latter is normalized to zero by convention). Extrapolating the linear trend into the treatment period yields 2.330 additional permits in the control group in the final period (since $\hat{\phi}_{-\underline{T}} = -1.942$ and $2.330 = 1.942 \times \frac{6}{5}$). However, we actually observe 0.203 fewer permits in the control group in the final period (since $\hat{\phi}_{\overline{T}} = -0.203$). Using the extrapolated trend as the counterfactual implies that the treatment effect in the final period is overstated by 2.533 (= 2.330 + 0.203) permits, or approximately 1213 permits across 479 statistical areas.

It is desirable to permit some margin for error when using pre-treatment trends to extrapolate a counterfactual scenario. This allows local deviations to potential nonlinearities in the trends. The approach suggested by RR (2023) is to adopt a set around the extrapolated trend. For example, Fig. 9 also includes a set of counterfactual scenarios in the control group such that there is a margin of error of ±5 permits in the final period. This means that the control group counterfactual for 2021 lies anywhere between –2.670 (= 2.330 – 5) and 7.330 (= 2.330 + 5) additional permits relative to the treatment period (2015). Note we specify the set lengths to grow linearly in $t \geq 1$, such that the sets are smaller for earlier periods.

Identification is then based on the difference between observed outcomes in treated areas and the set of counterfactual outcomes, which naturally gives rise to set (rather than point) identification of treatment effects. To formalize the set identification method, we partition $\beta = \left(\beta'_{pre}, \beta'_{post}\right)'$, where $\beta_{pre} = \left(\beta_{-\underline{T}}, \ldots, \beta_{-1}\right)'$ and $\beta_{post} = \left(\beta_1, \ldots, \beta_{\overline{T}}\right)'$. Following RR (2023), we decompose $\beta_{post} = \delta_{post} + \tau_{post}$, where τ_{post} is the true treatment effect, and δ_{post} is the difference between the treatment and control groups under the counterfactual scenario. The conventional assumptions required for DID analysis (including no spillovers) ensure that $\delta_{post} = 0$. The quantities δ_{post} and τ_{post} are unobserved and unidentified.

Example. Suppose that $\overline{T} = 1$ (one post-treatment period) and that upzoning only reallocated permits from control to treatment areas, so that no additional permits were generated. Then $\beta_1 = \delta_1$ and $\tau_1 = 0$.

RR (2023) use β_{pre} to generate a set of possible counterfactual outcomes when the parallel trends assumption $\left(\beta_{pre} = 0\right)$ does not hold. For example, in the three period DID case ($\overline{T} = \underline{T} = 1$), they discuss setting $\delta_1 = -\beta_{-1} \pm M$ for some $M \in \mathbb{R}^+$. The intuition is that observed pre-treatment trends in the treatment group relative to the control group are informative of post-treatment trends under the counterfactual. The case where $M = 0$ imposes a linear extrapolation, which is highly restrictive. Permitting general $M \in \mathbb{R}^+$ allows for nonlinear patterns within a set of counterfactual scenarios.

In our application we want to account for negative spillovers that cause the estimated treatment effects to overstate the true treatment effects. To do so, we need to place bounds on the size of the spillover. In this regard, pre-trends in the treatment effects β_{pre} are uninformative.[17] Instead, we propose using pre-treatment trends in control group outcomes to bound counterfactual outcomes. We therefore partition $\phi =$

[14] Urban extent is a geographical measure of Auckland's developed urban area that excludes rural, peri-urban (i.e., semi-rural) and open space areas. It is based on cadastral land parcels. See Fredrickson (2014) for further description of the concept and classification methodology. Auckland Council has used development outside the urban extent to approximate the concept of greenfield development –see https://www.aucklandcouncil.govt.nz/about-auckland-council/business-in-auckland/docsoccasionalpapers/the-brownfield-bounce-march-2018.pdf [Accessed 1 March 2023]

[15] For each upzoned residential parcel in the geographic unit, we calculate the Haversine distance to the nearest non-upzoned parcel; and for each non-upzoned parcel, we calculate the Haversine distance to the nearest upzoned parcel. Nearest parcels are not restricted to within the SA. We then average this minimum distance across all parcels within the SA. The measure builds on the empirical strategy used by Turner et al. (2017), who use distance to zoning boundaries to measure the external effects of zoning regulation.

[16] Turner et al. (2017) present evidence consistent with positive spillover effects. They find that external effects of land use regulation on land values are negative but statistically insignificant in the US. A negative external effect indicates that residents prefer locations that allow higher density.

[17] However, our approach to modeling counterfactual scenarios based on pre-treatment trends in the control group could easily be extended to incorporate trends in both the treatment and the control group. Under such a scenario, β_{pre} is informative and would be used to bound δ_{post}.

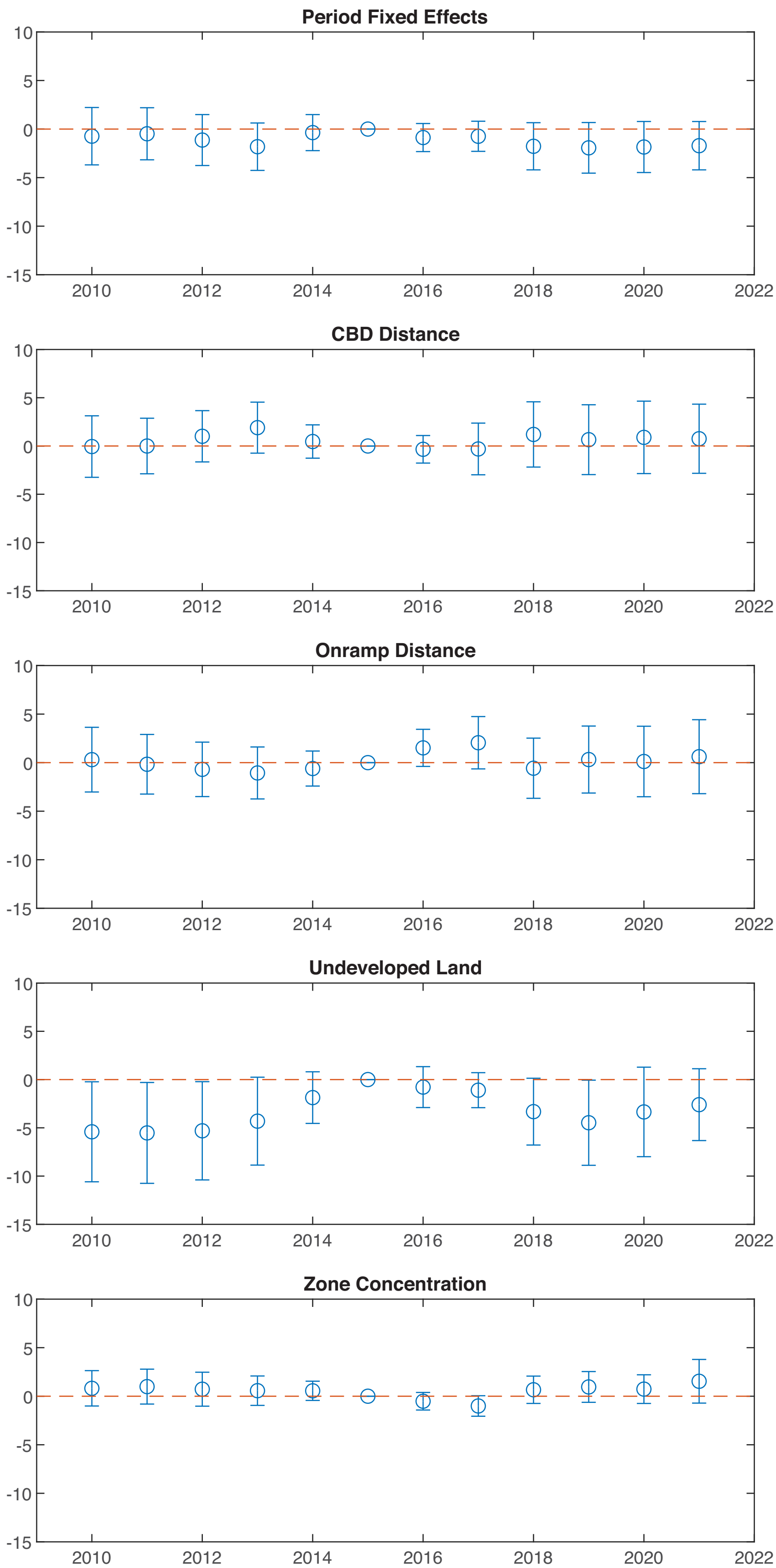

Fig. 8. Explaining variation in period fixed effects, 2010–2021. *Notes:* Point estimates (circles) and 95% confidence intervals (error bars).

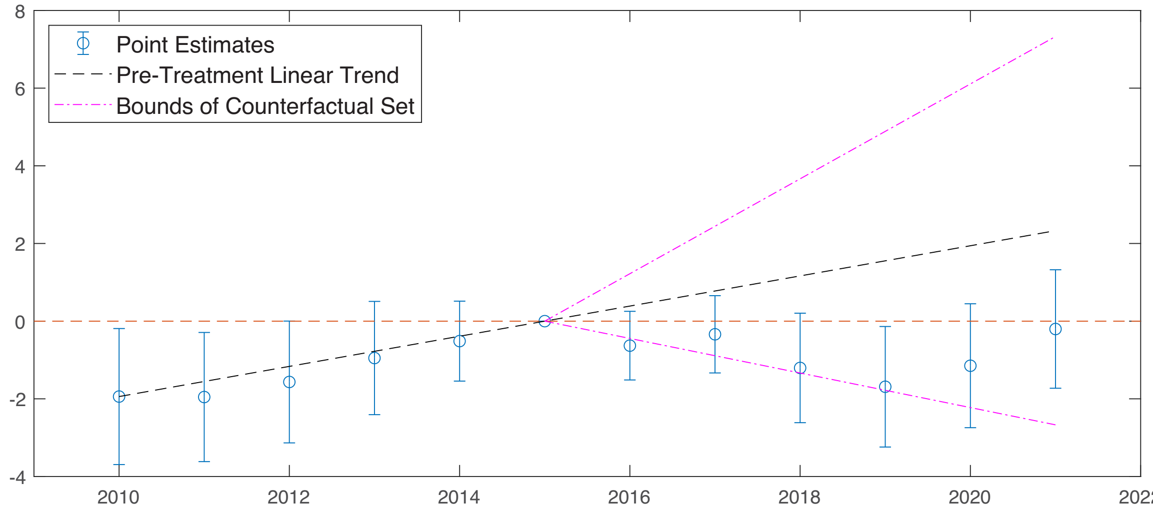

Fig. 9. Estimated period fixed effects and counterfactual sets, 2010–2021. *Notes:* The sequence of counterfactual sets allows a deviation of ±5 permits (equivalent to ±2395 permits over 479 statistical areas) from the linear trend in the final period (i.e. $M = 10$). The set of counterfactual outcomes in post-treatment periods is the space between the bounds.

$\left(\phi'_{pre}, \phi'_{post}\right)'$, where $\phi_{pre} = \left(\phi_{-\underline{T}}, \dots, \phi_{-1}\right)'$ and $\phi_{post} = (\phi_1, \dots, \phi_{\overline{T}})'$, and use ϕ_{pre} to generate a set of counterfactuals.

Example. Suppose that $\overline{T} = \underline{T} = 1$ (so that we have three periods), $\phi_{-1} < 0$ (outcomes in the control group trend upwards prior to the treatment), and $\phi_1 < 0$ (outcomes in the control group trend downwards after the treatment). If control group outcomes remained on trend under the counterfactual, negative spillovers account for the observed downward deviation from trend after the policy is implemented. Then $\delta_1 = -2(\phi_{-1} + \phi_1)$ and $\tau_1 = \beta_1 + 2(\phi_{-1} + \phi_1)$.

In our application, we allow deviations from the linear trend, and we have several pre- and post- treatment observations. For each $t = 1, \dots, \overline{T}$ we bound the set of counterfactual outcomes by $-\hat{\phi}_{-\underline{T}} t/\underline{T} \pm Mt/2\overline{T}$ for some $M \in \mathbb{R}^+$. $Mt/\overline{T}$ therefore denotes the length of the counterfactual set for period t. The set for δ_t is then given by

$$\Delta_t = \left\{ \delta_t : \delta_t \in \left(-2\hat{\phi}_{-\underline{T}} t/\underline{T} - Mt/\overline{T} - 2\hat{\phi}_t, -2\hat{\phi}_{-\underline{T}} t/\underline{T} + Mt/\overline{T} - 2\hat{\phi}_t \right) \right\} \tag{2}$$

Having articulated the set of counterfactuals in (2), we can adopt the inferential architecture supplied by RR (2023). Because our counterfactual sets are convex and centrosymmetric, fixed length confidence intervals (FLCI) are consistent: For a given significance level $\alpha \in (0, 0.5]$, the coverage of FLCIs converge to $1 - \alpha$. Remaining technicalities of the method are provided in the Appendix.

Returning to our empirical application, Fig. 10 superimposes the FLCIs for $\alpha = 0.05$ and $M = 10$ on the conventional point estimates of the treatment effects depicted in Fig. 6. Notably, the confidence intervals sit above zero for 2018, 2019, 2020 and 2021, meaning we can reject the null of no treatment effect at the 5% significance level when allowing for the counterfactual sets depicted in Fig. 9. Note that each set is centered below the corresponding point estimate of the treatment effect, which is consistent with a negative spillover.

5.1. Set-identified treatments effects

We now consider set identification under various counterfactual set lengths, M. Figure 11 exhibits the set-identified treatment effects for $M = 4, 9$ and 14. In all cases, the identified set lies above zero for 2021. The largest counterfactual set, $M = 14$, spans -2237 (= $479 \times (2.330 - 7)$) to 4469 (= $479 \times (2.330 + 7)$) permits (recall that the linear trend is 2.330 in 2021). The upper bound of this set is approximately four times the extrapolated linear trend (since $(7 + 2.330)/2.330 = 4.004 \approx 4$). This serves to pin down the magnitude of the increase in permits that would be necessary under a counterfactual set to render the treatment effects statistically insignificant. Specifically, we must allow for counterfactual scenarios that allow at least a four-fold increase in permits over the pre-treatment trend in order for the estimated treatment effects to become statistically insignificant. Such a scenario appears highly improbable. There is no concurrent policy change in the narrative record that could plausibly generate such a substantive increase in construction.

To help illustrate the substantive growth in permits that would be required under the counterfactual to render all of the treatment effects insignificant, Figure 15 in the Appendix presents the counterfactual sets when $M = 14$. The counterfactual set can even accommodate limited forms of exponential growth in permits over the six year post-treatment period, including a year-on-year growth rate of 13.68%.[18]

5.2. Set-identified treatments effects for attached and detached housing

This section applies the set identification approach to the subsamples of attached and detached housing.

5.2.1. Attached housing

First we fit the model to the subsample of attached dwelling permits. Figure 15 in the Appendix exhibits the estimated period fixed effects and the extrapolated linear trend fitted to the first period and the treatment period. Evidently, there is only a slight upward trend in attached dwelling permits prior to treatment, with the extrapolated trend yielding an additional 0.388 permits in 2021 compared to 2015. This implies an additional 186 (= 0.388×479) permits in total across the 479 statistical areas under the extrapolated trend.

Figure 12 exhibits set-identified confidence intervals under various counterfactual sets ($M = 5, 10, 15$). The confidence interval for the largest $M = 15$ set sits above zero for 2021. Thus, treatment effects are statistically significant at the 5% level even when the counterfactual set spans an additional 3778 (= $(7.5 + 0.388) \times 479$) permits under the counterfactual scenario. This is about twenty times the 186 additional permits in the control area implied by the extrapolated linear trend.

[18] In 2015 there were 2071 permits in non-upzoned areas. The upper bound allows up to 4469 permits in 2021, corresponding to an annual growth rate of 13.68%.

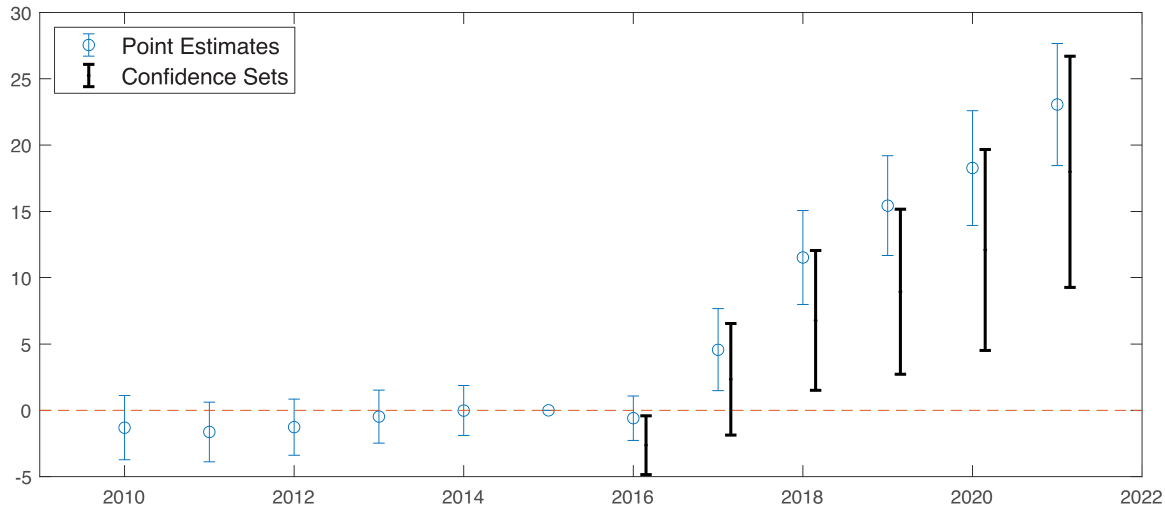

Fig. 10. Set-identified treatment effects, 2010–2021. *Notes:* Confidence sets obtained under the sequence of counterfactual sets depicted in Fig. 9. Treatment date is 2015. Outcome is permits per statistical area. Error bars denote 95% confidence intervals.

The conclusion seems unequivocal that upzoning has had a substantive impact on the construction of attached dwellings.

5.2.2. *Detached housing*

Next we fit the model to the subsample of detached dwelling permits. Figure 15 in the Appendix exhibits the estimated period fixed effects and the extrapolated linear trend fitted to the first period and the treatment period. Evidently, there is a marked increase in detached dwelling permits prior to treatment. The extrapolated trend then yields 1.942 additional permits in non-upzoned areas in 2021 compared to 2015. This would entail an additional 930 (= 1.942 × 479) permits in total.

Figure 13 exhibits the set-identified confidence intervals under various counterfactual sets ($M = 1, 2, 3$). In all cases, the confidence sets do not sit above zero, indicating acceptance of the null hypothesis of no positive treatment effect. The null is accepted even when M is set to the smallest possible value, zero (not pictured). We cannot conclude that upzoning had a substantive impact on the construction of detached dwellings.

5.3. *Set-identified treatment effects by zone*

We now analyze the impact of upzoning in each of the three constituent treatment zones separately. Figure 16 in the Appendix exhibits point estimated treatment effects for areas upzoned to Terrace Housing and Apartments (THA), Mixed Housing Urban, (MHU) and Mixed Housing Suburban (MHS). Treatment effects in all three areas are generally positive and statistically significant in the post-treatment period. There is some evidence of a downward pre-treatment trend for THA. The treatment effects in this area may therefore be under-estimated.

We also consider set identification of confidence intervals. Under the set identification approach there is no obvious method to allocate spillovers from the control group to the treatment groups. For example, all of the spillover could be allocated to a single area, such as upzoned to MHS. This would be consistent with *all* of the construction in the control zone spilling over into areas upzoned to MHS, and none into the MHU and THA areas.

In the absence of an obvious alternative, we elect to allocate the spillover to each of the three zones according to baseline levels of construction in each treatment area prior to upzoning. Between 2010 and 2014, 15.2% of permits were in areas upzoned to THA, 30.4% were in upzoned to MHU, and 54.4% were in upzoned to MHS. Let w_j denote the weights in zone j. For each $t = 1, \dots, \overline{T}$, we have

$$\Delta_t = \left\{ \delta_t \, : \, \delta_t \in w_j \left(-2\hat{\phi}_{-\underline{T}} t/\underline{T} - Mt/\overline{T} - 2\hat{\phi}_t, -2\hat{\phi}_{-\underline{T}} t/\underline{T} + Mt/\overline{T} - 2\hat{\phi}_t \right) \right\}.$$

Figure 16 exhibits the results with $M = 14$, which is the largest set considered earlier. For areas upzoned to THA and MHU, the treatment effects are statistically significant for 2019, 2020 and 2021. Meanwhile, the estimated effects for areas upzoned to MHS are statistically insignificant at the 5% level (two-sided). This is due to the fact that the treatment effects are small relative to the proportion of permits issued in this area prior to the policy. For example, the treatment effect for upzoned to MHU was 9.03 in 2021, which is slightly more than the 8.468 treatment effect in MHS. However, areas upzoned to MHS is allocated 54% of the spillover, whereas MHU receives only 30%.

5.4. *How many additional permits did upzoning enable?*

To obtain point estimates of the impact of upzoning, confidence sets were constructed with the counterfactual sets restricted to the counterfactual trend, i.e. $M = 0$. This implies that the treatment effect is estimated by subtracting $-2\hat{\phi}_{-\underline{T}} t/\underline{T} - 2\hat{\phi}_t$ from $\hat{\beta}_t$ for each $t = 1, \dots, \overline{T}$. In other words, two-times the difference between the extrapolated linear trend and observed permits in the control group is subtracted from the estimated treatment effect. This difference represents the additional permits that would have occurred in the control group had the policy not been implemented. Figure 14 depicts these "spillover-adjusted" point estimates of the treatment effects.

The spillover-adjusted treatment effects for each year between 2016 and 2021 are –2.63, 2.34, 6.79, 8.95, 12.09 and 18.00, respectively, yielding a cumulative total of 45.53. This implies 21,808 (= 45.53 × 479) additional permits as a result of the upzoning policy. To contextualize this figure, it corresponds to 4.11% of the city's extant housing stock.[19] Applying historic completion rates suggests that 21,808 permits would result in 20,718 (= 21,808 × 0.95) to 21,590 (= 21,808 × 0.99) completed dwellings.[20] It is important to note, however, that permits in upzoned areas are still trending upwards as of 2021, so the full impact of the policy will likely not be known for several more years.

A point of caution should be made in interpreting these findings. Mounting any counterfactual such as an extrapolated linear trend or any

[19] Statistics New Zealand estimates that there were 530,300 dwellings in Auckland by the end of 2016. Source: https://www.stats.govt.nz/experimental/experimental-dwelling-estimates, Table 8 [Accessed 1 March 2023].

[20] Building completions typically range between 95% and 99% outside of recessionary periods. Source: https://www.stats.govt.nz/experimental/experimental-dwelling-estimates, Table 5 [Accessed 1 March 2023].

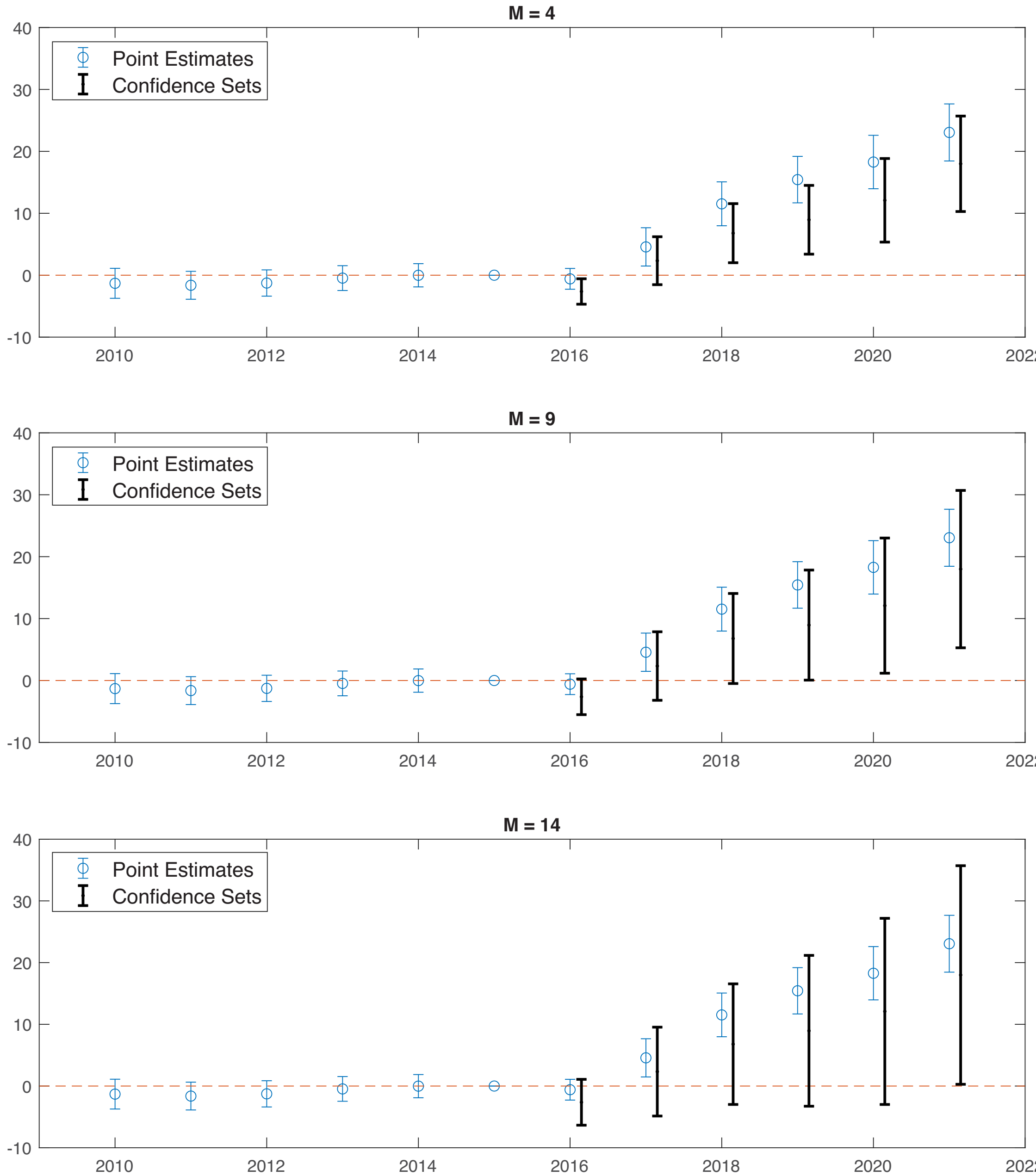

Fig. 11. Set-identified treatment effects, all dwellings, 2010–2021. *Notes: M* denotes the length of the set of counterfactual outcomes in the final period (2021). Treatment date is 2015. Outcome is permits per statistical area. Error bars denote 95% confidence intervals.

set of fixed points inevitably introduces potential misspecification due to the absence of an observable counterfactual scenario and the ambiguities in model selection. In this work a particular method for specifying a counterfactual has been used and point estimates will consequently be sensitive to changes in that specification. Importantly, set-identification mitigates such specification problems by constructing a set that covers a wide range of possible unobservable counterfactuals.

5.4.1. Residential zones

The analysis was repeated for the individual residential zones. We used the same weights as used in Section 5.3 above to allocate the spillovers to each of the three zones.

Figure 17 in the Appendix shows the results. For MHS, the spillover-adjusted treatment effects for each year have a cumulative total of 17.89 permits per statistical area, or 8570 additional permits across all statistical areas (SAs). For MHU, the corresponding cumulative total is 22.95 permits per statistical area, or 10,991 across all SAs. Finally, for THA, the corresponding cumulative total is 15.12 permits per statistical area, or 7241 across all SAs. 27.0% of the overall increase in permits occurred in areas upzoned to THA, 41.0% in areas upzoned to MHU, and 32.0% in areas upzoned to MHS.[21]

[21] Each area's contribution to the overall increase in period s is calculated as $\hat{\beta}_s^j + \left(w_j + \frac{1}{3}\right)\hat{\phi}_s$, where β_s^j denotes the treatment effect when $j \in \{\text{THA,MHU,MHS}\}$ is the treatment group. We use this attribution because $\sum_{j\in\{\text{THA,MHU,MHS}\}} \left(\hat{\beta}_s^j + \hat{\phi}_s\right) = \hat{\beta}_s^{\text{ALL}} + \hat{\phi}_s$ holds as an identity when the same control group is used for each area j (where β_s^{ALL} denotes the treatment effect for the aggregated areas).

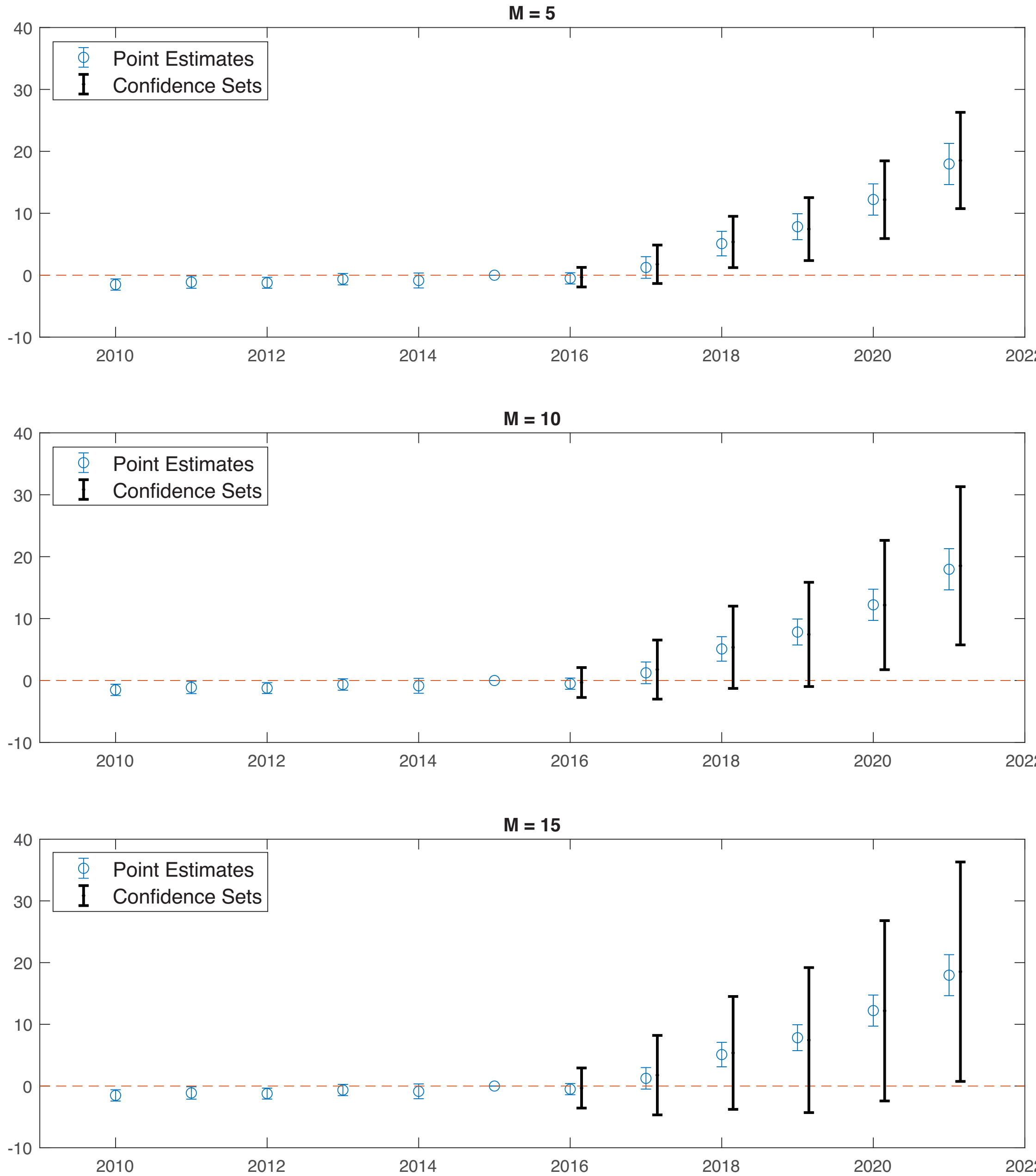

Fig. 12. Set-identified treatment effects, attached dwellings, 2010–2021. *Notes: M* denotes the length of the set of counterfactual outcomes in the final period (2021). Treatment date is 2015. Outcome is permits per statistical area. Error bars denote 95% confidence intervals.

5.5. Robustness checks

This section provides a brief description of results under various robustness checks.[22] Results and additional details are provided in the Appendix.

5.5.1. Selection into treatment and policy anticipation

Although the parallel trend assumption appears to hold in our sample, we perform three robustness checks to examine whether upzoning was anticipated or whether there was selection into treatment.

The first two robustness checks are based on a geocoded dataset of residential housing sales. Because the policy was first announced in March 2013, we use 2012 as the treatment date, as the housing market could respond to the policy prior to it being implemented. First, we fit the multi-period DID model to a spatial panel of (log) sales volumes. Interestingly, treatment effects become positive and statistically significant in 2017, suggesting sales activity increased in upzoned areas only after the policy was operationalized. Prior to 2017, coefficients are statistically indistinguishable from zero, indicating that there were no differential trends in sales volumes between upzoned or non-upzoned areas prior to policy implementation. Second, we fit the multi-period DID model to individual dwelling sales prices, wherein the site intensity ratio of the property is interacted with the treatment indicators in order to obtain treatment effects on land values, rather than the overall value of the property (Greenaway-McGrevy et al., 2021).[23] Abstracting from external effects of increased density or new construction, upzoned

[22] We thank two anonymous referees for suggesting many of these robustness checks.

[23] The site intensity ratio is the value of improvements divided by the total value of the property, so that vacant land has an intensity ratio of zero. Valu-

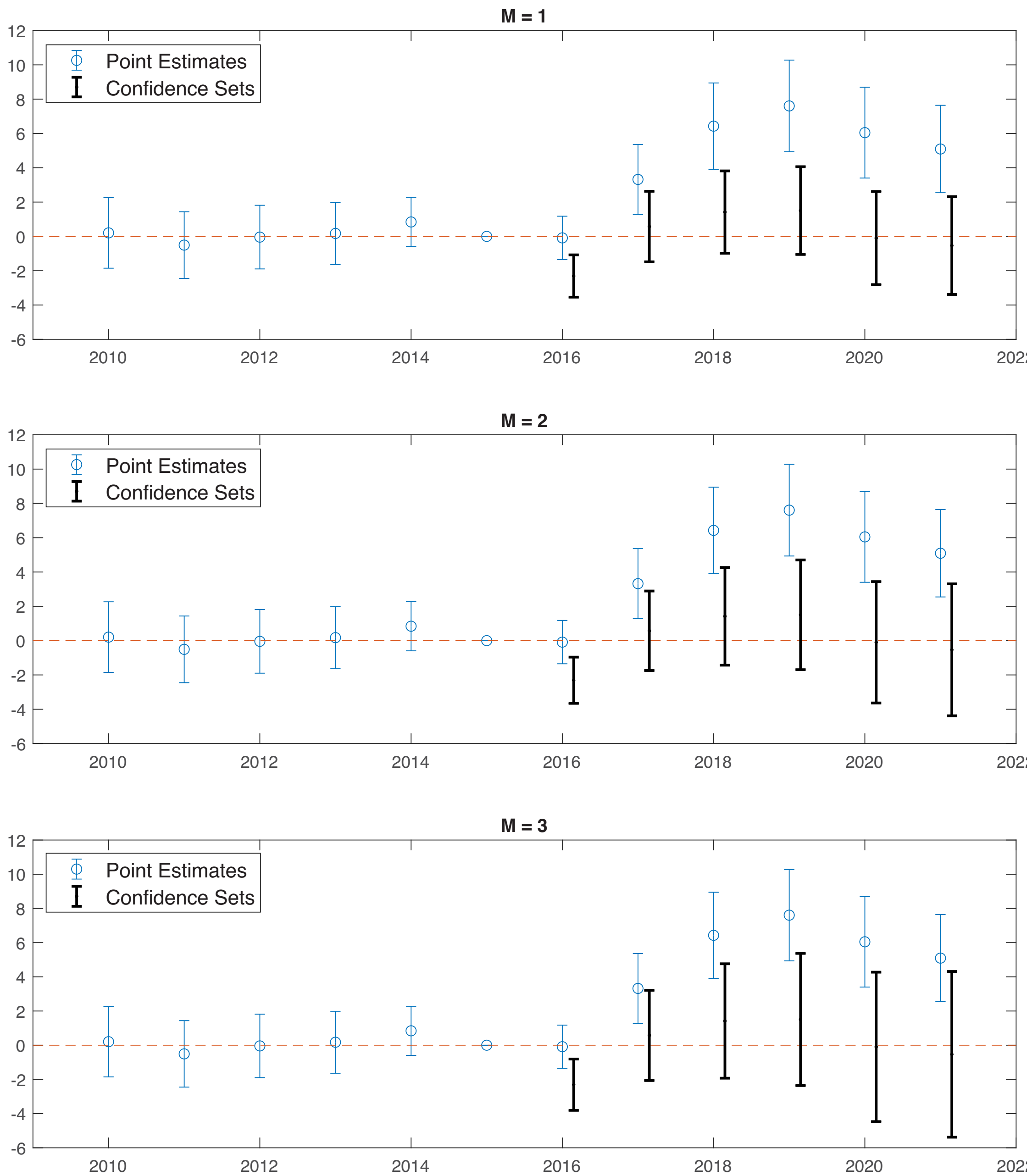

Fig. 13. Set-identified treatment effects, detached dwellings, 2010–2021. *Notes: M* denotes the length of the set of counterfactual outcomes in the final period (2021). Treatment date is 2015. Outcome is permits per statistical area. Error bars denote 95% confidence intervals.

land should be priced higher than non-upzoned land due to its greater potential floorspace capacity (Turner et al., 2017; Greenaway-McGrevy et al., 2021), all else equal. Relative to non-upzoned areas, land prices in upzoned areas increase from 2014 through to 2016, indicating that upzoning was capitalized into land prices soon after the policy was first announced in March 2013. Prior to 2013, coefficients are statistically indistinguishable from zero, indicating that there were no differential trends in land prices between upzoned or non-upzoned areas prior to policy announcement.

Another method to account for selection into treatment is to adopt an empirical model with period fixed effects that vary by geographic unit, which control for neighborhood-level demand trends. These trends may be a concern if policymakers direct development-intensive zones to neighborhoods that are experiencing upward or downward demand trends. The estimated treatment effects are robust to heterogeneous period fixed effects.

5.5.2. *Alternative treatment dates and samples*

We consider alternate specifications in which 2013, 2014 and 2016 are used as the date of treatment. Point estimates of treatment effects and spillover-adjusted treatment effects are reported in the Appendix. Estimates of the cumulative increase in the number of permits are slightly larger when alternative treatment dates are used, which is unsurprising given that permits in non-upzoned areas peaked in 2015.

We also consider empirical designs in which treatment and control areas are delineated differently. In the first, THA, MHU and MHS zones are the treatment group and SH areas are the control group. This ap-

ations are local government estimates used for the purpose of levying property taxes. See Greenaway-McGrevy et al. (2021) for additional details.

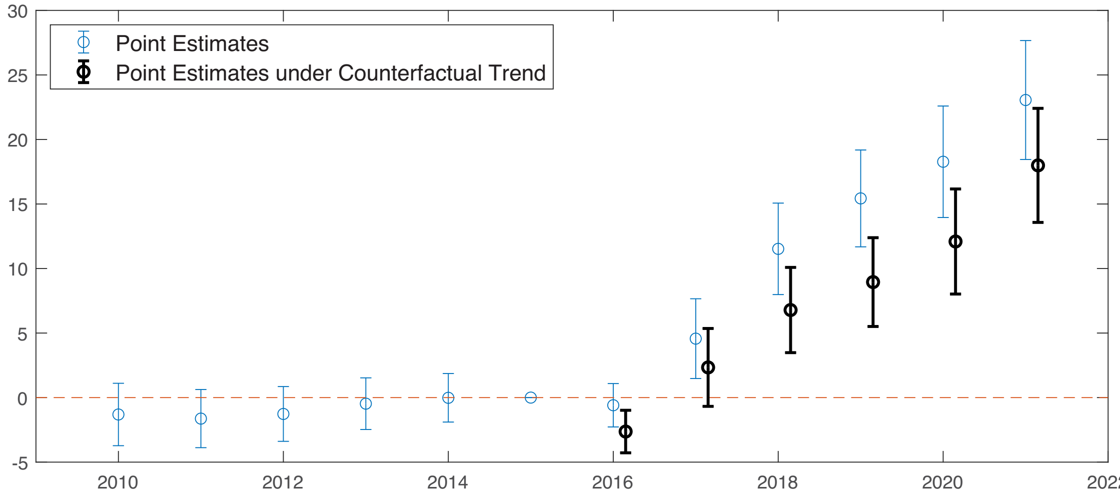

Fig. 14. Estimated treatment effects under counterfactual trend, all dwellings, 2010–2021. *Notes:* Estimates under the counterfactual trend are obtained by restricting the lengths of the counterfactual sets to zero, i.e. $M = 0$. Treatment date is 2015. Outcome is permits per statistical area. Error bars denote 95% confidence intervals.

proach ignores whether the floor area ratio (FAR) has changed. In the second, downzoned areas, where the FAR decreased, are excluded from the analysis. Our results and findings from these designs do not change substantively. Finally, we also consider a larger sample that includes permits issued under Special Housing Areas (see Section 2). Again, our findings and conclusions do not substantively change, although the point estimate of the net increase in permits under the linear trend counterfactual decreases to 17,957.

6. Discussion

The empirical findings show strong evidence to support the conclusion that upzoning raised dwelling construction in the city of Auckland. Set-identified treatment effects remain statistically significant even under counterfactual sets that include an implausibly large, four-fold increase in the trend rate of construction in control areas under the counterfactual of no-upzoning. The data also reveal that much of this increase is in the form of the more capital intensive, attached (or multifamily) structures in the inner suburbs of the city.

These findings are a positive sign for proponents of upzoning as a solution to unresponsive housing supply, particularly when compared to recent studies that show that zoning reforms have not had a substantial impact on housing construction (Freemark, 2019; Limb and Murray, 2022). Although the present paper does not explicitly identify factors that mediate the efficacy of zoning reforms in different contexts, comparisons to other reforms may shed light on the underlying mechanisms and thereby assist in directing future research. For example, the large-scale upzoning in Auckland may have fostered greater competition in land supply to developers, resulting in lower upzoned land prices than would have occurred if the policy had instead been restricted to specific neighborhoods or transit corridors. Alternatively, demand for housing in Auckland has significantly outstripped supply over the past few decades, resulting in housing that is amongst the most expensive in the world when measured against local incomes: Auckland may have significantly more latent demand for housing than other cities. We anticipate future research will address these questions to further guide policymakers in the design and implementation of zoning reforms.

We conclude by noting that the impact of upzoning on housing construction and housing markets will continue to be felt over coming years. Permits for attached dwellings are still trending upwards and permits for detached dwellings remain significantly above their pre-upzoning average. In future work, and as new data become available, the impact of the policy on the housing stock will be updated and new research will seek to determine the particular characteristics of parcels that predict the uptake of redevelopment. Such findings should be useful in assisting the design and refinement of future upzoning policies.

CRediT authorship contribution statement

Ryan Greenaway-McGrevy: Conceptualization, Investigation, Methodology, Software, Writing – original draft. **Peter C.B. Phillips:** Methodology, Supervision, Writing – review & editing.

Appendix A.

The Appendix provides additional details concerning the Auckland Unitary Plan (AUP), the methods employed in our empirical work, with additional findings and robustness checks.

A1. Background and detailed timeline of the Auckland unitary plan

Prior to 2010, the greater Auckland metropolitan region comprised seven city and district councils: Auckland City Council, North Shore City Council, Waitākere City Council, Manukau City Council, Rodney District Council, Papakura District Council, and Franklin District Council. On 1 November 2010, Auckland Council (AC) was formed when the eight previous governing bodies in the region were amalgamated. Legislation was also passed by the central government requiring AC to develop a consistent set of planning rules for the whole region under the Local Government Act 2010. This set of planning rules is embodied in the Auckland Unitary Plan (AUP).

Key dates in the development and implementation of the AUP are as follows:

- 15 March 2013: AC releases the draft AUP. The next 11 weeks comprised a period of public consultation, during which AC held 249 public meetings and received 21,000 items of written feedback.
- 30 September 2013: AC released the Proposed AUP (PAUP) and notified the public that the PAUP was open for submissions. More than 13,000 submissions (from the public, government, and community groups) were made, with over 1.4 million separate points of submission.
- April 2014 to May 2016: an Independent Hearings Panel (IHP) was appointed by the central government, which subsequently held 249 days of hearings across 60 topics and received more than 10,000 items of evidence.

- 22 July 2016: the IHP set out recommended changes to the PAUP. One of the primary recommendations was the abolition of minimum lot sizes for existing parcels. The AC considered and voted on the IHP recommendations over the next 20 working days. On 27 July the public could access and view the IHP's recommendations.
- 19 August 2016: AC released the "decisions version" of the AUP, including the new zoning maps. Several of the IHP's recommendations were voted down, including a IHP recommendation to abolish minimum floor sizes on apartments. However, the abolition of minimum lot sizes for existing parcels was maintained. This was followed by a 20-day period for the public to lodge appeals on the decisions version in the Environment Court. Appeals to the High Court were only permitted if based on points of law.
- 8 November 2016: A public notice was placed in the media notifying that the AUP would become operational on 15 November 2016.
- 15 November 2016: AUP becomes operational. There were two elements of the AUP that were not fully operational at this time: (i) any parts that remain subject to the Environment Court and High Court under the Local Government Act 2010; and (ii) the regional coastal plan of the PAUP that required Minister of Conservation approval.

All versions of the AUP ("draft", "proposed", "decisions" and "final") could be viewed online.

A2. Upzoning classification

For each geocoded permit in our sample, we identify the zone that previously applied to the permit's location using GIS databases for each of the seven city and district plans. Then, for each of the approximately 115 residential zones (across the seven councils) that previously existed, we calculate the floor area ratio (FAR) based on the height limits and site coverage ratios in the district and city plans. Height limits are translated into storey limits based on building on with minimum 0.6 m ground clearance, 2.68 m per storey, and at least 2 m for a roof. The maximum FAR is then calculated as the product of the effective storey limit and the site coverage ratio. Permits that are located in areas that were previously not zoned as residential (business, rural, or open space) are classified as upzoned since they have been converted to enable residential housing.

We can apply the same algorithm to identify the zones of individual land parcels in order to quantify the amount of upzoned land. We obtain GIS information on land parcels for November 2016, when the AUP was operationalized. We then assign each parcel to a pre- and post-AUP zone using the polygon's centroid, and apply the same algorithm described above to classify upzoned parcels. This process allows us to quantify the amount of upzoned land, as discussed in Section 2.

The parcel dataset is also used to calculate the amount of undeveloped residential land and the zoning concentration measure for each SA. These measures are used in the spillover analysis in Section 4.3. Parcels are also used to repair consents with geocoordinates that fall onto road frontages by finding the nearest parcel to the geocoordinate. This repair affects less than 2% of our sample.

A3. Structural break in trend in permits

For $j = 0$ (i.e., control group), we estimate

$$y_{i,j,t} = \alpha_{i,j} + \beta_j 1_{t\geq 1} + \delta_j t + \gamma_j 1_{t\geq 1} t + \varepsilon_{i,j,t}$$

where recall that $y_{i,j,t}$ is the number of permits in zone j in area i in year t, $1_{t\geq 1}$ denotes an indicator set to one for time periods after the treatment date (2015). OLS estimates are $\hat{\beta}_0 = 1.960$ (t-statistic = 1.383), $\hat{\delta}_0 = 0.418$ (t-stat = 3.0100) and $\hat{\gamma}_0 = -0.441$ (t-stat = −2.175), indicating a statistically significant reduction in the upwards linear trend after 2015. t-statistics are based on panel data Newey-West standard errors with the temporal bandwidth set to two periods.

A4. Set identification

This section is based on Section 3.1 of RR (2023). Let $\theta = l'\tau_{post}$ be a linear combination of the treatment parameters of interest, where $l \in \mathbb{R}^{\overline{T}}$. For example, if we are interested in the treatment effect in the final period, $l = (0, \dots, 0, 1)'$. Next, let $\hat{\lambda}_n$ be a relevant m-subvector of the estimate $\hat{\Lambda}_n = \left(\hat{\phi}_n', \hat{\beta}_n'\right)'$, where $\hat{\lambda}_n \sim \mathcal{N}\left(\lambda, \Sigma_n\right)$. That is, there exists a full column rank $\left(\underline{T} + \overline{T}\right) \times m$ selection matrix $\mathbf{J}$ such that $\hat{\lambda}_n = \mathbf{J}'\hat{\Lambda}_n$. The choice of $\hat{\lambda}_n$ depends on both the parameter of interest θ and the counterfactual set. A specific example is given below. We similarly define $\lambda = \mathbf{J}'\Lambda$, where $\Lambda = \left(\phi', \beta'\right)'$ can be decomposed as follows

$$\Lambda = \begin{bmatrix} \phi_{pre} \\ \phi_{post} \\ \beta_{pre} \\ \beta_{post} \end{bmatrix} = \begin{bmatrix} \phi_{pre} \\ \phi_{post} \\ \beta_{pre} \\ \delta_{post} \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0 \\ \tau_{post} \end{bmatrix} =: \delta + \tau.$$

The decomposition above accords with that given for β in (2) of RR (2023). We simply extend their framework to include ϕ in the parameter space of interest.

We consider FLCIs based on affine estimators of θ of the general form

$$C_{\alpha,n}(a, v, \chi) = \left(a + v'\hat{\lambda}_n\right) \pm \chi,$$

where α and χ are scalars, $v \in \mathbb{R}^m$, and $\alpha \in (0, 0.5]$ denotes a significance level. We choose a and v to minimize

$$\chi_n(a, v; \alpha) = \sigma_{v,n} \cdot cv_\alpha\left(\bar{b}(a, v)/\sigma_{v,n}\right),$$

where $\sigma_{v,n} = \sqrt{v'\Sigma_n v}$, and $cv_\alpha(\cdot)$ denotes the $1 - \alpha$ quantile of the folded normal distribution with unit variance, $\left|\mathcal{N}(\cdot, 1)\right|$. The quantity $\bar{b}(a, v)$ denotes the worst-case bias of the affine estimator for a given a and v, namely

$$\bar{b}(a, v) := \sup_{\delta\in\Delta, \tau_{post}\in\mathbb{R}^{\overline{T}}} \left|a + v'\left(\mathbf{J}'\delta + \mathbf{J}'\tau\right) - l'\tau_{post}\right|, \tag{3}$$

where Δ denotes the set of permissible values of δ articulated under the counterfactual.

To demonstrate the method in more detail, we take $\theta = \tau_{\overline{T}}$ (so that interest is focused on the final treatment effect) and obtain the set of permissible values of $\delta_{\overline{T}}$ from (2):

$$\Delta_{\overline{T}} = \left\{\delta_{\overline{T}} : \delta_{\overline{T}} \in \left(-2\hat{\phi}_{-\underline{T}}\overline{T}/\underline{T} - M - 2\hat{\phi}_{\overline{T}}, -2\hat{\phi}_{-\underline{T}}\overline{T}/\underline{T} + M - 2\hat{\phi}_{\overline{T}}\right)\right\}, \tag{4}$$

Thus $\lambda = \left(\phi_{-\underline{T}}, \phi_{\overline{T}}, \beta_{\overline{T}}\right)$ is the subvector of parameters of interest. The affine estimator is then defined on $\hat{\lambda}_n = \left(\hat{\phi}_{-\underline{T}}, \hat{\phi}_{\overline{T}}, \hat{\beta}_{\overline{T}}\right)$, and (3) can be more succinctly expressed as

$$\bar{b}(a, v) := \sup_{\delta_{\overline{T}}\in\Delta_{\overline{T}}, \tau_{\overline{T}}\in\mathbb{R}} \left|a + v'\left(\begin{bmatrix} \hat{\phi}_{-\underline{T}} \\ \hat{\phi}_{\overline{T}} \\ \delta_{\overline{T}} \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ \tau_{\overline{T}} \end{bmatrix}\right) - \tau_{\overline{T}}\right|.$$

A5. Robustness checks

A5.1. Sales

We fit the multi-period DID model to the log of residential housing sales. We set 2013 as the treatment date, since the policy is first announced in March 2013. Figure 21 shows that there is no significant increase in sales prior to implementation in 2016.

A5.2. Land prices

Let $p_{i,t}$ denote the log sales price of house i in year t. Our empirical model is

$$p_{i,t} = \delta_0' Z_i + \sum_{s=-\underline{T},s\neq 0}^{\overline{T}} \mathbf{1}_{s=t}\delta_s' Z_i + \mathbf{1}_{i\in u}\beta_{0,j}' Z_i + \sum_{s=-\underline{T},s\neq 0}^{\overline{T}} \mathbf{1}_{s=t}\mathbf{1}_{i\in u}\beta_{s,j}' Z_i + \varepsilon_{i,t}, \quad (5)$$

where $Z_i = \left(1, z_i, X_i'\right)$, and where z_i is site intensity, and X_i is a vector of standardized control variables, including floorspace, building age, number of garages, Manhattan distance to CBD, distance to nearest highway onramp, and distance to the nearest rapid transit station. The sample is a repeated sample of cross sections, since properties are not sold in every year of the sample period. $\mathbf{1}_{i\in u}$is an indicator equal to one if house i is located in an upzoned area.

Site intensity is the ratio of improvements to total value of the property. Valuations are constructed by Auckland Council for levying property taxes. Vacant land, and properties with improvements valued at zero, have a site intensity of zero. Thus, the average change in the land price differential between upzoned and non-upzoned properties in period s is given by the first element of $\beta_{s,j}$, holding all else equal. We plot point estimates of these coefficients in Figure 22, both with and without control variables in the model specification. Land prices in upzoned areas increase relative to non-upzoned areas soon after announcement, but not before, indicating that the policy was not anticipated by the market. The model with controls indicates that land prices in upzoned areas increased by between 20 and 25% relative to non-upzoned areas, holding all else constant.

A5.3. Local period fixed effects

We estimate

$$y_{i,j,t} = \alpha_{i,j} + \sum_{s=-\underline{T},s\neq 0}^{\overline{T}} \phi_{i,s}\mathbf{1}_{s=t} + \sum_{s=-\underline{T},s\neq 0}^{\overline{T}} \beta_s \mathbf{1}_{s=t,j=1} + \varepsilon_{i,j,t} \quad (6)$$

where the period fixed effects $\phi_{i,s}$ are now indexed by the statistical area i. Figure 20 exhibits estimated treatment effects.

A5.4. Alternative treatment dates

Figure 18 exhibits estimated treatment effects when 2013, 2014 or 2016 is used as the treatment date instead of 2015. Constraining the counterfactual to the linear trend results in 26,800, 23,544 and 31,808 additional permits when 2013, 2014 and 2016 are used as the treatment date, respectively. The corresponding upzoned differentials (i.e., the cumulative difference between upzoned and non-upzoned areas) for these three treatment dates are 34,406, 34,670 and 36,318 permits, respectively.

A5.5. Alternative treatment and control areas

Figure 19 exhibits estimated treatment effects under different delineations of treatment and control areas. In the top panel, THA, MHU and MHS zones comprise the treatment areas, and SH is the control area. Constraining the counterfactual to the linear trend results in 20,195 additional permits. The upzoned differential is 35,052 permits. In the middle panel, downzoned areas are removed from the baseline sample, as defined in the main text. Constraining the counterfactual to the linear trend results in 20,307 additional permits. The upzoned differential is 34,897 permits. In the bottom panel, permits issued under Special Housing Areas are included in the sample. Constraining the counterfactual to the linear trend results in 17,957 additional permits, while the upzoned differential is 33,137 permits. Under set identification (not pictured), the confidence sets remain statistically significant even when allowing for a more than three-fold increase in the pre-treatment trend in non-upzoned areas.

A6. Additional figures

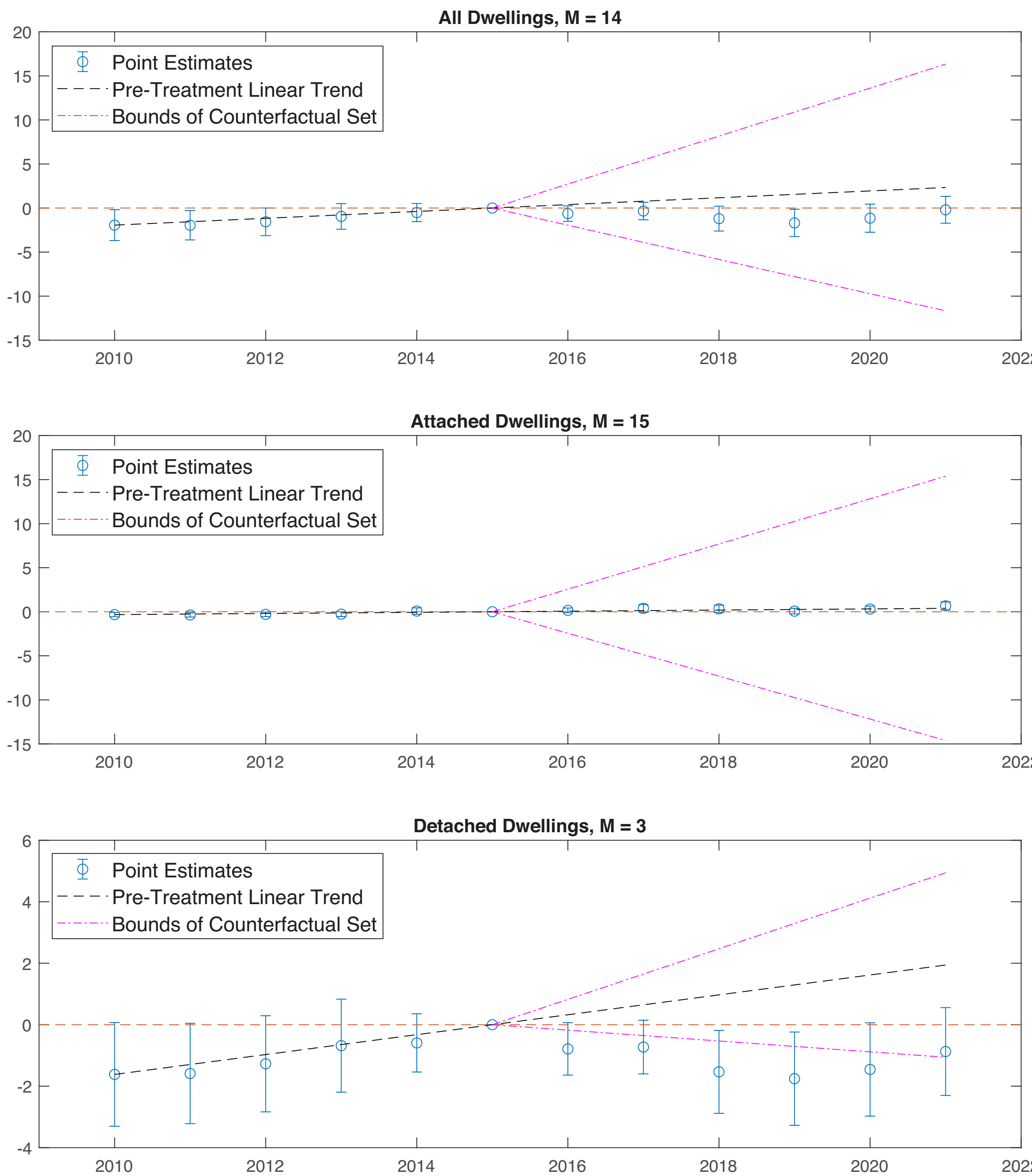

Fig. 15. Estimated period fixed effects and post-treatment counterfactual sets, 2010-2021. *Notes: M* denotes the length of the counterfactual set in the final period (2021). The set of counterfactual outcomes in post-treatment periods is the space between the bounds.

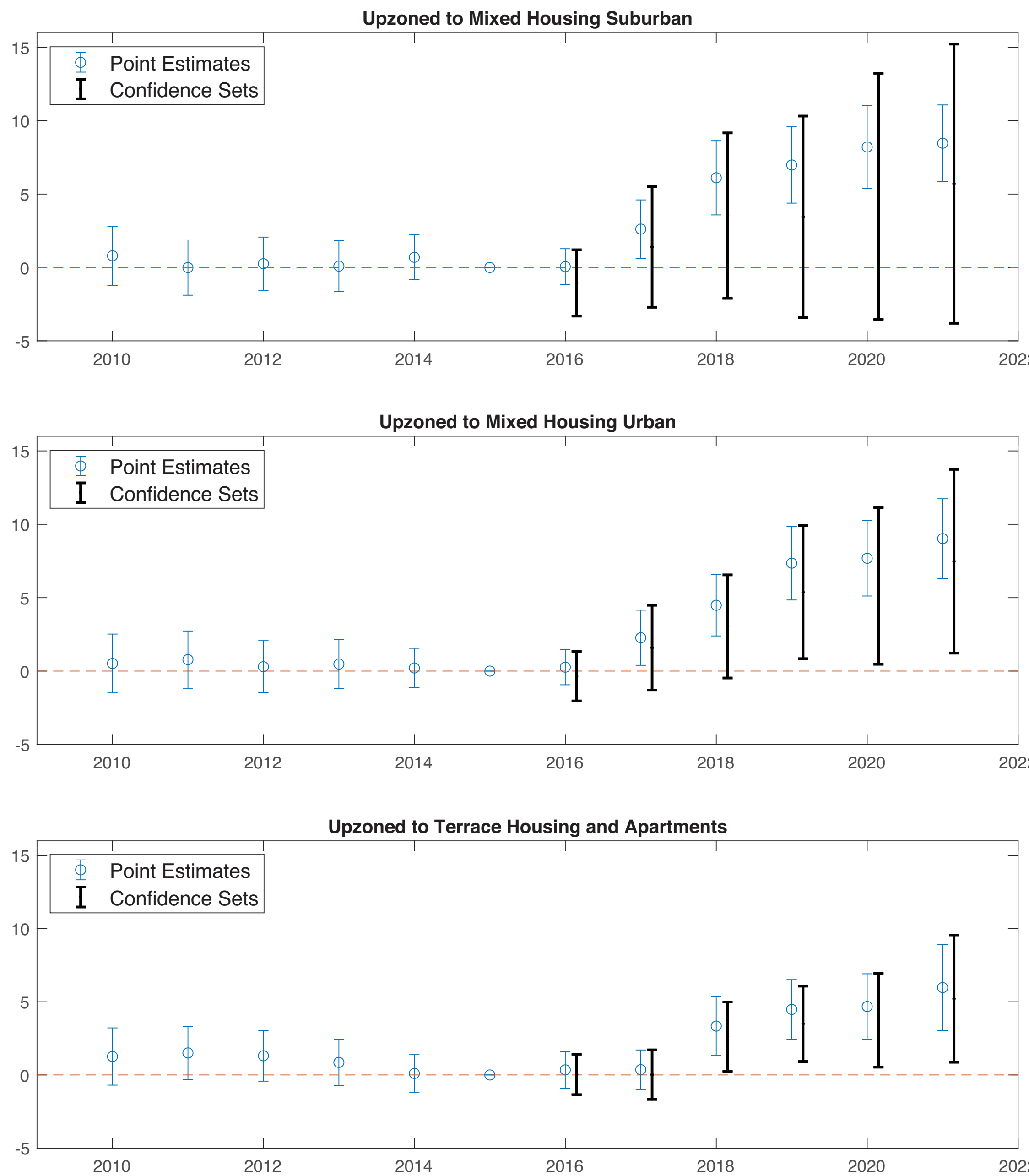

Fig. 16. Set-identified treatment effects by residential zone, 2010-2021. *Notes:* The length of the counterfactual set for the final period (2021) is set to 14, i.e. $M = 14$. Treatment date is 2015. Outcome is permits per statistical area. Error bars denote 95% confidence intervals.

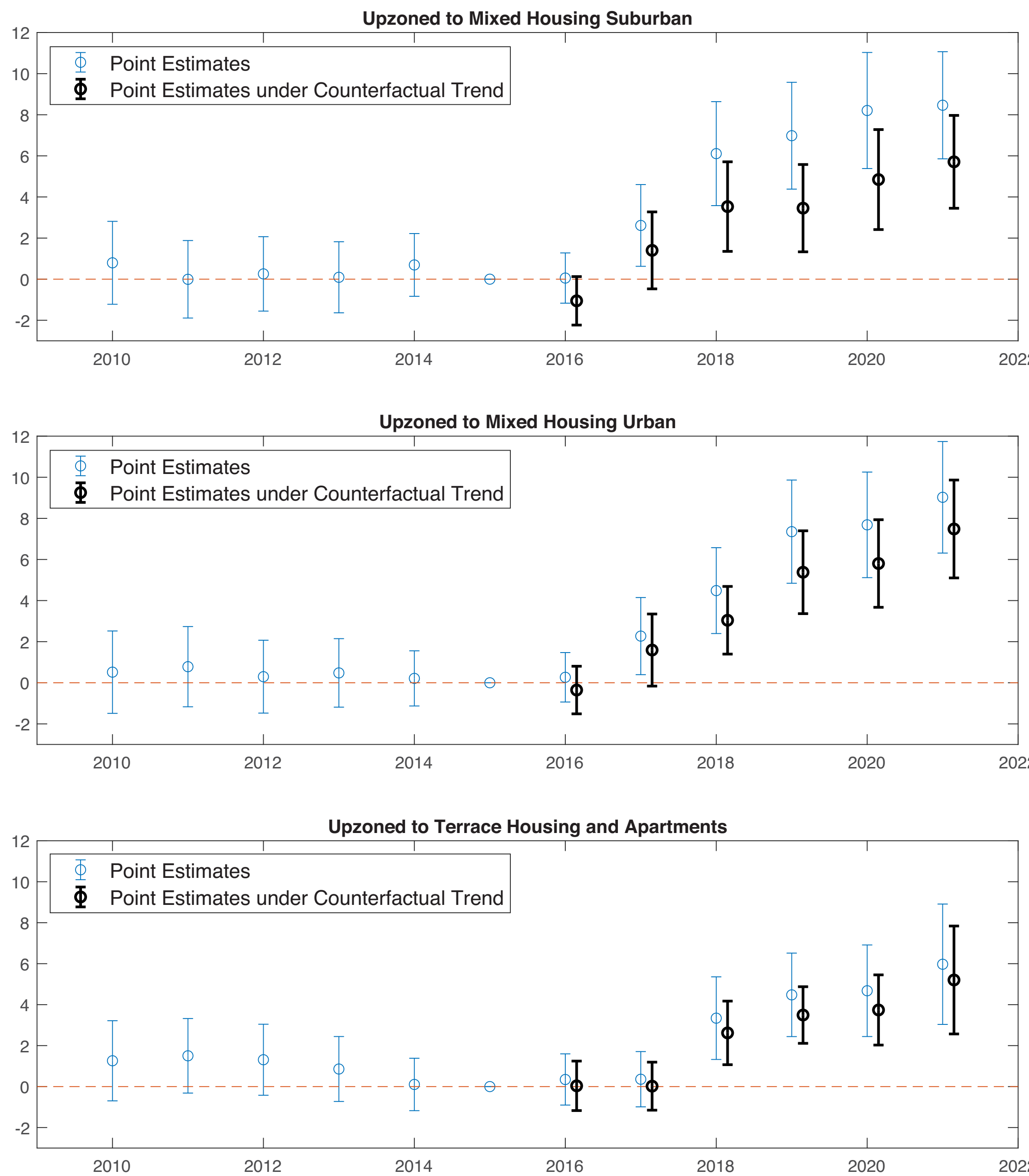

Fig. 17. Estimated treatment effects by residential zone under counterfactual trend, 2010-2021. *Notes:* Estimates under the counterfactual trend are obtained by restricting the lengths of the counterfactual sets to zero, i.e. $M = 0$. Outcome is permits per statistical area. Error bars denote 95% confidence intervals.

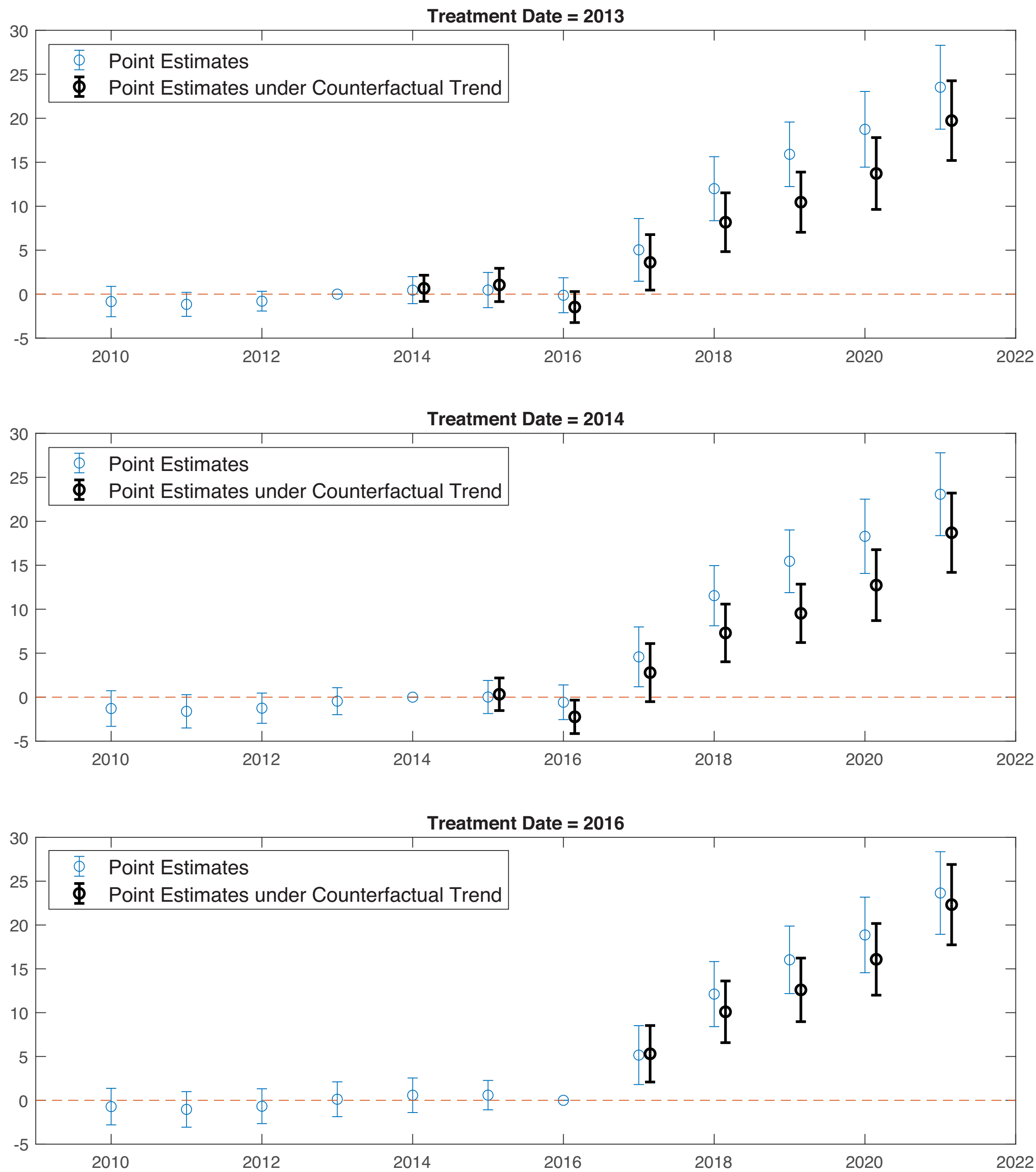

Fig. 18. Estimated treatment effects under alternative treatment dates. *Notes:* Estimates under the counterfactual trend are obtained by restricting the lengths of the counterfactual sets to zero, i.e. $M = 0$. Outcome is permits per statistical area. Error bars denote 95% confidence intervals.

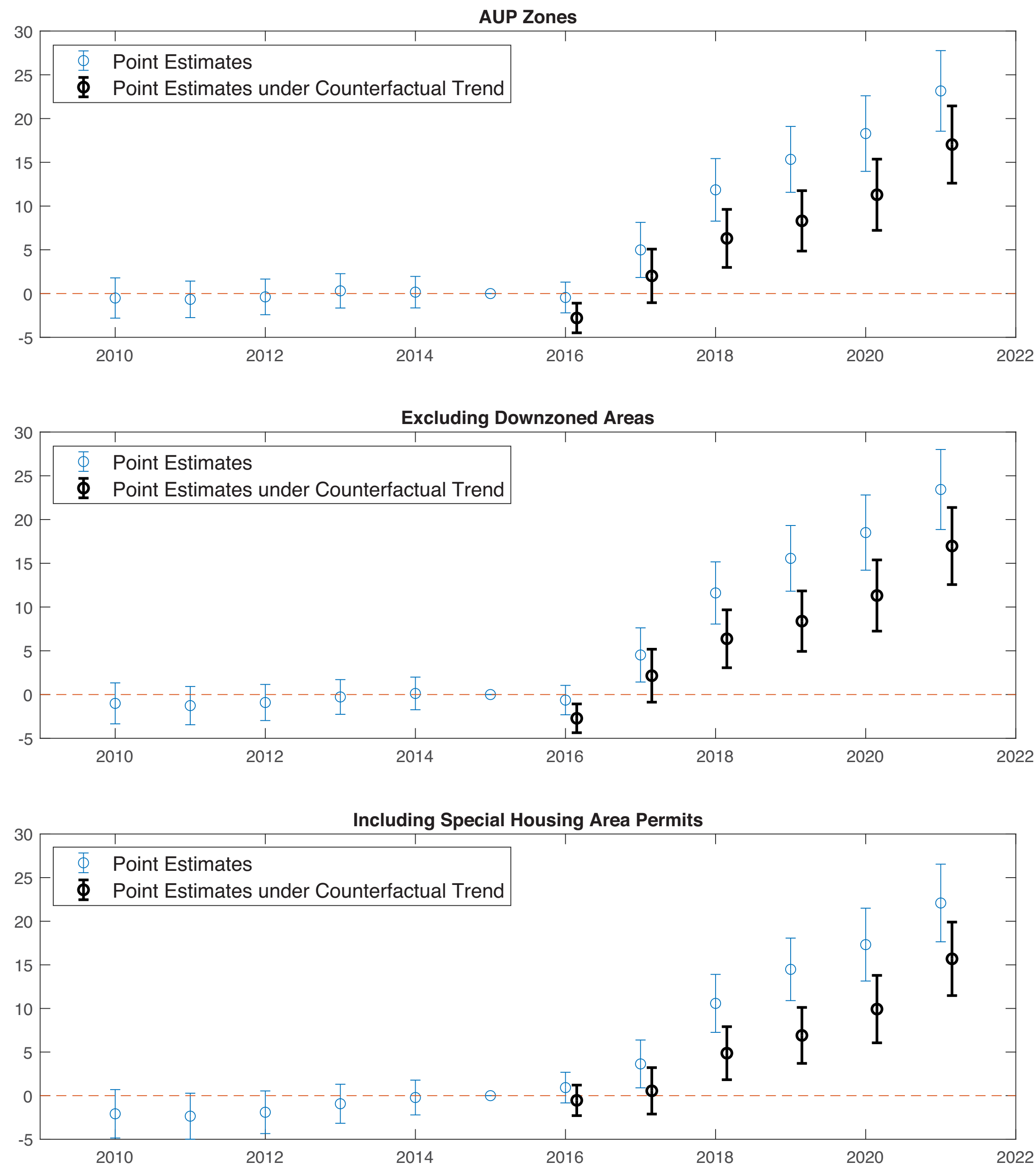

Fig. 19. Estimated treatment effects under alternative treatment and control areas. *Notes:* Estimates under the counterfactual trend are obtained by restricting the lengths of the counterfactual sets to zero, i.e. $M = 0$. Top: Terrace Housing and Apartments, Mixed Housing Urban and Mixed Housing Suburban zones comprise the treatment group, and the Single House zone is the control group. Middle: Downzoned areas removed from the sample. Bottom: Permits issued under special housing areas (see Section 2) are included in the sample. Outcome is permits per statistical area. Error bars denote 95% confidence intervals.

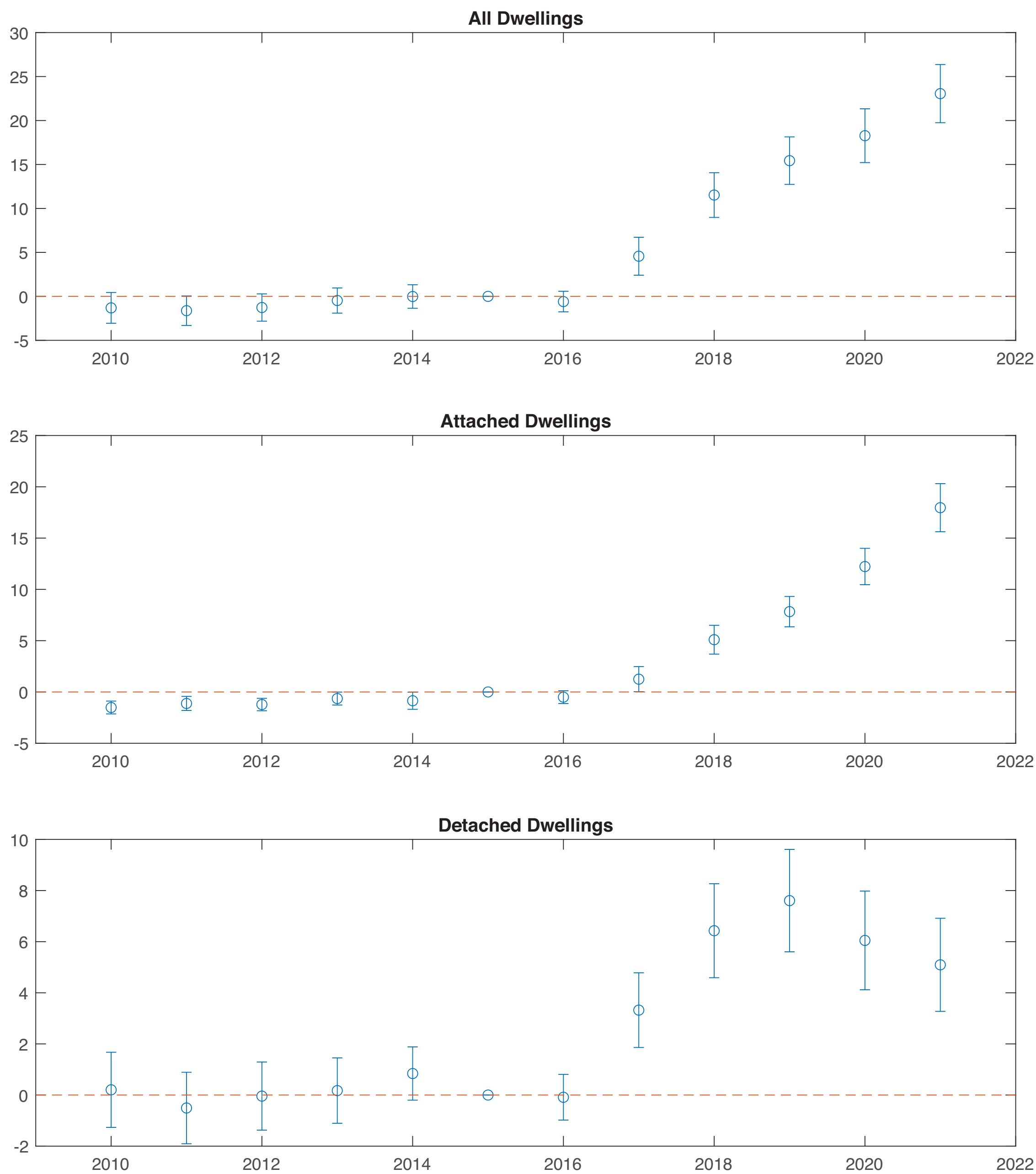

Fig. 20. Estimated Treatment Effects under Specification with Local Period Fixed Effects. *Notes:* Estimated treatment effects (circles) and 95% confidence intervals (error bars). Treatment date is 2015. Outcome is permits per statistical area.

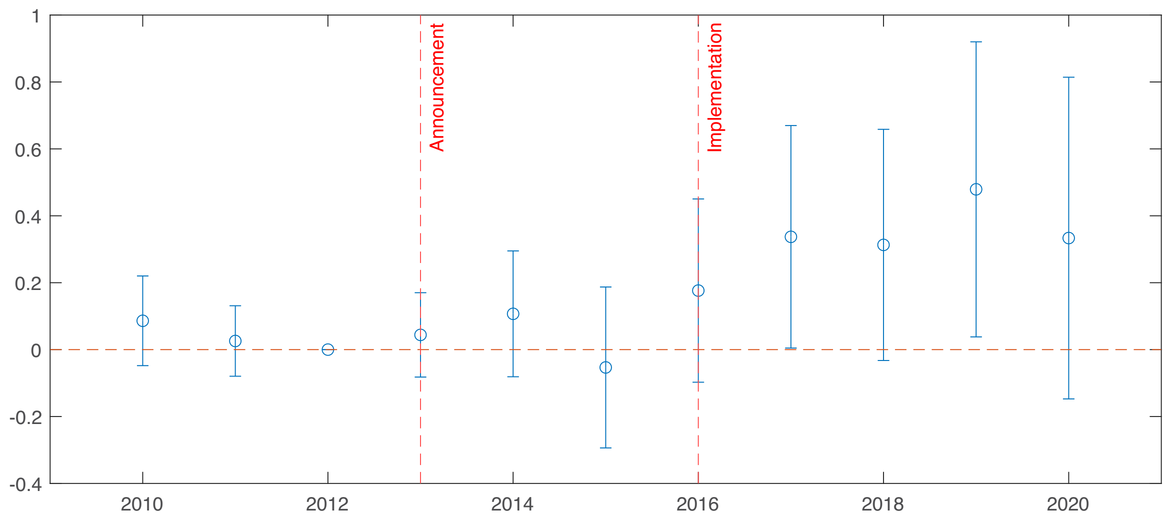

Fig. 21. Estimated Treatment Effects for Housing Sales, 2010-2021. *Notes:* Estimated treatment effects (circles) and 95% confidence intervals (error bars). Treatment date is 2012. Outcome is log housing sales per statistical area.

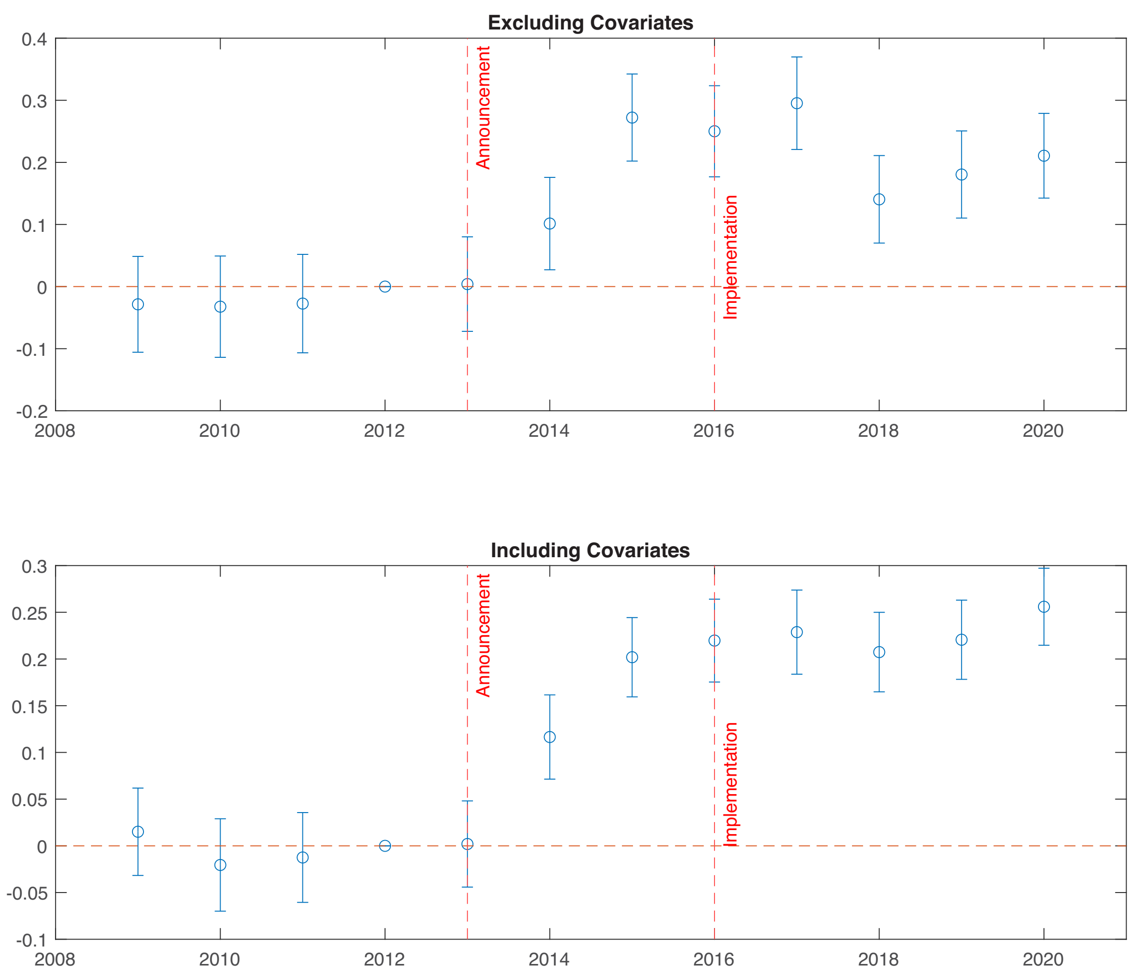

Fig. 22. Estimated Treatment Effects for Land Prices, 2010-2021. *Notes:* Estimated treatment effects (circles) and 95% confidence intervals (error bars). Treatment date is 2012. Models with (bottom) and without (top) covariate control variables. Outcome is log land prices.

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