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ARTICLE

Exploring the nexus between entry affordability and rent affordability in the private rental market of greater Melbourne

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Abstract
Recognising the discrepancies in the features of dwelling types, we adopted a submarket model using quarterly panel data for 31 local government areas (LGAs) of Greater Melbourne, spanning March 2000 to December 2021, and documented the following findings. First, challenging entry affordability is causing a deterioration of rent affordability in the private rental housing market. As entry to the market has become a difficult venture for prospective homebuyers, the ultimate result is an expansion of the private rental market. Second, as the supply of vacant dwellings with multiple bedrooms increases, the rent of dwellings with fewer bedrooms would likely drop. Third, the more the state government offers the first homeowner grant, the greater the chances of improving rent affordability in the private rental market. These results could inform the decisions of various stakeholders of the private rental housing market including policymakers, residential property developers, and investors in terms of their activities in the rental market.

Keywords Greater Melbourne · Entry affordability · Rent affordability · Regional policy · Private rental market

1 Introduction

The continuous deterioration of housing affordability in many metropolitan cities across the globe has become a subject of discussion in the housing literature. This ongoing astronomical increase in housing prices experienced by households is caused by both the supply and demand sides of the market (Akinsomi et al., 2024; Ghimire and Skinner 2022). More households are being priced out of the housing market, especially in metropolitan cities. This situation is worsened by comparatively low household income growth, causing significant affordability challenges (Bangura & Lee, 2023, 2024b).

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Moreover, the deterioration in affordability is not uniform across Australia but rather, more evident in the Sydney and Melbourne housing markets (Whelan et al., 2023). This is reiterated in the Demographia affordability index, which cited Melbourne as one of the most severely unaffordable cities in the world next to San Jose in the USA, Vancouver in Canada, Hong Kong, and Sydney in Australia. Melbourne is also one of the cities that experienced the largest housing affordability deterioration from the pre-pandemic period to 2021 (Demographia 2022). Consequently, the percentage of mortgaged homeowners declined by 4%, while the proportion of renting households increased by 4.5% between 2006 and 2016. More importantly, the 20% deposit on a median-priced property has risen from 93% of annual household income in 2001 to 143% in 2017. This is indicative of a trend towards greater levels of rental tenure (Parliament of Victoria, 2017).

Deteriorating housing affordability is producing an inflated proportion of lifelong renters in the housing market, subsequently causing an expansion of the private rental housing market (Brett, 2021; Newman 2019). The rent paid by households in the growing private rental market is also rising and it varies across cities, depending on the interplay between renters and landlords in the market (Gilderbloom and Wesley 2022). This often triggers state policies to help cushion the effect of rising rent on low-income households. In Australia, for example, Commonwealth rent assistance and public housing schemes are used to help ease the financial burden of increasing rents on these demographics. This support is somewhat limited, leaving many renting households to face the challenges in the private rental market. Therefore, an enhanced understanding of how market entry is linked with the private rental market will offer significant implications for the private rental market. Many studies relating to residential rent have focussed on institutional and individual investment, the supply of rental properties, demand, and policies (Gurran et al., 2021; Hulse & Yates, 2017; Lawson et al., 2018; Morris et al., 2021; Pawson et al., 2019). The link between declining entry affordability and its effects on the private rental housing market has not received much attention in the literature. This is acknowledged by Chiang (2016), who noted the growing number of studies dedicated to house price behaviour, while little attention is paid to rental markets.

More importantly, existing studies on housing rent analysis are somewhat aggregated despite the importance of housing submarket analysis in metropolitan areas initially raised by Grigsby (1963). Further, as Leishman et al. (2013), Randolph and Tice (2014), Costello et al. (2019), and Bangura and Lee (2022, 2023) concluded, existing empirical evidence has shown that housing submarket analysis is no longer contestable due to the existential discrepancies in the social, economic, and demographic makeup of housing systems, especially in metropolitan areas. Morley and Thomas (2016) and Lee (2017) reiterated that different dwelling types are characterised by different risk-return profiles, which means housing types are critical in delineating housing submarkets. Nishi et al. (2019) supported these findings and concluded that housing types and features significantly impact housing rent.

Despite the importance of disaggregated analysis, limited attention has been paid to housing rent from a submarket perspective using dwelling types in the context of an advanced economy. Moreover, the recent findings of Morris et al. (2021) and Palm et al. (2021) elucidated the importance of a more detailed analysis of the private rental market for a more informed regulatory framework for this market. Therefore, an exploration of the nexus between entry affordability and rent affordability in a private rental market, the causal relationship between these variables as well as the connection between rent and the supply of vacant rental dwellings across dwelling types, is critical in understanding rent dynamics and in regulating the private rental market.

Melbourne, the capital city of Victoria in Australia, presents a fascinating case study for disaggregated housing rent analysis by dwelling types. According to the Australian Bureau of Statistics [ABS] (2020), Greater Melbourne is projected to become the largest city in Australia by 2066, with an expected population of 12.2 million by 2057. A research report from the Parliament of Victoria (2017) also revealed a steady increase in the proportion of the renting population in the private rental market of Greater Melbourne between 2006 and 2016. Further, ABS (2017) reported a 17% increase in the renting population of Greater Melbourne between 2011 and 2016. Greater Melbourne's housing market is also one of the least affordable in Australia due to the sustained increase in housing prices over income growth. There is also a substantial drop in social housing as a percentage of total housing stock, thereby expanding the private rental market of the city (Morris et al., 2021). What is more, the city has developed submarkets in the rental market over the years. King () has extensively discussed the formation of housing submarket diversity within Melbourne over time. They identified service improvement, the public transport network, and changes in economic activities over time as contributing factors to rent differentials across dwelling types. Therefore, Greater Melbourne is ideal for a submarket analysis of the private rental market. Noting the limited literature on housing rent analysis, we define housing submarkets at two different levels (i.e. dwelling types; and high-end and low-end dwellings) and focus on the following research components: market entry of prospective homebuyers for different property types; the entry and rent affordability nexus; the interaction between rent and the supply of vacant rental dwellings; and the impact of state government budgetary allocation via the first homeowner grants on rent affordability.

The rest of the paper is structured as follows: Sect. 2 contains the literature review, while Sect. 3 discusses the conceptual framework of the private rental market. Section 4 presents the data and methodology used in the study. We discuss the results in Sect. 5 and present the concluding statements in Sect. 6.

2 Literature review

Recent studies have provided colossal evidence of the rapid decline in homeownership and an increasingly less affordable and insecure private rental housing market across cities (Waldron, 2021; Whelan et al., 2023). Malpezzi (2023) and Bangura and Lee (2023) identified income, household characteristics, and population as critical demand-side factors contributing to declining affordability. Other studies, like Whelan et al. (2023) and Garde and Song (2022), noted the increasing importance of supply-side measures to curb affordability. As entry into the housing market becomes more challenging, more households are making their way to the rental market. Leishman and Baker (2019) found the proportion of the renting population is increasing, especially the age bracket of 20–39, which leaped from 34% in 2006 to approximately 41% in 2016. Similarly, Byrne (2020) reported younger households are likely to stay in the rental market longer than those born after the baby boomer generation in Ireland, the United Kingdom, and Spain. This trend continues to put pressure on the private rental market as the supply of public housing is also shrinking. OECD (2023) provided further evidence about the shortage of low-rent housing stock in the private rental housing markets of many OECD nations. This declining trend in the supply of rental housing stock is increasing housing costs. Maalsen et al. (2020) noted that housing costs had shifted about 1.3 million Australians into poverty, and furthermore, that private rental housing has ceased to be a transient measure to the housing challenges

of many Australians before the pandemic. Gurran et al. (2021) reported the shortage of affordable rental housing as being more predominant in metropolitan than in non-metropolitan regions of Australia. They further found the private rental sector in the Australian housing system increased by 17% from 2011 to 2016.

The importance of the private rental market has also motivated empirical studies on the key drivers of housing rent. Empirically, Staikos and Xue (2017) found housing rent to be generally sensitive to interest rates and housing values. More recent studies have offered empirical evidence of the asymmetric effects of rent burden among households. Brett (2021) found rent gaps across several cities and territories in Danish, German, Swedish, and US cities. Grossmann et al. (2021) supported Brett's (2021) findings and highlighted the disproportionate rent burden among households, with income-poor households expending a greater proportion of their income on rent compared to their income-rich counterparts. McKee et al. (2020) also discussed the diversity in households being accommodated by the private rental market in the UK and highlighted the emotional toll of private renting on low-income cohorts. MacDonald et al. (2018) highlighted the role of race in the rental market as they found minority renting households in neighbourhoods characterised by low employment rates and higher crime rates. The work of Ambrose et al. (2015) noted the significant difference in rent across cities in the USA, while Wang (2016) found that, in most core areas of metropolitan cities, the rate of growth of housing rent far outstrips wage increase. Relating their study to the quality of the rental market, Yamagishi (2021) analysed the low-quality rental market and found a 10% increase in minimum wage would increase rent by 2.5% to 4.5%.

Focussing on policies that seek to ameliorate housing rent, in Australia, Berry (2003) and Wood and Ong (2011) identified Commonwealth rent assistance and public housing as the two main forms of housing assistance policies. The Commonwealth rent assistance is a non-taxable cash supplement provided by the Commonwealth government to private or community renter households who receive pensions, allowances, or Family Tax Benefit Part A (Department of Social Services [DSS] 2016). Public housing is subsidised housing that is typically managed by state and territory housing authorities such as Housing NSW. Public housing is offered to eligible tenants at below-market rents, thereby creating a demand–supply gap (Wood & Ong, 2011). In addition, the National Rental Affordability Scheme (NRAS) is part of the Australian Government's long-term response to the issue of housing affordability. Commencing on 1 July 2008, the NRAS seeks to stimulate the supply of new affordable rental dwellings through collaboration with state and territory governments. NRAS homes are rented to eligible tenants at a rate that is at least 20% below the market value rent, subject to meeting a set of eligibility criteria that principally include household income (DSS 2016). Newell et al. (2015) found that NRAS provides a relatively stable income stream that improves affordability. Kangasharju (2010) examined the impact of housing allowance policy on low-income renters. They found that, in the private sector, one extra Euro allowance would increase the rent of these households by a margin of 60–70 cents. Weber and Lee (2020) argued against rent control because it could deteriorate housing quality, impede the construction of new houses, and shrink the private rental market.

The role of institutional investors in promoting the rental market has also been examined in the literature. While Godwin et al. (2012) highlighted the lack of institutional framework for regulating landlord-tenant relations in the private rental housing market, Nethercote (2020) made a comparative inquiry into the concept of build-to-rent in the context of institutional investors and documented that these investors often maintain single ownership of a portfolio of large apartment complexes because of secured rental income and capital gains. However, in Australia, there are a smaller number of institutional investors in residential

property, including Real Estate Investment Trusts (REITs), due to low returns, high risk, high management cost, illiquidity, and poor market information (Berry 2003). This was resounded by Berry and Hall (2005), who highlighted taxation, government housing, and other policies as disincentives for institutional investors. This is in spite of the fact that the performance of residential REITs and private housing markets is closely linked (Bangura & Lee, 2024a) and residential REITs are an effective investment vehicle (Lin et al., 2019). Newell et al. (2015) surveyed Australian institutional investors about investment in residential property. They also identified the absence of appropriate structures in residential investment and low returns as critical issues in the residential property market. More recently, Newell et al. (2015) documented that the self-standing nature of residential properties requires management efficiencies that discourage institutional investors in residential properties.

As echoed by Palm et al. (2021) and Liu et al. (2016), previous studies have focussed on trends, location, supply–demand-side effects, and the regulatory frameworks and policies of private rental housing. However, most of these studies are narrative and aggregated at the metropolitan city, state, or country level. This is against the back of obvious variation in the risk-return profiles, types, and features of houses in these markets (Grigsby 1963; Randolph & Tice, 2014; Morley & Thomas, 2016; Costello et al., 2019; Nishi et al., 2019; Bangura & Lee, 2023). Our study, therefore, focuses on private rental housing using a submarket model defined by dwelling types.

3 Conceptual framework and hypothesis development

We conceptualise the private rental markets by linking three components: the economic segment, the social segment, and regulatory and policy environments. The economic segment represents the demand-side factors that determine the private rental market condition, and the social segment examines household characteristics and desires that determine their preferences. In contrast, the regulatory and policy environment represents the supply side of the housing market. Each of these components contributes to the dynamics of the private rental market. Figure 1 is, therefore, a visual representation of the conceptual framework of the rental market, providing a comprehensive overview of the multifaceted nature of this market that impacts rental prices and affordability.

According to Yates (2008) and more recently by Bangura and Lee (2023), rising population growth could expand housing demand and subsequently affect housing rent. Additionally, circumstances of net positive migration to a city, inability to enter the housing market, the unwillingness of some households to move to other cities or towns when priced out, and proximity to employment opportunities may impact the budgetary allocation of renting households. The Parliament of Victoria (2017), for instance, reported the proportion of renting households increased by 4.5% between 2006 and 2016. This is indicative of the increasing trends of rental tenure. The social factors also play a cardinal role in the rental market. Leung and You (2019), for instance, raised the nexus between household size, housing space, and facilities. However, households can sometimes trade off facilities for a lower rent. This shows the differing effects of social services and amenities on multifamily rent (Peng & Knaap, 2021). Also, during global events like the COVID-19 pandemic, socio-economic activities, and households' daily lives are significantly affected, resulting in changes in locational preferences in the rental market (Ou et al., 2023). This indicates household characteristics and external events, including rental market dynamics,

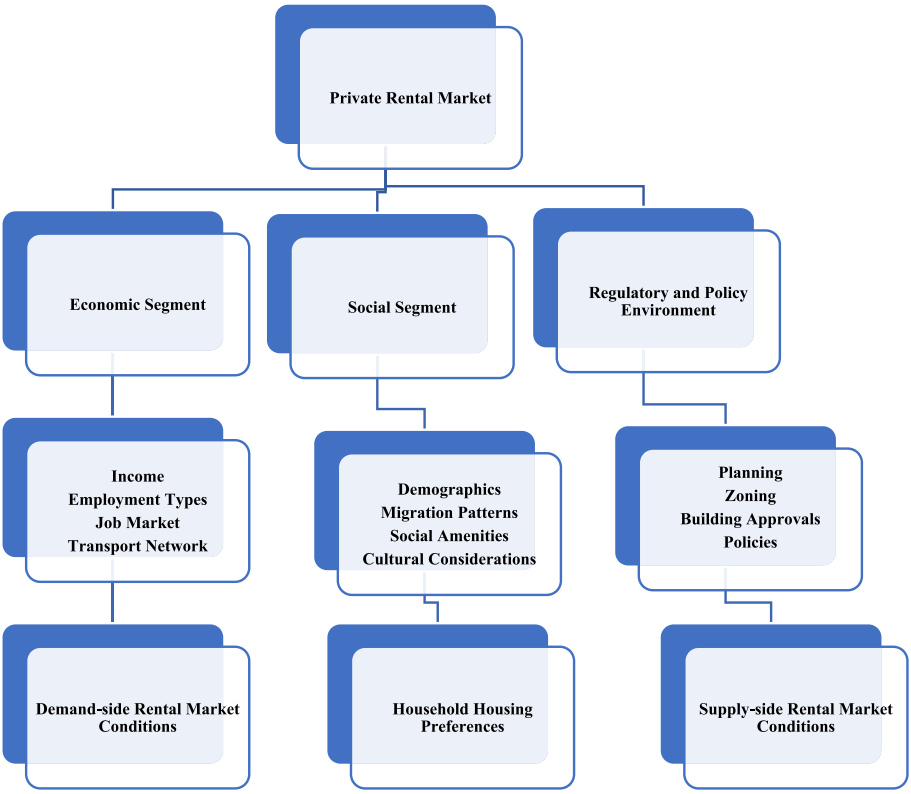

Fig. 1 Conceptual framework of the private rental housing market

are pivotal in household renting decisions (Harish et al., 2024; Karlen et al., 2022). Regulations also play an important role in shaping the rental market, especially the supply of housing products. This is supported by the empirical findings of Jacobo and Kholodilin (2022) who found rental market regulations are statistically significant and have an inverse relationship with the growth rate of real housing rents. As such, a novel and robust regulatory environment is effective in improving housing rent affordability. This is in line with Hyun and Heinig's (2023) call for increased regulations in the rental housing market.

The interplay across the economic, social, and regulatory environments is an important footprint in the rental housing market. Moreover, the overlapping patterns of households' economic situation, their housing preferences, and the availability of housing products will continue to shape the rental housing market. As the literature suggests, the deterioration of entry affordability is causing the private rental market to grow as households with insufficient income to buy a property will continue as tenants in the rental market. This brings to the fore the issue of rent affordability in the private rental market. The issue becomes more pronounced as more people are migrating to urban areas (Li et al., 2019). In China, for instance, Chiang (2016) found that since 2001, residential rent has increased by 30%, while inflation rose by 18% during this period, causing a significant upsurge in residential rent, especially in metropolitan cities. In the United States, about 25% of renting households are spending more than 70% of their income on rent (Matthew, 2018). It is now evident that

a large proportion of renting households are spending more than 30% of their income on rent, especially in advanced economies (Leishman & Baker, 2019). Therefore, evidence of deteriorating entry affordability is expected to expand the private rental market and, by extension, the price for occupying a rental property. Premised on this discussion, we hypothesise as follows:

Main Hypothesis The deterioration in entry affordability is causing an expansion of the private rental market.

To determine the connection between entry affordability and rent affordability, firstly, we estimate the affordability levels of these indices to gauge their intensity. This is followed by several causality tests between these indices using various property types, and finally, an investigation of the link between rent and the supply of vacant rental property for various dwelling types and other variables. This will provide some explanation on the role of the three segments—economic, social, and the policy and regulatory environment in shaping the private rental market.

4 Data and methodology

4.1 Data

We collected quarterly data for 31 local government areas (LGAs) of Greater Melbourne for the period 2000 to 2021.[1] The data on median house price, median rent, and the supply of vacant private rental dwelling types in each LGA of Greater Melbourne were collected from the Australian Government (2023) website data.gov.au. The yearly median household income per LGA was obtained from the Australian Bureau of Statistics (ABS), while the first homeowner grant data per LGA was collected from State Revenue Office Victoria. To disaggregate our study, first, we used median rent to define high-end and low-end rental markets. The high-end market is characterised by dwellings whose median rent is higher than the median rent of Greater Melbourne (this is the cluster of three-bedroom and four-bedroom rental houses), while rent in the low-end rental market is below the median rent of Greater Melbourne (this is the collection of two-bedroom and three-bedroom apartments[2]). Second, we delineated Greater Melbourne into four dwelling types such as two-bedroom apartments, three-bedroom apartments, three-bedroom houses, and four-bedroom houses. Again, as reported by Morley and Thomas (2016) and Lee (2017), and more recently by Bangura and Lee (2020), different dwelling types are characterised by different risk-return profiles, suggesting that housing types are particularly important in defining housing sub-markets. We clustered the LGAs to derive a panel dataset using dwelling types.

[1] The 31 local government areas (LGAs) are listed in Appendix 1. Greater Melbourne is the capital of the state of Victoria in Australia.

[2] Apartment and flat are used interchangeably in this paper.

4.2 Methodology

4.2.1 Cost-to-income entry affordability index

Following Bangura and Lee (2020), we used the cost-to-income index to determine entry affordability for houses and units for various census periods. This index integrates the purchasing price of the property, down payment, mortgage lending rate, and the loan term, and it is expressed as a percentage of household median income per LGA as follows:

$$\mathbf{EAI} = \frac{100}{\mathrm{HMI}} \times \left(\mathbf{PP} \times \mathbf{LTV} \times \frac{\frac{r}{12}}{1 - \left(\frac{1}{\left(1 + \frac{r}{12}\right)12n} \right)} \right) \times 12 \tag{1}$$

From (1), EAI denotes entry affordability index, HMI denotes annual household median income per LGA, PP is the purchasing price of the property, LTV denotes loan-to-value ratio, r is the mortgage lending rate, and n is the term of the loan. The index is an annualised effective cost of servicing the loan and it is a standard 30-year annuity formula (that is n = 30) with monthly compounding. The LTV is 80%, assuming a 20% down payment. As discussed earlier, we used a 30% threshold to determine entry affordability, suggesting that a dwelling type is affordable if the amortised mortgage payment is below 30% of the annual household median income.

4.2.2 Rent affordability index

From the work of Colburn and Allen (2018), we defined rent affordability as the ratio of total rent payment in the year divided by the annual household median income per LGA. The rent affordability index is given as:

$$\text{Rent Affordability Index (RAI)it} = \frac{\text{Weekly Median Rent} * 52}{\text{Annual Household Median Income}} \times 100 \tag{2}$$

From (2), if $\mathrm{RAI}_{\mathrm{it}}$ is greater than 30%, it indicates a rent burden, which shows the household is expending more than 30% of their household income on rent. However, an index below 30% signifies affordable rent (Colburn and Allen 2018). The second stage is a panel analysis using the System Generalised Method of Moment (SGMM) to examine the key drivers of rent affordability for each dwelling type. The SGMM is chosen over difference GMM because it overcomes any dynamic panel bias and potential endogeneity of the regressors (Berk et al., 2020). This means System GMM has the advantage of addressing any possible model misspecifications and producing more consistent results (Bangura & Lee, 2023). We modelled the SGMM as follows:

$$\begin{aligned} &\ln \mathrm{RAI}_{\mathrm{it}} = \beta_0 + \beta_1 \ln \mathrm{RAI}_{\mathrm{it-1}} + \beta_2 \ln \mathrm{POP}_{it} + \beta_3 \ln \mathrm{VRD}_{\mathrm{it}} + \beta_4 d \ln \mathrm{HP}_{\mathrm{it}} + \beta_5 \ln \mathrm{FHOGV}_{\mathrm{it}} + \varepsilon_{\mathrm{it}} \\ &\text{where } \varepsilon_{\mathrm{it}} = \alpha_i + \mu_{\mathrm{it}} \text{and } E(\alpha_i) = E(\mu_{\mathrm{it}}) = E(\alpha_i \mu_{\mathrm{it}}) = 0 \end{aligned} \tag{3}$$

The disturbance term in (3) has two orthogonal factors: the fixed effect (α_i) which is a time-invariant error term that captures factors that are unique to the LGA; and the

idiosyncratic shocks (μ_{it}) which capture all other factors other than the specified explanatory variables. RAI_{it} represents the rent affordability index for LGA_i at time t; RAI_{it-1} denotes lagged rent affordability for LGA_i at time t; POP_{it} represents resident population for LGA_i at time t; VRD_{it} denotes available vacant rental dwelling type for LGA_i at time t; HP_{it} represents median house price for LGA_i at time t; and $FHOGV_{it}$ denotes first homeowner grant value for LGA_i at time t. We cannot hypothesise the coefficient of the lagged rent affordability index a priori. β_2 is hypothesised to be positive as the rising population could trigger housing demand thereby putting pressure on rent (Bangura & Lee, 2023; Yates, 2008); β_3 is expected to be negative as an increase in vacant rental dwelling types is likely to improve rent affordability (Laurence, 2016); β_4 is also hypothesised to be positive as an increase in house price is expected to be shifted to rent which could worsen rent affordability (Berry, 2003; Yates, 2008); β_5 is hypothesised to be negative as we expect more State Government spending on FHOG to increase the supply of vacant dwellings and subsequently lower rent. The SGMM panel analysis would show how each dwelling type is impacted by these explanatory variables.

4.2.3 Rent and supply of vacant rental dwellings nexus

To examine the link between rent and the supply of vacant rental properties, we began with a correlation analysis between the rent of a smaller number of bedrooms and the supply of a vacant higher number of bedrooms. A negative correlation means any increase in the supply of a vacant higher number of bedrooms is expected to lower the rent of a lower number of bedrooms and vice versa. This occurs as renting households are expected to move to rental dwellings with multiple bedrooms, causing an increase in the supply of lower numbers of bedrooms, resulting in lower rent for these dwellings. Following the preliminary correlation analysis is a panel cointegration analysis of rent for smaller numbers of bedrooms and the supply of vacant higher numbers of bedrooms. Preceded by the IPS panel unit root test, we employed Westerlund's (2007) panel cointegration test to explore the existence of a long-run relationship between dwelling types over time, if any. Once cointegration was established, we employed the Dumitrescu and Hurlin (2012) Panel Granger-Causality test to further determine if the supply of vacant dwelling types contains information that can impact the rent of another dwelling type and vice versa. These approaches can reveal important information about the rent-supply linkage that is explained by the connection between the supply of a dwelling type with vacant high numbers of bedrooms and the rent of a dwelling type with a low number of bedrooms.

Table 1 Entry affordability index in inter-censual periods

Housing type	2001 (%)	2006 (%)	2011 (%)	2016 (%)	2021 (%)
Houses	51	52	59	53	55
Units	41	46	54	43	42

5 Results and discussion

5.1 Entry affordability of various dwellings types

From Table 1, since 2001, entry affordability has gradually declined for both houses and apartments. The index shows households are expected to spend more than 50% of their annual median income for a three-bedroom or four-bedroom freestanding house when they enter the market. For apartments, households are expected to budget at least 41% of their annual median income for paying a mortgage. Both results reveal the severity of affordability as families would spend more than 30% of their income to maintain their mortgage. Also, as expected, entry affordability for houses has glaringly exceeded apartments throughout these census years. The results represent the rapidly growing housing prices over household income in the study period. According to the ABS (2022), even though all capital cities of Australia recorded a significant increase in housing prices over the past decade, Melbourne's 20% annual rise is the largest in the country between the June quarter of 2010 and the December quarter of 2021. The rising housing demand in metropolitan cities also contributed to the worsening affordability (Staikos & Xue, 2017).

These findings are consistent with previous studies that reported the sustained decline in housing affordability in major cities as housing price growth continues to remarkably outpace household income growth (Bangura & Lee, 2023, 2024b; Berry, 2003; Soltani & Lee, 2024; Yates, 2008). This is supported by Saberi et al. (2017), who argue that housing affordability is a complex phenomenon that depends largely on household income and changes in housing prices. This culminates in a greater proportion of lifelong renters in the housing market, giving rise to the growth of the private rental housing sector (Berry, 2003). Morris et al. (2021), for instance, reported that the percentage of private renting households in Australia increased from 20% in 1997/98 to 27% in 2017/18. Similar trends of private rental market expansion were found in the USA by Newman (2019) and in Ireland, the United Kingdom, and Spain by Byrne (2020). These findings generally show that the challenges of entering the market are contributing to a surge in the proportion of renting households in major cities across the globe, a corollary that highlights the importance of examining rent affordability (Berry, 2003; Liu et al., 2016; Whitehead et al., 2012).

5.2 Rent affordability of various dwelling types

As discussed in the previous section, the resulting expansion of the rental market from the deterioration of affordability raises the issue of rent affordability. Following Colburn and Allen (2018), from Table 2, the rent affordability index of two-bedroom units was below 30% in the 2001, 2006, and 2011 census years, indicating relative affordability

Table 2 Rent affordability index in inter-censual periods

Housing type	2001 (%)	2006 (%)	2011 (%)	2016 (%)	2021 (%)
2-Bedroom unit	26	28	29	37	39
3-Bedroom unit	29	32	35	42	44
3-Bedroom house	33	38	40	46	48
4-Bedroom house	37	39	41	49	53

for this dwelling type during these periods. However, rent affordability for two-bedroom units deteriorated sharply in 2016 and 2021. For three-bedroom units, apart from the slight affordability in 2001, households' expenditure on this dwelling type consistently increased from 2006 to 2021. Rent affordability for three-bedroom houses and four-bedroom houses was severe, especially after 2006. Further, as expected, the greater the number of bedrooms, the higher the rent affordability index. There is also a clear difference in the index between three-bedroom units and three-bedroom houses, with the latter constantly exceeding the former. Generally, rent for all dwelling types in the private rental market of Greater Melbourne is unaffordable as it takes more than 30% of households' income. As discussed earlier, ABS (2020) statistics revealed the rapid growth of the population of Greater Melbourne, and it is expected to become the most populous city in Australia by 2066. In 2019–2020, for instance, Greater Melbourne recorded the highest net gains through regional overseas migration (ABS 2021). The rapid population growth, combined with the extreme challenges of entering the housing market, is contributing significantly to the decline in rent affordability. Moreover, a supply-side response does not cope with the housing demand for rental properties (Liu et al., 2016). This echoes the rental housing stress documented by Leishman and Baker (2019), as households' expenditure on rent is beyond 30% of their income. These results are also consistent with the study by Wang (2016), who reported deteriorating rent affordability and attributed it to the rate of growth of housing rent far outstripping wage increase in most metropolitan cities.

5.3 The link between entry affordability and rent affordability

Due to the excessively rising housing prices over income, entry to the market has become an almost impossible venture for many households. The rental market, which acts as a second fiddle to the homeowner market is also becoming extremely unaffordable. To authenticate this link between entry to the market and the rental market, we computed the entry affordability index for each LGA, developed a panel of the 31 LGAs, and conducted cointegration and Granger causality tests between these markets. The results of the cointegration and Granger-causality are reported in Tables 3 and 4. From Table 3, the results present evidence of a long-run relationship between entry affordability and rent, suggesting a close link between homeownership and the rental market. To validate whether worsening entry affordability is leading to an expansion of the rental market, we conducted a Granger-causality test. From Table 4, entry affordability is Granger-causing rent affordability without any reciprocity for all dwelling types. The results support our main hypothesis which indicate that entry affordability contains relevant information that can impact rent. Both the cointegration and Granger-causality results reveal that more households are expected to stay longer in the rental market as entry to the housing market becomes more challenging.

Our findings support the assertion made by Byrne (2020) on the connection between the decline in homeownership and the expansion of the private rental market. Our results also mirror the findings of Liu et al. (2016), who argued that the once-regarded tenure of transition for prospective homebuyers is becoming a permanent option for many households, especially those with low incomes. Our results also support Tually et al. (2016) who reported an increase in the proportion of long-term renters in Australia (i.e. those renting for 10 or more consecutive years), from 25% in 1994 to 33.4% in 2011. This resulting decline in both homeownership and rent affordability requires targeted policies to ameliorate the situation, especially for low-and-medium-income households (Janssen-Jansen and

Table 3 Westerlund (2007) panel error correction-based (ECM) cointegration results

	Entry affordability and median rent of 2-bedroom unit	Entry affordability and median rent of 3-bedroom unit	Entry affordability and median rent of 3-bedroom house	Entry affordability and median rent of 4-bedroom house
	P value	*P* value	*P* value	*P* value
G_t	0.99	0.89	1.00	1.00
G_a	0.88	1.00	1.00	0.98
P_t	0.07*	0.52*	0.00***	0.45**
P_a	0.06*	0.48**	0.00***	0.41**

For the group statistics (G_t and G_a), the null hypothesis H_0: $\varphi = 0$ is tested against the alternative hypothesis H_1: $\varphi i = \varphi < 0$ for all i, which specifies that a rejection is considered evidence of cointegration for the entire group. For the panel statistics (P_t and P_a), the null hypothesis H_0: $\varphi = 0$ is tested against the alternative hypothesis H_1: $\varphi i < 0$ for at least some i, signifying that a rejection is evidence of cointegration for at least one of the cross-sectional units. *** denotes a rejection of the tested hypothesis at the 1% level, ** is rejection of the null hypothesis at the 5% level, * is a rejection of the tested hypothesis at the 10% level

Table 4 Dumitrescu and Hurlin (2012) panel granger-causality results

Granger tet	*P*-Value
Entry affordability does not granger-cause 2-bedroom unit rent	0.00***
Entry affordability does not granger-cause 3-bedroom unit rent	0.00***
Entry affordability does not granger-cause 3-bedroom house rent	0.00***
Entry affordability does not granger-cause 4-bedroom house rent	0.00***

H_0: = Entry affordability does not granger-cause rent of a dwelling type is tested against the alternative hypothesis H_1: at least one panel of entry affordability does granger-cause rent of a dwelling type. *** denotes a rejection of the tested hypothesis at the 1% level, ** is rejection of the null hypothesis at the 5% level, * is a rejection of the tested hypothesis at the 10% level

Schilder 2018). As Tually et al. (2016) put it, these trends have clear financial implications for private renters that require coping strategies, especially for low-income families.

5.4 The link between rent and rental property supply

From the previous discussion, we examined entry affordability and rent affordability separately as well as the long-term relationship between these markets. In this analysis, we examined the connection between rent and the supply of vacant rental properties, if any. We started by examining the correlation between the rent of a smaller number of bedrooms with the supply of a vacant higher number of bedrooms. The aim is to find out if increasing the supply of dwellings with multiple bedrooms will lower the rent of those with a lower number of bedrooms. The intuition is that as rental demand rises, higher-income renting households tend to move to rental dwellings with more bedrooms, thereby creating more supply for lower bedrooms and subsequently generating lower rent for these lower-bedroom dwellings. Therefore, a negative correlation sign would indicate a greater impact of supply on rent, while a positive sign would point to the lack of impact of supply on rent for a given pair of dwelling types. We estimate the correlation for the two submarkets—low-end and high-end rental dwellings—and between various dwelling types. The results of the correlation are reported in Table 5.

Table 5 Correlation of housing type rent and rental dwelling supply

Housing type rent and dwelling supply	Correlation/*P*-Value
Low-end market rent and high-end housing supply	−0.19 (0.03)**
2-Bedroom unit rent and 3-bedroom unit supply	0.04 (0.12)
2-Bedroom unit rent and 3-bedroom house supply	−0.21 (0.04)**
2-Bedroom unit rent and 4-bedroom house supply	−0.08 (0.08)*
3-Bedroom unit rent and 3-bedroom house supply	−0.08 (0.09)*
3-Bedroom unit rent and 4-bedroom house supply	−0.06 (0.07)*

The correlation is the degree of association between rent of dwelling type with lower number of bedrooms and the supply of vacant dwelling type with higher number of bedrooms. A negative correlation is evidence of filtering as the rising supply of vacant dwelling type with higher number of bedrooms is expected to lower the rent of dwelling type with lower number of bedrooms. A positive correlation means there is no filtering. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels

The correlation between low-end market rent and high-end housing supply is negative (-0.19) and statistically significant at the 5% level, indicating that the more three-bedroom and four-bedroom houses in the private rental market, the greater the tendency that the market rent for apartments (whether two-bedroom or three-bedroom) will drop. As discussed earlier, due to the differences in the return-risk profile of dwellings, we examined the correlation between pairs of various dwelling types. Our correlation results have the expected negative sign for each of the following pairs: rent of two-bedroom units and supply of vacant three-bedroom houses (-0.21); rent of two-bedroom units and supply of vacant four-bedroom houses (-0.08); rent of three-bedroom units and supply of vacant four-bedroom houses (-0.08); and rent of three-bedroom units and supply of vacant four-bedroom houses (-0.06). These negative correlations have shown preliminary evidence of the rent-supply association effect between these dwelling types. However, the correlation is positive (0.04) for the rent of two-bedroom units and the supply of vacant three-bedroom units. This suggests that rising income among renters, if any, may stimulate a move to a three-bedroom or four-bedroom house instead of a three-bedroom flat. This shows the lack of association effect between rent and supply between units.

Since the correlation only shows the degree of association between rent and supply of vacant dwelling type, our next analysis of the rent-supply nexus involves panel cointegration and panel Granger causality. The panel cointegration examines any possible long-run relationship between rent and supply of vacant dwelling type, while the panel Granger causality would reveal if the supply of vacant dwelling type contains any useful information that can predict the rent of dwellings with lower numbers of bedrooms. Both results would expound our analysis of the relationship between rent and supply. The panel cointegration results are reported in Table 6, while the results of the panel Granger causality are reported in Table 7.

From Table 6, we found evidence of a long-run relationship between the rent of the low-end market and the high-end supply of vacant dwellings at the 5% significance level. Activities in both markets are interwoven, highlighting the interconnectedness between units and houses as increasing the supply of three-bedroom and four-bedroom houses is expected to lower rent for two-bedroom and three-bedroom apartments. As high-income renting households tend to move to high-end dwellings, more vacancies among low-end dwellings will be created and this in turn can result in lower rent for these dwelling types. For the different dwelling types, from Table 6, the results further reveal the existence of a long-run relationship between the rent of two-bedroom units and the supply of vacant three-bedroom houses, and between the rent of two-bedroom units and the supply of vacant four-bedroom houses at the relevant significant levels. The results also show evidence of connected rental activities between the rent of three-bedroom units and the supply of vacant four-bedroom houses and between three-bedroom house rent and the supply of vacant four-bedroom houses. These results generally confirm that the rent of dwellings with a lower number of bedrooms and the supply of vacant dwellings with multiple bedrooms are closely connected over time. However, there is no evidence of such a connection between the rent of two-bedroom units and the supply of vacant three-bedroom units. Again, these results reveal the disconnect between rent for apartments and the supply of vacant apartments, supporting our earlier discussion that interaction is likely to occur between units and houses but unlikely to occur between units.

The next stage of our analysis involves panel Granger-causality. The results from Table 7 reveal that the high-end housing supply contains important information that can impact the rent of the low-end rental market. The results from Table 7 further reveal that both the supply of vacant three-bedroom houses and four-bedroom houses are essential in

Table 6 Westerlund (2007) panel error correction-based (ECM) cointegration results

	Low-end rent and high-end house supply	2-Bedroom unit rent and 3-bedroom unit supply	2-Bedroom unit rent and 3-bedroom house supply	2-Bedroom unit rent and 4-bedroom house supply	3-Bedroom unit rent and 4 bedroom house supply	3-Bedroom House rent and 4-bedroom house supply
	P value	*P* value	*P* value	*P* value	*P* value	*P* value
G_t	0.99	1.00	0.91	1.00	1.00	0.98
G_a	0.98	1.00	0.84	1.00	1.00	0.99
P_t	0.03**	0.76	0.04**	0.00***	0.08*	0.02**
P_a	0.02*	0.73	0.06*	0.01**	0.06*	0.03**

For the group statistics (G_t and G_a), the null hypothesis H_0: $\varphi = 0$ is tested against the alternative hypothesis H_1: $\varphi i = \varphi < 0$ for all i, which specifies that a rejection is considered evidence of cointegration for the entire group. For the panel statistics (P_t and P_a), the null hypothesis H_0: $\varphi = 0$ is tested against the alternative hypothesis H_1: $\varphi i < 0$ for at least some i, signifying that a rejection is evidence of cointegration for at least one of the cross-sectional units. *** denotes a rejection of the tested hypothesis at the 1% level, ** is rejection of the null hypothesis at the 5% level, * is a rejection of the tested hypothesis at the 10% level

Table 7 Dumitrescu and Hurlin (2012) panel granger-causality results

Granger test	*P*-Value
Higher-end housing supply does not granger-cause lower-end rent	0.00***
3-Bedroom unit supply does not granger-cause 2-bedroom unit rent	0.10
3-Bedroom house supply does not granger-cause 2-bedroom unit rent	0.00***
4-Bedroom house supply does not granger-cause 2-bedroom unit rent	0.00***
4-Bedroom house supply does not granger-cause 3-bedroom unit rent	0.00***
4-Bedroom house supply does not granger-cause 3-bedroom house rent	0.00***

H_0: = supply of a dwelling type does not granger-cause rent of a dwelling type is tested against the alternative hypothesis H_1: at least one panel of the supply of a dwelling type does granger-cause rent of a dwelling type. *** denotes a rejection of the tested hypothesis at the 1% level, ** is rejection of the null hypothesis at the 5% level, * is a rejection of the tested hypothesis at the 10% level

predicting the rent of two-bedroom units. Similar results are documented for the supply of vacant four-bedroom houses on the rent of both three-bedroom units and houses. However, there is no evidence to suggest that the supply of vacant three-bedroom units is Granger-causing the rent of two-bedroom units, which strengthens our findings about the lack of interaction between apartments. The intuition is that renters with relatively high but insufficient income to enter the market may likely rent a house with more bedrooms. Furthermore, the supply of three-bedroom units is limited in Australia and fails to meet the needs of residents who like apartment living environments (Yang et al., 2024). Therefore, it is intuitively possible to observe no strong Granger-causing evidence between three and two-bedroom units.

5.5 The drivers of rent affordability

The final analysis is to examine the determinants of rent affordability for various dwelling types in the private rental market. From Table 8, as hypothesised, the effect of the population is positive and statistically significant at 5% and 1% for three-bedroom and four-bedroom houses but is statistically insignificant for two-bedroom and three-bedroom units. The results show that population is a key driver of rent affordability for houses but not for units. As documented in Nethercote (2019), this can be attributed to the over-supply of high-rise developments in the city. Further, Leishman and Baker (2019) found that, as the population grows, whether, by natural change or migration, rental demand is expected to rise and households with relatively high but insufficient income to enter the market may potentially shift to renting houses with multiple bedrooms, leaving units for low-income renters or other cohorts (Palm et al., 2021). As expected, house price is positive and statistically significant at the relevant levels for all dwelling types. An increase in dwelling prices is expected to increase rent and with income failing to catch up, this would result in a deterioration in the rent affordability index. The total value of the first homeowner grant is negative and statistically significant at the relevant levels for all dwelling types. This result indicates increasing state government budgetary allocations on first homeowner grants will improve rent affordability for all dwelling types. Intuitively, the grant may stimulate entry to the market and possibly free up some rental properties which can result in a reduction in rent. The supply of vacant dwellings is negative for all dwelling types. However, the supply of all vacant dwellings with a greater number of bedrooms is a statistically

Table 8 System generalised method of moment (SGMM) results

Explanatory variables against rent affordability index	2-bedroom unit RAI	3-bedroom unit RAI	3-bedroom house RAI	4-bedroom house RAI
	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value	Coefficient *p*-value
lnPopulation	0.05 (0.71)	0.40 (0.14)	0.19 (0.03)**	0.51 (0.00)***
lnHouse price	0.16 (0.06)*	0.01 (0.05)**	0.12 (0.00)***	0.08 (0.00)***
lnFHOGva	−0.71 (0.03)**	−0.02 (0.08)*	−0.17 (0.02)**	−0.01 (0.07)*
lnVacant 2-bedroom unit	−0.31 (0.08)*	−0.88 (0.10)	−0.01 (0.18)	−0.43 (0.34)
lnVacant 3-bedroom unit	−0.91 (0.40)	−0.19 (0.04)**	−0.91 (0.10)	−0.42 (0.25)
lnVacant 3-bedroom house	−0.82 (0.06)*	−0.67 (0.06)*	−0.92 (0.07)*	−0.72 (0.22)
lnVacant 4-bedroom house	−0.57 (0.00)***	−0.35 (0.00)***	−0.22 (0.01)**	−0.46 (0.00)***
Lag (1) of dependent variable	0.99 (0.08)*	0.82 (0.00)***	0.67 (0.00)***	0.42 (0.00)***
Constant	0.29 (0.33)	0.38 (0.00)***	0.02 (0.11)	0.19 (0.27)
P-Value (F)	0.00***	0.00***	0.00***	0.00***
First-order arellano–bond Test	0.04**	0.04**	0.01***	0.03**
Second-order arellano–bond Test	0.02**	0.01**	0.02**	0.00**
Hansen's J test	0.10	0.12	0.70	0.11

The general model of the SGMM is given as $\ln RAI_{it}=\beta_0+\beta_1 \ln RAI_{it-1}+\beta_2 \ln POP_{it}+\beta_3 \ln VRD_{it}+\beta_4 d\ln HP_{it}+\beta_5 \ln FHOGV_{it}+\varepsilon_{it,}$ where $\varepsilon_{it}=\alpha_i+\mu_{it}$ and $E(\alpha_i)=E(\mu_{it})=E(\alpha_i\mu_{it})=0$ in (2). The disturbance term in (2) has two orthogonal factors—the fixed effect (α_i) which is a time-invariant error term that captures factors that are unique to the LGA; and the idiosyncratic shocks (μ_{it}) which captures all other factors other than the specified explanatory variables. The *P*-value of the F-test shows the overall significance of the SGMM, while the Arellano–Bond tests the null hypothesis of no autocorrelation and the results failed to reject at $P<0.05$ for both first and second orders. The *p*-value of the Hansen's J test failed to reject the tested hypothesis of overidentifying restrictions are valid. This indicates that our instruments are valid. *** denotes variable is significant at the 1% level, ** denotes variable is significant at 5% level, and * means the variable is significant at 10% level

significant determinant of rent affordability for two-bedroom and three-bedroom units at the relevant significant levels. The supply of vacant two-bedroom units only impacts its rent affordability, while the supply of three-bedroom units impacts the rent affordability of both two-bedroom and three-bedroom units. As emphasised by Grossmann et al. (2021), these findings reflect the importance of integrating the supply-side variable in examining rental housing models.

To sum up, the correlation analysis, panel cointegration, panel Granger-causality, and the System GMM revealed some significant results about the private rental market. The interaction in the rental market is likely to occur between dwellings with a greater number of bedrooms and those with a lower number of bedrooms. We found that as the supply of vacant dwellings with multiple bedrooms increases, the rent of dwellings with a lower number of bedrooms would likely drop. This means that when new houses with more bedrooms are built, relatively old properties become more affordable. Households who could not enter the market would likely opt for recently built rental properties with more bedrooms, creating more rental properties with fewer bedrooms. Further, the results of the rent-supply nexus reveal interaction is likely between houses and apartments but unlikely between units as we found that increasing the supply of vacant three-bedroom units would not result in a reduction in the rent of two-bedroom units. These results indicate that renting households are less likely to move between units, but they are more intrigued by moving from units to houses. Finally, the more first homeowner grants are offered by the state Government the greater the chances of improving rent affordability in the private rental market. These findings offer important information for policymakers seeking to ameliorate the rent issue of households. Residential property developers and investors could also use these findings for more informed decisions.

6 Conclusion and implications

The increasing challenges faced by households in entering the housing market have resulted in a significant jump in the proportion of renting households in most metropolitan cities. As the literature indicates, there are no signs of reversal in the deterioration of housing affordability, a situation that is expected to continue to expand the rental market. Despite such a trajectory, studies about the rental market are still limited. Existing studies have focussed on investment opportunities in the rental housing market, the supply of rental properties including social or community housing, demand trends, and policies, while little attention has been paid to households' rental activities in the private housing market. To fill this lacuna in the literature, we recognise the discrepancies in the risk-return profile and other features of rental dwellings and delineate the private rental market in a submarket framework that takes two forms. The first submarket is the breakdown of the entire private rental market into the high-end market (which clusters dwellings whose rent is greater than the median rent of Greater Melbourne) and the low-end market (which clusters dwellings whose rent is below the median rent of Greater Melbourne). The second submarket deals with the individual dwelling types. We position our study in the context of these submarkets to examine the linkage between entry affordability and rent affordability, the rent-supply linkage for various dwelling types, and the key drivers of rent affordability. We collected annual data for 31 local government areas (LGAs) of Greater Melbourne for the period 2000 to 2021 and applied a range of statistical and econometric methods. We recorded the following findings.

First, we examined the linkage between entry affordability and rent affordability in a private rental market. We found that entry affordability is Granger-causing unaffordability in the private rental housing market without any reciprocal effect. The inter-censual analysis of entry affordability shows no sign of improvement since 2001, causing more households to enter the rental market while others tend to prolong their tenancy, confirming that challenging entry affordability is a causative agent of rising tenancy activities in the rental market. The ensuing bulging rental market has also become challenging for households as they spend more than 30% of their income on rent. This corollary highlights the deterioration in entry affordability is not only preventing households from entering the housing market but is also pushing households to the unaffordable end of the rental market.

Second, we offered a better understanding of the link between rent and the supply of vacant rental dwellings in the private rental market of a metropolitan city. These results generally revealed that rent-supply linkage does not occur between units, but it is likely to occur between units and houses in the private rental market. Specifically, three-bedroom and four-bedroom houses are important predictors of rent for units in the private rental market. This occurs when high-income renting households move to high-end rental dwellings, thereby creating more vacant low-end rental properties that could lead to lower rent. As entry to the market becomes more difficult, the private rental market continues to grow and, as such, households are likely to opt for high-end dwellings when their income improves, leaving the low-end dwellings for relatively low-income households.

Third, we provided evidence that supports the Victorian Government's policy of supporting first homebuyers to help improve affordability in the rental market. By increasing the budgetary allocation to first homeowner grants, they would increase the chances of prospective homebuyers entering the market which could potentially ease the rental pressure. Finally, we made a methodological contribution to the literature on residential rent. Previous studies of rent affordability and other dimensions of rent were highly qualitative. We employed several statistical and econometric tools to examine the relationship between entry affordability and rent affordability as well as the association effect and causality between rent and the supply of vacant dwellings in the rental market. These methods provided a more robust analysis of the private rental market in a metropolitan city.

These findings have significant policy implications. The findings on the link between entry affordability and rent affordability highlighted the severity of rent unaffordability especially for low-income households. This evidence could inform housing policymakers in developing more targeted programs to improve rent affordability in major cities. These findings could also be used as a tool by various housing advocacy groups in advancing their agenda for an improvement in housing rent. The findings on the rent-supply link have offered an alternative vehicle for navigating the rental market in search of relative affordability, especially for low-income households. It will also aid developers' decisions on which housing types to supply, especially those employing a build-to-rent model. The significance of the first homeowner grant could advance the argument to increase budgetary allocations to prospective homebuyers in the hopes of easing the financial pressure of the rental market on low-income cohorts.

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