

RESEARCH ARTICLE

THE IMPACT OF URBAN GROWTH BOUNDARIES IN MELBOURNE ON URBAN SUSTAINABLE DEVELOPMENT

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ABSTRACT

The consensus of using the compact city as a model for urban sustainable development has inevitably led to governments restricting outer urban expansion as an urban management tool. Urban growth boundaries (UGBs) have become one of the most widely used policy tools to achieve this goal. To evaluate the impact of UGBs on urban sustainable development in Melbourne, Australia, we compare the temporal and spatial changes of population, dwelling density, and growth before and after the implementation of the UGB policy in the Melbourne metropolitan area. The results indicate that, since the implementation of the UGB policy, the urban population, dwelling density, and growth have significantly accelerated; however, nearly half of the new population is located on the urban fringe. Based on the pressure of population growth, the UGB in Melbourne has been adjusted frequently, which has reduced its binding force on urban growth. Herein, we focus on the reasons for amendments to the Melbourne UGB, namely, urban density and the intensity of urban land use and compare the UGB policies of the Melbourne and Portland, Oregon (USA), metropolitan areas. We argue that the state government should restrict urban growth boundaries and increase urban density. At the same time, UGB policy must be coordinated with broader government policy, such as urban land use, urban transportation, and environmental planning, and a mechanism should be established to release land supply in defined areas. In addition, governments should expand public participation in the UGB amendment process and in supporting the implementation of the UGB policy.

KEYWORDS

UGB, strategic metropolitan planning, land use, urban sustainable development, Melbourne, Australia

1. INTRODUCTION

An urban growth boundary (UGB) is a common land-use planning policy tool used to alleviate urban sprawl and promote the transformation of a city into a compact development pattern. The London, England, metropolitan area greenbelt is the original growth management tool, which was instituted as early as the 1930s (Munton, 20087). Similarly, an UGB is known as a legally binding, legislatively created line that separates rural land from urban land (Sullivan, 2014). Knaap pointed out that the qualitative difference between the UGB and the traditional land-use regulations are the addition of the dimension of timing for its function of regulating future land use (Knaap, 1985).

The American Planning Association proposes that UGBs be established to promote compact and contiguous development patterns that can be efficiently served by public services, as well as preserve or protect open space, agricultural land, and environmentally sensitive areas (Ding et al., 1999). An UGB is the dividing line that determines whether land can be developed into urban land, and essentially is an authoritative distribution of the social benefits of land use by a government. The practical experience of cities shows that the land values of undeveloped regions inside and outside an UGB differ substantially. It is this great value difference that makes the establishment of UGBs successful, attracting the attention of many stakeholders. In the land market interest chain, stakeholder groups include consumers and developers, builders, marketers, government, and local communities. The effectiveness of UGB policy implementation

depends on the influence of these stakeholders.

Melbourne was one of the first cities to introduce an UGB policy in Australia. The Victoria state government issued a strategic plan in 2002, Melbourne 2030, which outlined UGB and Green Wedge policies to constrain the inefficient expansion of Melbourne. In the past 15 years, strategic planning for the Melbourne metropolitan area has been amended constantly, leading to a consensus among scholars that Melbourne 2030 failed (Buxton et al., 2016; Mees, 2011). The UGB did not prevent the sprawl of the city, but instead become a primary indicator for successful land speculation. Developers purchased land around the UGB and then lobbied the government to extend the UGB to include their land, reducing the binding effect of the UGB against urban development (Buxton et al., 2016).

The rapid increase of population in Melbourne's metropolitan area has led to incompatible pressures to convert non-urban lands to housing, and also to protect them for environmental purposes, such as water management, food production, ecosystem services, recreation, waste management, and mineral resources to support urban populations. Land protection in the urban fringe is facing greater pressure. The effect of implementing an UGB is influenced by a series of factors, such as government policy, the rational basis of the UGB itself, public participation, and social acceptance. Therefore, the purpose of this paper is to explore the reasons for the failure of UGB policy by reviewing and evaluating the effect of UGB policy in Melbourne. At the same time, drawing from rapid urbanization in

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developing countries, the paper summarizes the experience and lessons of international urban development to evaluate UGB policy.

In this paper, we review the impact of UGB policies on urban development patterns, housing, and land price. An UGB is the most widely discussed and controversial tool in the arsenal of urban containment policies (Buxton and Taylor, 2011). Since the 1970s, many countries have introduced UGBs to control urban growth, providing many case studies for researchers. Some researchers found that UGBs had a significant effect on containing development and preserving prime farm and forest lands (Nelson and Moore, 1993; Patterson, 1999; Kline et al., 2014). Meanwhile, other researchers argued that UGBs did not curtail urban sprawl as expected (Weitz and Moore, 1998; Bengston and Youni, 2006; Cho et al., 2007). Knapp and Nelson concluded that UGBs may spatially constrain urban growth, but also face a risk of low-density development to “leak” out of existing UGBs (Knaap and Nelson, 1992). Nelson compared the states with and without growth management and found that the growth-management efforts in those states with growth management are effective (Nelson, 1999).

Kline and Alig proved that Oregon’s land-use planning program has tended to concentrate development within UGBs, but its effect on reducing the likelihood of development of resources remained uncertain (Kline and Alig, 1999). Cunningham estimated that the effect of the UGB around the greater Seattle, Washington, area was to lower the likelihood of new housing outside the boundary by between 28% and 39% (Cunningham, 2007). Existing research shows contradictory results on the effects of an UGB on land and housing prices. One view is that UGBs result in higher land prices by limiting the supply of developable land (Birrell et al., 2005; Moran, 2006; Jun, 2006). Another view is that land-price increases are affected synthetically by many variables, and it is not certain that UGBs or other urban containment policies must have raised the land price (Buxton and Taylor, 2011; Dawkins and Nelson, 2002; Nelson et al., 2007). Scholars have also put forward their views on how to promote the effect of UGB policy. Pendall pointed out that the urban containment policy of any metropolitan area should be understood as the sum of a wide array of tools, not just the regulatory tool of UGBs (Pandell et al., 2002).

Some scholars suggest that containment strategies must provide an inflexible boundary to provide permanent protection to the green belt by prohibiting development (Pendall et al., 2002; Morris, 1997; Buxton and Goodman, 2014). Participation by citizens and other stakeholders has often been identified as a vital element for the success of growth management and open-space protection efforts (Bengston et al., 2004). The impact of UGBs on land prices can be regulated by certain measures, such as making additional land available on the urban fringe, requiring higher densities on the fringe, and expedited development (Nelson et al., 2017). It can be difficult to identify the policy impacts of an UGB from many other factors that may affect urban development. Nelson and Moore assessed the effectiveness of the growth management and resource lands preservation policy of metropolitan Portland in 1993 (Nelson and Moore, 1993).

They divided three adjacent counties using UGBs into four research areas—urban area, urbanizable area, urban fringe area, and peri-urban area—and compared residential building permits, residential land divisions, and development density of the four regions to assess the effectiveness of urban growth management in metropolitan Portland. A comparison of the population, land area, and density in the Portland urbanized area between 1980, 1990, 2000, and June 2004 led researchers to conclude that Portland’s UGB did not slow suburbanization and enhance infill development.

In summary, scholars tend to use the method of comparative analysis of the changed regulation of human activities and land use inside and outside UGBs at different times to evaluate the impact of UGBs on urban development. Regional development policies may also influence the effectiveness of UGBs by locating populations in contained regional centers outside an UGB and relieving urban pressure inside the UGB. Therefore, in this paper, we compare Melbourne’s regional population density, population increase, and dwelling density before and after the implementation of the UGB policy to access the UGB policy’s impact on Melbourne’s urban growth. This is done using census data from the Australian Bureau of Statistics. We also analyze the reasons for the adjustments to Melbourne’s UGB. We place changes to the Melbourne UGB in an international context by comparing Melbourne’s UGB to Portland’s UGB as a case study.

2. MELBOURNE’S UGBS

Melbourne, the capital city of Victoria, Australia, is located on the

southeastern fringe of the Australian landmass. The study area is situated in the metropolitan area of Melbourne (Greater Melbourne), consisting of 31 councils, with an area of 8833 km². Greater Melbourne is one of the most extensive metropolitan areas in the world. The terrain of the Melbourne metropolitan area is flat, overlooking Port Phillip Bay to the Southwest, with mountain ranges adjacent to the northwest and northeast. Greater Melbourne has a population of over 4.5 million people (Australian Bureau of Statistics, 2017), accounting for approximately 75% of the total population of Victoria. It is expected to grow by 3.4 million people by 2051 (Department of Sustainability and Environment, 2016).

Melbourne is a city favored by immigrants, with more than 40% of the population coming from overseas, and this number is increasing. Melbourne’s complex matrix of road and rail transport networks is the best in Australia. The railway line extends radially from the center of the city to the suburbs. People and goods are efficiently transported throughout the metropolitan area. Melbourne’s urban planning advocates that cities grow along the growth corridors, which grow along major rail lines like “fingers.” With increasingly scarce land resources in the southeast, the government has identified the west and north as the key development areas in recent years, and has greatly improved the infrastructure conditions of the region.

Melbourne has a long history of strategic planning, with over 21 distinctive policies or plans produced so far. In 1929, to solve the problems of dilapidated housing conditions and traffic congestion brought about by the rapid development of the urban population, the *Plan for General Development* was developed by the Metropolitan Town Planning Commission to prevent “misuse” of land and to protect property values; this was the first Melbourne strategic plan. In the 1950s, Melbourne suffered from congestion in the inner areas and from sprawling suburban development. *The Melbourne Metropolitan Planning Scheme, 1954* was prepared by an independent planning authority, the Melbourne and Metropolitan Board of Works (MMBW).

The scheme put forward a strategy based on development in urban growth corridors and designated higher-density zones for the inner suburbs and lower-density zones for the middle and outer suburbs (MMBW, 1954). The 1971 *Planning Policies for the Melbourne Metropolitan Region* was Melbourne’s third strategic plan, and proposed seven urban growth corridors interspersed with green wedges to shape the direction of urban growth for over 30 years (Goodman et al., 2010; Amati, 2016). The 1981 *Metropolitan Strategy Implementation* encouraged development in existing areas and focused on housing, transport, employment, and community facilities (MMBW, 1981).

In 2002, the Victoria state government released *Melbourne 2030: Planning for Sustainable Growth*, which proposed to manage growth across metropolitan Melbourne and the surrounding region. The plan confined outer urban growth by an UGB and sought to shift outer urban development to the existing metropolitan area. The new metropolitan planning strategy, *Plan Melbourne 2017–2050*, was released by Victoria’s state government in 2017. It builds on previous metropolitan strategies, including *Melbourne 2030*, *Melbourne@5million*, and *Plan Melbourne 2014*. The planning system and its administration have fluctuated between varying degrees of centralized and local control, and is now controlled by the state government (Pendall et al., 2002).

The boundary of containing urban growth was introduced as a statutory planning tool in 1971 in Melbourne’s third strategic plan. The Victoria government passed the Planning and Environment (Metropolitan Green Wedge Protection) Act in May 2003, which defined an UGB and a green wedge, required ministerial approval before councils could initiate planning-scheme amendments, and required parliamentary ratification for any change to the growth boundary (Buxton et al., 2016). *Melbourne 2030* outlined the UGB and green wedge. The UGB’s function in *Melbourne 2030* was to set clear limits for metropolitan Melbourne’s outward development, as well as to set aside land for future urban growth. Melbourne’s UGB is mainly delimited along the existing urban area and urban growth corridors. *Melbourne 2030* delineated four growth corridors, including Werribee, Hume, Whittlesea, and Cranbourne-Pakenham. The green wedge area was embedded between the development corridors. The UGB has been amended three times since the first delimitation in 2002. Figure 1 reflects the updated UGB in Melbourne’s metropolitan area and the non-urban areas within the UGB planned for urban growth areas by 2050.

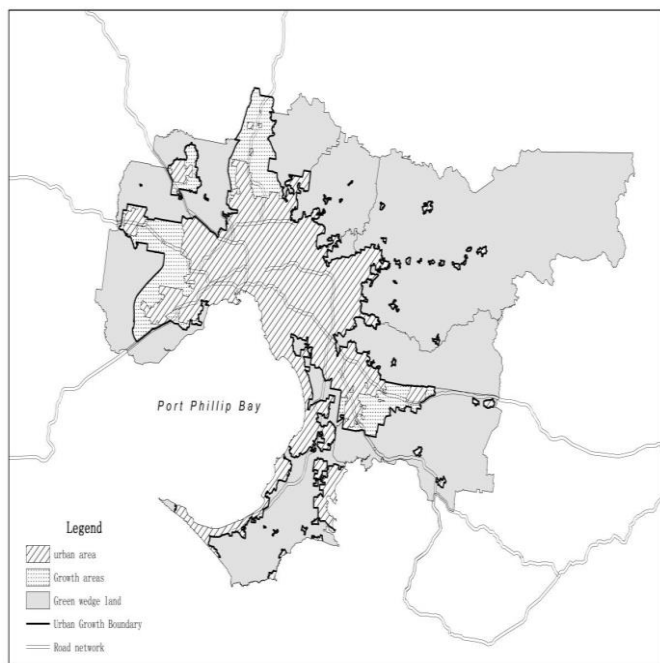


Figure 1: Melbourne's urban growth boundary.

3. DATA SOURCES AND METHODOLOGY

3.1 UGB data

The spatial data of the UGB and other land use comes from the Department of Environment, Land, Water and Planning of the State of Victoria. Since

the first release of the UGB in 2003, the Victoria state government has made three adjustments: in 2005, 2010, and 2012. For analysis of its adjustment, ArcGIS software (GeoSoft, Inc., Toronto, Canada) was used to integrate the previous adjustment boundaries with remote-sensing images of Melbourne's metropolitan area in 2015 to obtain the UGB change map.

3.2 Population and dwelling data

The source for the population and dwelling data in this study are the census data from the Australian Bureau of Statistics. We calculated the population density and dwelling density of every council area in the years 1996, 2001, 2006, 2011, and 2016.

4. RESULTS

4.1 Population density

Over the past 20 years, the population density of the Melbourne metropolitan area has increased progressively (Figure 2), and most of the region's growth rate has accelerated since 2001. This phenomenon is prominent in the cities of Melbourne, Yarra, Port Phillip, Stonnington, Moreland, and Glen Eira. The average annual population increase per square kilometer was 158 in these municipalities from 1996 to 2001, whereas the number reached 330 from 2002 to 2016. At the same time, the population density in the green wedges grew slowly and steadily, especially in the municipalities of Nillumbik, Yarra Ranges, Mornington Peninsula, and Cardinia. The population density in outer urban growth corridors is low but increasing. Successive strategic plans concentrate urban fringe development into five main corridors. The use of UGBs and green wedges has facilitated the compact development of the city of Melbourne and, at the same time, has also effectively controlled the development in the green wedge area.

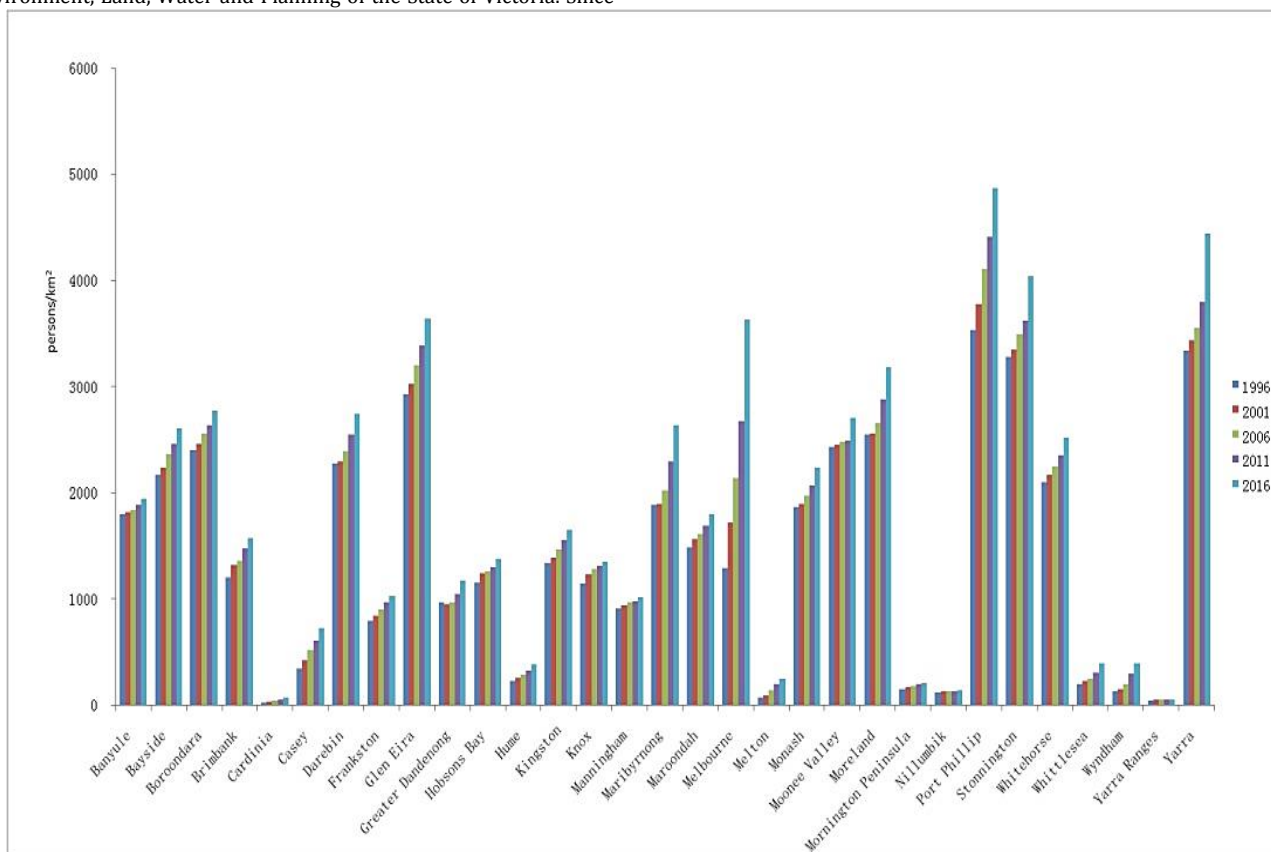


Figure 2: Change of population density from 1996 to 2016 in Greater Melbourne

4.2 Population increase

From 1996 to 2016, the total urban population increase in Melbourne's metropolitan area was 1,276,482 and the average annual population increase was 63,827. There were significant differences in population growth in different regions. In Wyndham, Casey, Whittlesea, Melton, Melbourne, Hume, and Cardinia, the population grew at a faster rate, and the sum of the population growth in these areas accounted for 55.87% of

the total population growth in the entire metropolitan area. In contrast, population growth in Nillumbik, Banyule, Moonee Valley, Manningham, and Hobsons Bay was low. Figure 3 shows the spatial distribution of population growth. Population growth occurred primarily in the inner urban area and urban growth corridors, while growth in the middle-ring suburbs was lower due to the smaller area, stable living mode, and relatively small population increase.



Figure 3: Distribution of population changes from 1996 to 2016 in Greater Melbourne

4.3 Dwelling density

From 1996 to 2016, the total urban dwelling growth in Melbourne was 543,907 units. Similar to the spatial distribution of population growth, dwelling growth in the urban fringe areas, such as Casey, Melton, Wyndham, and Whittlesea, was larger, whereas dwelling growth in Nillumbik, Banyule, Moonee Valley, and Manningham was relatively low (see Figure 4). Table 1 reflects the comparison of dwelling structures between 2001 and 2016. Separate-house construction fell from 75.3% of the total in 2001 to 67.8% in 2016; semi-detached, row or terrace houses, and townhouse construction rose from 8.9% to 16.8%, Flat, unit, or apartment construction rose from 13.1% to 14.7%. High-density residential construction is increasing, concentrated primarily in the central city. Many of the established suburbs are still dominated by separate houses. Dwelling density increased in all districts, from an average of 139 sets/km² in 1996 to 204 sets/km² in 2016. Residential density reduced in turn from the city center to the suburbs. The average number of households in the urban area was maintained at approximately 2.6, which changed little.

Table 1: Comparison of dwelling structures in Melbourne between 2001 and 2016

Year		2001	2016
Dwelling structure	Separate house	75.3%	67.8%
	Semi-detached, row or terrace house, townhouse	8.9%	16.8%
	Flat, unit, or apartment	13.1%	14.7%
	Other dwelling	2.7%	0.4%

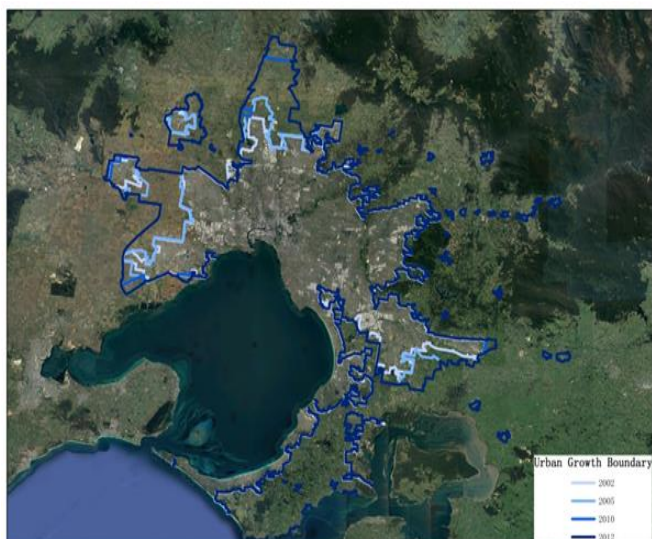


Figure 4: Distribution of dwelling changes from 1996 to 2016 in Greater Melbourne

4.4 UGB

An UGB changes frequently, and since the initial delimitation of urban growth borders in 2002, Melbourne's has been revised three times. The boundary was expanded in December 2003 by 1,610 ha, in November 2005 by 11,132 ha, and in 2010 by 43,000 ha (Buxton et al., 2016). To investigate the compactness of urban construction within the UGB, the revised UGB since 2002 and the satellite image map of Melbourne city in 2016 were combined (shown in Figure 5). As can be seen from the chart, the UGB expanded outward along the main development corridors. A large area of open space was included into the UGB inside area from 2010. In fact, many areas within the previous UGB have not yet filled; as a result, the city continued to expand outward. The original 2030 plan proposed transferring 25% of the population's outer growth to the established urban area, but the proportion of housing development in the outer corridors increased from 31% in 2002 to 48% in 2010.

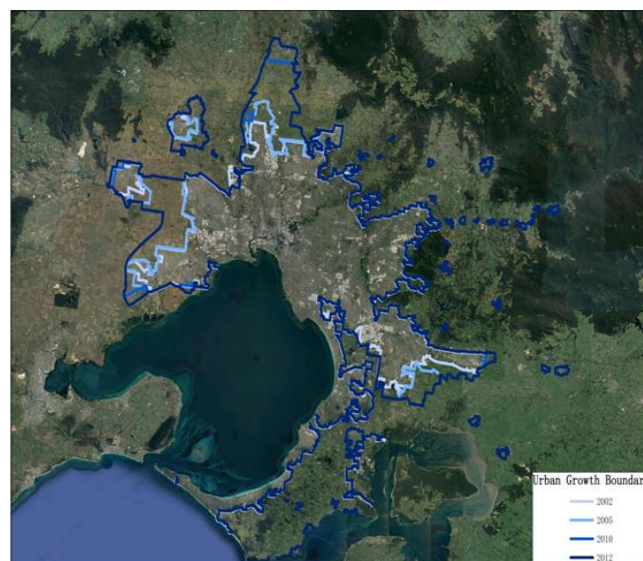


Figure 5: Melbourne's UGB in all past years and satellite image map of Melbourne city in 2016

4.5 Comparison of population growth percentage and housing growth percentage

This paper compares the percentage of dwelling and population growth in 31 Melbourne metropolitan regions from 1996 to 2016 (shown in Figure 6). Overall, the dwelling growth rate and population growth rate in the 15-year period were 47.1% and 40.7%, respectively. As shown in Figure 6, in recent years, most of the residential area grew faster than the population's growth rate. However, the differences between them in the individual regions were large in Frankston and Whittlesea, with the dwelling growth rate being higher than the population growth rate of 32.33%. On the contrary, in other regions, such as Melbourne (city) and Glen Eira, the population growth rate was higher than the dwelling growth rate. The reason for this phenomenon is dwelling structure. The building volume ratio is relatively high in the downtown area in order to accommodate

many people, while elsewhere residential structures are dominated by separate houses occupying a lower volume ratio and a greater land area than downtown; thus, the average household size is significantly lower. In

addition, the land use in suburban areas seems chaotic, with industrial land and commercial land covering large areas.

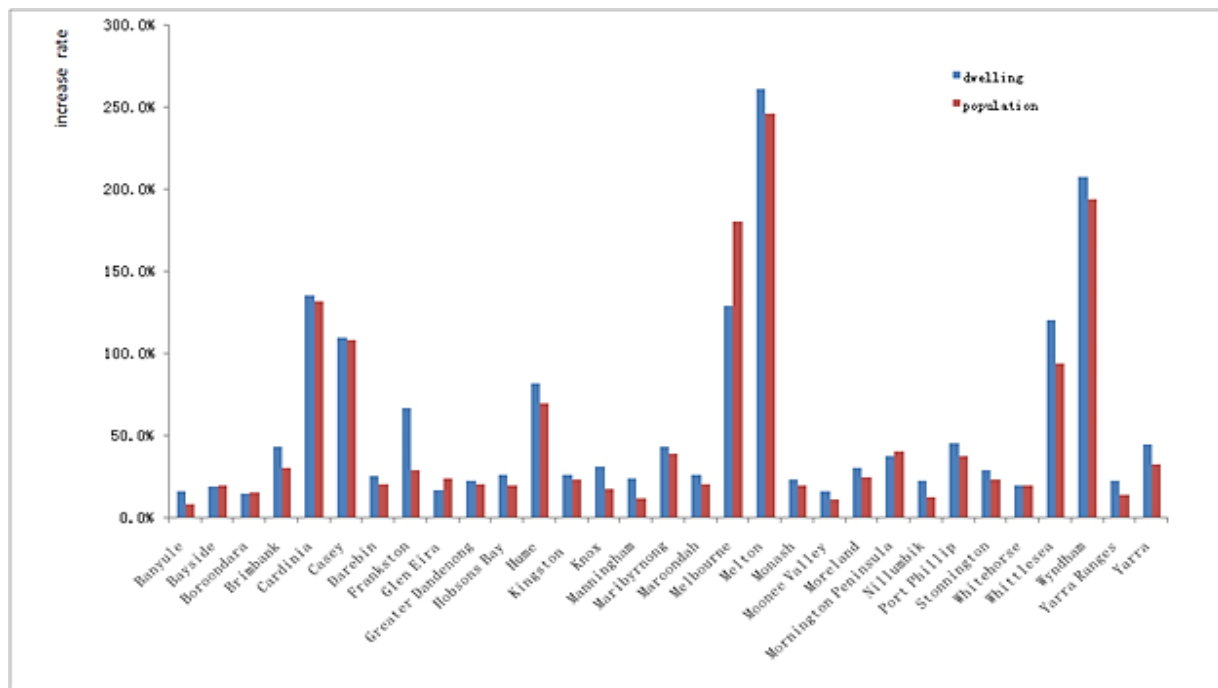


Figure 6: Comparison of population-growth percentage and housing-growth percentage from 1996 to 2016.

5. DISCUSSION

5.1 UGB

Introducing an UGB in Melbourne was necessary to prevent excessive outward growth of the city. The UGB and green wedge policy in Melbourne was a continuation of the green-belt policy formulated by the MMBW in the early 1970s. It defined the boundaries of urban development, which promoted the Melbourne metropolitan area to develop along the four urban growth corridors. Figures 2 and 3 show that the Melbourne metropolitan population density and dwelling density, respectively, have been increasing steadily since 1996. Moreover, the growth rate has been markedly accelerated since the implementation of the UGB policy. To some extent, the UGB has also contributed to the concentration of the population.

However, the moving UGB reduced the credibility of the policy, thereby affecting its binding force on urban development. Some scholars have pointed out that the adjustment of the UGB is the result of government compromises to accommodate developer speculation. The development of the city is not consistent with the envisaged "urban filling" compact model. On the contrary, the relatively low housing prices in the outer suburbs of the city attract large numbers of people to those areas. The inefficiency of urban growth has led to excessive use of land reserved for urban development. The pressure on the UGB has risen sharply, and at the same time has raised the question of whether the UGB has pushed up housing prices. In general, Melbourne's UGB only controls the direction of development and cannot control the development intensity and development model, nor can it fundamentally control the growth of cities.

5.2 Urban development density

Urban low-density development is unsustainable. In 2016, the large proportion of separate houses in the Melbourne metropolitan area accounted for 67.8% of the total dwellings. While people fully enjoy the "idyllic city" style brought about by this low-density development, the city also bears the higher social and environmental costs accompanying low-density development. The number of cars in the greater Melbourne region increased by 331,101 from 2001 to 2016. Traffic congestion and commuting costs are increasing in Melbourne, and high-rise buildings are concentrated in about 2 km² of the central city and some inner urban areas. The greater the distance from the city center, the lower the land development density. In 1990, to promote intensive development of the city, the Victoria government proposed specifying the density index of 15 households/ha in the growth corridors. The residential data of 2016

reflected that residential density is lower than this for 87% of the metropolitan area.

The average size of the greater Melbourne region's population has increased by approximately 70,000 per year in recent years. At this pace of development, the population of the greater Melbourne region will increase from approximately 4 to 5 million by 2030. Using the current average of 2.6 people per household at 15 dwellings/ha of residential development density, residential land will need to increase by 25,641 ha by 2030. The population pressure and the huge demand for low-density housing will inevitably lead to continued outer growth. This will, in turn, lead to a loss of suburban agricultural land and threaten the environment. A forward-looking urban-planning strategy that does not vary strict limits to the boundaries of urban development, and increases density across the metropolitan area, would need long-term approval by all political parties to break the cycle of constant change and achieve the compact structures of European and re-developed coastal West European cities.

5.3 Intensive use of urban land

Greater Melbourne is a vast city and the use of urban land in different regions varies. The metropolitan area can be divided into three general areas according to differences in population density and residential density: the city center, the established suburbs, and the new outer urban growth corridors. The city-center area has concentrated the vast majority of the city's commercial and office space and is characterized by high buildings and intensive land uses. The established suburbs are low-density residential areas focused on traditional main-street retail areas, malls, and big-box retailing, with an average population density of 1,500 people/km². The growth corridors are gradually adopting the typical suburban characteristics of low-density detached housing, car-dependent commercial and service facilities, insufficient public-transport services, and inefficient land uses.

The established suburbs and growth corridors provide extensive opportunities for intensified land uses. Melbourne 2030 advocated the construction of higher-density housing and utilization of brownfield and other infill sites in cities to promote urban compactness. For example, the government has invested in the reconstruction of the Docklands and Southbank areas around the central city. However, land ownership and development issues present obstacles to more intensive land uses, allowing developers to continue to build low-density single-residential buildings and substantially expand the UGB, making land speculation profitable.

For instance, Frankston, Whittlesea, and Melton are located at the edge of urban development but have been the focus of government development in recent years. From the statistical data, the growth rate of residential areas in these regions is significantly higher than the growth rate of the population because residential density is so low. To summarize, a single UGB policy cannot effectively increase urban concentration alone. Instead, the achievement of a compact city requires integrated policy development across a range of connected functions, particularly urban transport, land use, open space, urban planning, and a range of other coordinated economic, environmental, and social sectors.

5.4 International comparison of relevant policies on UGB

An UGB is not an isolated policy, but its policy impacts are closely related to its delineation, implementation, amendment, supervision, and supporting policy settings. In Oregon, the UGB is an element of a statewide land-use system. In 1973, the Land Conservation and Development Commission (LCDC) was established to adopt state land-use planning goals, implement rules, and assure local compliance with state goals (Dempsey and Plantinga, 2013). The LCDC required cities and counties to designate UGBs to contain the inefficiency of urban development. Portland's UGB was approved by the state in 1980. The Metro Government (the former Metropolitan Service) is responsible for establishing and

amending Portland area's UGB (Kang et al., 2018). The Oregon state legislature has enacted mechanisms to assure that certain UGBs are more rigorously reviewed than others and that the Metro Government, in particular, has sufficient buildable land to meet regional residential needs. Portland's UGBs have operated for almost 40 years and its experience in growth management has been an important reference for urban-containment policy design. To explore the reasons why the Melbourne UGB policy did not achieve the desired results, we compare it with the UGB policy in Portland. The results are shown in Table 2.

The table shows that both cities clearly define the UGB management structure, land supply goals, and amendment procedure, but Portland was significantly better than Melbourne in terms of public participation, monitoring, and relevant policy support. In 1994, the Portland Metro Government, in preparing the "2040 Growth Concept," used extensive TV, radio, and newspaper advertising, as well as questionnaires, public speaking, and other means to solicit participation in future planning (Wang et al., 2018). This approach not only improved the public awareness of the UGB, but also assisted implementation. The public participation in the Melbourne UGB was relatively minor. Public recognition of the UGB was not high, and high-density residential construction was seen by many residents as reducing the quality of the urban environment

Table 2: Comparison of UGB policy between Portland and Melbourne

City	Who has the power to establish and amend the UGB?	Who has the power to supervise the UGB?	UGB amendment procedure	Land supply	Relevant policies	Extent of Public Participation	Monitoring
Portland	Metro Government , an elected governing body and enhanced planning powers.	The Land Conservation and Development Commission (LCDC) , a statewide body, has the responsibility to, among other things, adopt and enforce binding land-use policies, administrative rules, and planning procedures for the state and its component parts.	Normal Amendments: Metro Government is responsible for amending UGB according to the analysis of the UGB and buildable lands analysis every 6 years. Major Amendments: Can be used to amend its UGB to provide land for public facilities needs during unconventional adjustment period. Minor Amendments: Can be used for minor changes, such as making boundary lines contiguous, placing utility lines for public services, or swapping land inside the UGB with land outside of it.	Ensures that the UGB contains sufficient buildable land for a rolling 20-year period .	Urban Growth Management Functional Plan; Regional Framework Plan; Senate Bill 1011; Regional Transportation Plan; urban reserve and rural reserve.	Various styles in Planning stage. Public Hearing during UGB Amendment.	The Oregon Court of Appeals; Land Use Board of Appeals (LUBA); 1000 Friends of Oregon , which is a voluntary Oregon organization has worked comprehensively statewide to defend the purpose and potential of the Oregon land-use system.
Melbourne	Department of Environment, Water, Land and Planning.	The Minister for Planning of Victoria.	UGB amendment requires prior ministerial approval before local government councils could initiate planning-scheme amendments, and parliamentary ratification. Local councils or the government propose an amendment. An independent panel the amendment at a public hearing considers. Then, Parliament must approve any amendment.	Guaranteed 15-year supply of land for development and land-supply program.	Metropolitan Green Wedge Protection Act; Planning and Environment Act 1987; Planning Policy in Planning Schemes; Melbourne 2030; Green Wedge and Urban Growth Corridor.	Communication with public in network during UGB implementation.	None.

In Portland, the Land Use Board of Appeals (LUBA) and The Oregon Court of Appeals have the discretion to adjudicate on the legality of UGB changes and supervise the implementation of UGB policy. In addition, it is noteworthy that a non-profit organization, "1000 Friends of Oregon", was

established in 1975 to defend statewide land-use planning and to protect Oregon's productivity, beauty, and livability. Land-use planning and social supervision also play a positive role in upholding the interests of the Oregon public. In Melbourne, no third-party institutions supervise or monitor the correct implementation of UGB, although legislation requires

prior ministerial approval and parliamentary ratification of amendments (Khoo et al., 2019). However, both main parties have combined to expand the UGB and alter planning zones, rendering legislation protection ineffective. Supporting policies provide another point of difference. In 1979, Portland implemented the UGB in land-use planning, and after many years of practice, the related laws and framework for integrated regional planning were relatively intact.

In November 1996, the Portland Metro Government passed the Urban Growth Management Functional Plan, which provided the requirements of the local government and the policy tools, including the prediction of population growth down to the local government in the overall planning,

for large-scale retail business development of new control measures, coordination measures with surrounding cities, coordinated land-use and transport planning, low-income housing, and 2040 Growth Concept indicators. The Regional Framework Plan, adopted in December 1997, was a collection of space-management policies, including land use, transportation, open space, water quality, air-quality management, natural disaster prevention and control, and planning and implementation. The Victoria government passed the Metropolitan Green Wedge Protection Act in 2003, which defined the UGB, and the Green Wedge and UGB amendment procedures. Melbourne 2030 is a metropolitan strategic plan with economic, social, and environmental policies. Implementation of the plan quickly failed. As a result, the role of UGB in limiting urban sprawl was substantially weakened.

6. CONCLUSIONS

Based on the census data published by the Australian Bureau of statistics, the spatial and temporal distributions of population and residential density and growth in Melbourne, Australia, were analyzed by means of GIS software. It was found that in the past 20 years, the population density and housing density have increased in the greater Melbourne metropolitan area, and the distribution law has decreased from downtown to the suburbs. Nearly half of the population and residential growth are distributed in the outer urban areas, and the growth rate is increasing year by year. The number of multi-story dwellings grow slowly, and they are concentrated in the urban central region. UGB amendments are frequent and large, extending outward along the urban development corridors. The results of these indicators suggest that Melbourne's UGB has not effectively promoted the development of the compact city, and that there is a trend of further expansion.

Based on the above data, we discussed the characteristics and causes of the low density of urban development and the unbalanced land use in Melbourne. The residential preferences of residents and the established development model of developers are an interactive market supply-and-demand activity, as well as an objective cause of the low density of urban development. The government has adopted strategic objectives aimed at strictly limiting the boundaries of urban development and formulated rules to improve the density of urban development to regulate urban developer activity. Urban suburbs and fringe areas provide the greatest potential for urban intensification.

To release the land-use potential, UGB policy needs to be integrated with various departments, such as urban land use, urban transportation, and environmental planning, in a comprehensive and coordinated manner, and linked to an effective system of intensified land uses. The comparison between Melbourne and Portland's UGB policies suggests that the gap between them is in the areas of public participation, monitoring, and relevant policies. In this paper, we argued that the public participation of Melbourne's UGB policy was limited, and public attitudes towards housing type and the UGB was affected by urban-developer housing supply and expectations. Melbourne lacks third-party agencies to supervise the implementation of the UGB, and social supervision is weak. Finally, in the formulation of supporting policies, the lack of an inter-departmental coordination mechanism hinders the implementation of UGB policy.

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