Are Urban Development and Densification Patterns Aligned with Infrastructure Funding Allocation? Examining Data from Melbourne 1999-2015

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Abstract

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Keywords

Disciplines

Education | Social and Behavioral Sciences

Publication Details

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Recognising both the social justice and strategic dimensions of the density-infrastructure nexus, this paper examines data on spatial patterns of capital investment and population growth in Victoria (VIC). We focus on spending by the Victorian State Governments in a range of urban infrastructures and services in Melbourne since 1999. The findings highlight the limits and potential of these data and point to some inconsistencies between State Governments' infrastructure spending patterns and their urban development strategies.

Key Words: *Densification; Infrastructure; State Investment; Resident Opposition; Melbourne*

Introduction

> Our villages are getting more cramped, they are getting taller, and finding parking has become a daily chore. (James Newbury, Liberal Member for Brighton, Victoria, 1 June 2017).

In the next 30 years, the population of Melbourne is expected to almost double to 8 million people (Tomazin, 2017). To accommodate this growth, the Victorian State Government has expanded the scope for densification, including in Melbourne's suburbs. This includes a removal on the 'cap' of number of dwellings permitted per lot while mandating maximum height and minimum garden space in modified residential zones (Victorian Department of Environment, Land, Water and Planning, 2017). While these changes are the continuation of longer-term strategies of urban consolidation, densification has occurred unevenly. Of known major developments in Melbourne in 2009-2010 for example, larger developments (those of 25 dwellings or more) excluding those in the central business district (CBD) were concentrated in inner-eastern and inner-northern suburbs. Among these suburbs, South Yarra, Richmond, Moreland and Darebin absorbed 20 per cent of all large development (Cook *et al.*, 2012). Other studies that show that densification through the 1990s was concentrated in Melbourne's inner suburbs (Buxton and Thieman) and more recently along suburban transport networks, including rail lines and suburban centres (Randolph, 2006). The Australian Bureau of Statistics (ABS) also shows inner suburban population growth, such as Melbourne's suburb of Abbotsford, where population doubled to 8110 between 2006-2016 (Colebatch, 2017).

This uneven pattern of densification raises questions around the balance between increased apartment supply and infrastructure investment in densifying neighbourhoods. While a common goal of compact city policies is to extract more value from existing infrastructure, population increases place additional pressure on public services. This includes hard infrastructure such as 'roads, highways, water and sewerage systems, railways, wires, cables and transmitters' and soft infrastructures such as 'education, health care, cultural activities, financial services' (Filion and Keil, 2017, p. 8). Studies of resident opposition to higher-density housing suggest that the increased demand for public investment in these areas, particularly parking, traffic and amenity (Davison *et al.*, 2016), is a concern among citizens whose influence over local planning decisions can often limit the nature and extent of densification through the political process (Ruming, Houston and Amati, 2012; Taylor, Cook and Hurley, 2016). In a large online survey of residents in 24 selected Australian cities

(Productivity Commission, 2011, p. 28) only 12 percent of respondents agreed with the statement that they would 'like more people living in [their] suburb or community and the increase in housing required for this'. The result was similar in capital cities (11%) and all other cities (12%). In contrast, more than half (52%) of those in capital cities, (and just under half in other cities) indicated they would not like 'more people living in their suburb'. Asked to explain their response, 85 percent of those in capital cities cited 'increased congestion', followed by 'increased noise' (59%) 'loss of street appeal' (44%) and 'more crowded public transport' (35%). In Sydney and Melbourne, 89 and 86 percent of respondents opposed to higher population density selected 'congestion' with 46 and 37 percent selecting 'more crowded public transport' respectively.

Residential densification however generates not only demand for increased services and infrastructure. Through enlarging the pool of local and State property taxes it potentially generates public revenue that could (and perhaps should) be used to finance this demand. Alignment between densification and public spending on infrastructure thus provides an incentive for residents and local governments to embrace and plan for higher density cities. Indeed, in the community survey, of those participants who wanted more people in their suburbs (just 12 percent of participants), more than half said it was because 'it would bring increased services' (Productivity Commission, 2011, p. 29). As born out in the majority of responses above, concerns raised about inadequate infrastructure in densifying areas nonetheless indicate a strong perception that such density dividends are redirected to other areas and priorities, reinforcing frustration about the uneven distribution of the costs and benefits of densification (Troy, 2017). Despite these divergent perceptions, we have a limited empirical foundation to examine the extent to which densification and infrastructure funding allocation patterns align spatially. In other words, whether those communities that do the 'heavy lifting' in dwelling approvals can expect a return through public investment.

Recognising the significance of increasing density for resident satisfaction, perceptions of planning, and urban social justice this paper examines the relationship between density and public infrastructure funding allocation. It takes as its focus infrastructure spending in the areas of Melbourne that have densified most rapidly from 1999 to 2016. By integrating two types of data –area-based population growth and public accounts on capital spending – the paper develops a mechanism through which to relate densification to State Government infrastructure allocation. Before setting out the method in more detail, we first chart the challenges of infrastructure that densification poses in Australian cities.

The politics of density and infrastructure

> Whilst sometimes taken for granted – at least when they work amongst wealthier or more privileged users and spaces – energy, water, sewerage, transport, trade, financial and community infrastructures allow modern urban life to exist. (Graham, 2010, p. 1)

Stephen Graham (above) argues that even though infrastructure plays a critical role in cities, it is often barely regarded or recognised by citizens. This is because much of the infrastructure underpinning urban expansion and intensification is hidden from daily view; or conversely, is so routine that it becomes taken-for-granted. One of the features of modern urbanism is the disconnection between the structures that support housing and urban systems (such as water and sewerage systems) and the everyday experiences of residents in cities and homes (Graham, 2010; Kaika, 2004). Every type of settlement hinges on the provision of infrastructure to provide for human life such that infrastructures are 'enablers, providing conditions to make other activities possible' (Fillion and Keil, 2017 p. 8). They are seen to be a marker of civilised society and the modern state and increasingly enlisted in debates about urban futures (Graham, 2010). It is not until there is a disruption to these hidden and taken-for-granted networks through for instance, disaster or energy failure that they become more legible and made more public.

Densification arguably produces a set of conditions where infrastructure is made more visible. With increasing density, residents can become aware of increasing congestion on roads or public transport; or the increased time it takes to move from, to and within their neighbourhood. Density is thus anticipated and eventually becomes known to residents through the frustration of waiting for public services and infrastructures. As McFarlane (2016) suggests, density is not just a topographical measure of concentration, but registers topologically, meaning it is experienced and perceived in the ebb and flow of daily life. This affective politicisation of bodies has produced a series of resistances to higher density in planning; sometimes by residents, and also by local councils. Densification is thus a political rather than purely technical process (McFarlane, 2016; Ruming, Houston and Amati, 2012), and managing this transition has become a key challenge for urban planning authorities in Australia.

Mediating resident opposition to higher density housing and viewpoints can nonetheless be a difficult process. Studies show that residents can develop a territorial view of their neighbourhood, shaped by their economic, social and practical investments in their homes and communities (Cook, Taylor and Hurley, 2013). Shifting the perception that they will have to share scarce resources in denser neighbourhoods is difficult when there is no indication of whether densification is supported through lasting enhancements to infrastructure and urban services. As Graham (2010) suggests, infrastructures are 'materializations of the starkly contested and divided political, ecological and social processes which tend to characterize contemporary cities' (p. 1). However, as Filion and Keil (2017) suggest, experts play central roles in infrastructure decisions and funding allocation is therefore not routinely open to debate among other 'interested parties' (p. 11). Infrastructure allocation decisions are also highly politicised and can produce a pattern of winners and losers divided across spatial and socioeconomic lines (Wiesel, Liu and Buckle, in press). In order to develop a clearer understanding of the extent to which densification drives infrastructure allocation, this paper brings Annual State Government Infrastructure Allocation together with density and socio-economic data. We turn to this method next.

State Government Infrastructure investment in Melbourne's densification frontiers
Method
Infrastructure expenditure data
State infrastructure spending data were collected from annual state budget papers published by Department of Treasury and Finance, Victoria state government for budget years 1999/2000 to 2015/16 (Victorian Department of Treasury and Finance, 2017). These budget papers include spending on capital projects, excluding public-private partnership projects. These capital projects, which typically represent 20 to 30 per cent of total state government annual budget, were allocated by the state government and funded from various sources including state government revenue, federal government payment (i.e., Commonwealth infrastructure grant funding), public sector borrowings, asset recycling, and private sector contributions (excluding public-private partnerships), and aimed to enhance the state's productive capacity and to improve services to the population and community (see, e.g., Victorian Department of Treasury and Finance, 2015, p. 5).

Funded projects were categorized into twelve groups, including: public housing; community services (including neighbourhood facilities, aging, disability and home care facilities and homelessness services facilities); education; hospitals; policing and emergency facilities (i.e., police stations and fire stations); justice facilities (including court houses and correctional facilities); road and traffic; public transport facilities (station upgrades, rail links and Transit City projects); amenities (i.e., sports, recreational and cultural facilities); urban development (i.e., urban renewal projects, such as Docklands and West Melbourne redevelopment); utilities (water, sewage and treatment facilities); and, other government projects (such as government office accommodation and government management).

Each project was geo-referenced to suburb level using the ABS' 2011 state suburb codes in Australian Standard Geographical classification (ABS, 2011b) in alignment with the Greater Capital City Statistical Areas (ABS, 2011a). A total of 5,812 projects within Melbourne metropolitan area were identified from the database (out of 8,561 projects funded state-wide). To account for inflation and the time value of money, all historical expenses were compounded to 2015 dollars at an annualised rate of five per cent. We also analysed the data using rates of two per cent and seven percent, and the results were not sensitive to the use of these different level of rates.

Measuring and representing the urban structure of Melbourne
For the purpose of analysing infrastructure spending patterns in Melbourne's 'densification frontiers', we divided its metropolitan area into sub-regions defined by the following variables: population density, population growth rate since 2001, percentage of flats and units within total dwellings, distance to the CBD, and Index of Relative Socio-Economic Disadvantage from Socio-Economic Indexes for Areas of 2011 Census (ABS, 2013).

We applied stratified clustering analyses using SPSS Statistics 24 and ArcGIS 10.4 for representation of the sub-regions constructed through these variables. Of thirteen possible clusters, eight yielded the most varied yet legible differences and were eventually utilized for analysis (See Figure 1 and Table 1). Among the eight clusters, we further identified three clusters as Melbourne's 'densification frontiers': the Melbourne central business district (CBD), inner-city and inner-suburbs. These three subregions, encompassing a total of 89 suburbs, have experienced the highest level of population growth in the metropolitan area through densification of existing built up area. The remainder of the paper focuses on these densification frontiers to examine the relationship between rates of densification and infrastructure spending.

Figure 1. Melbourne's Urban Structure (CBD and 30 km Radius)
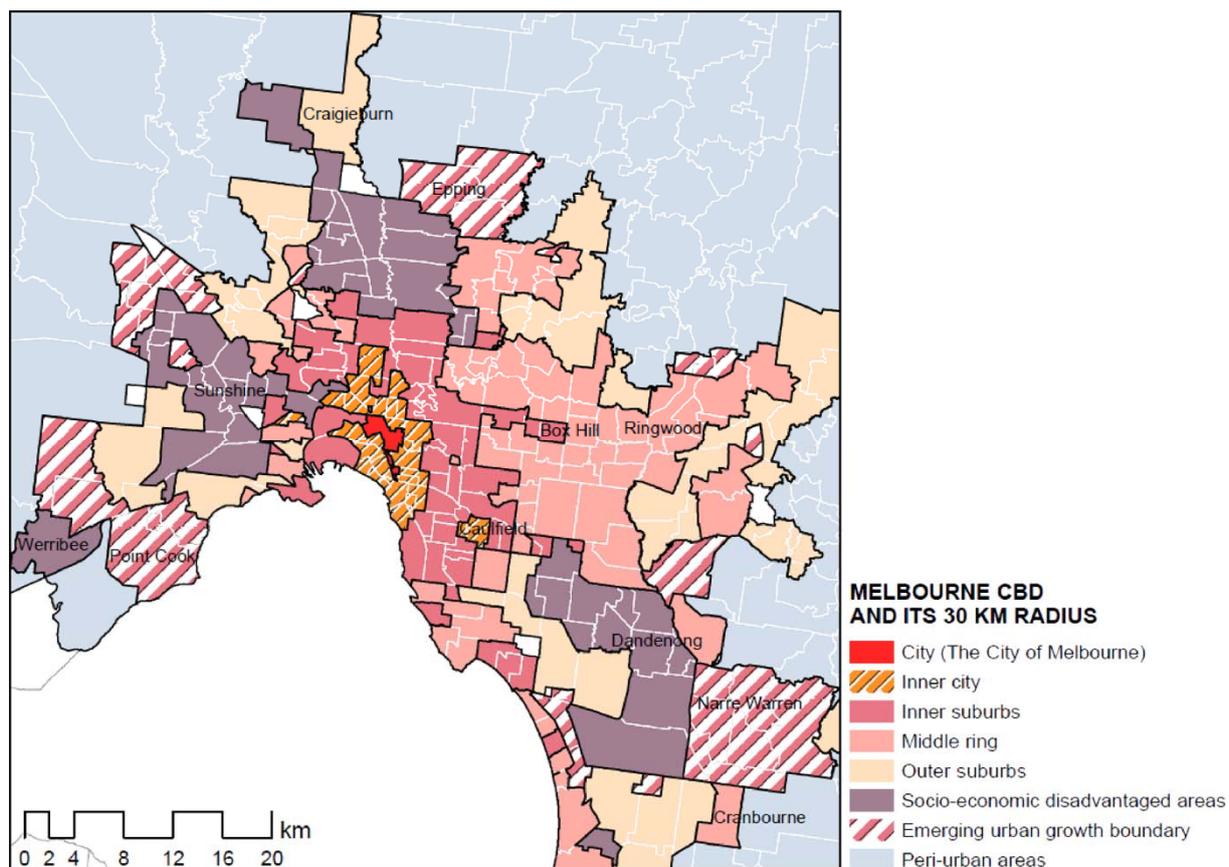
Table 1. Melbourne's Densification Subregions, Using Stratified Clustering Analysis

	No. of suburbs	2011 ISRD score		Residential density, 1986 (persons/km^2)		Residential density, 2011 (persons/km2)		Densification, 1986 – 2011	km to CBD	% of flats and units
		Mean	*SD*	*Mean*	*SD*	Mean	*SD*	*Mean*	*Mean*	*Mean*
CBD	1	1027.06		1183.49		4547.88		5.53%	0	84.55
Inner city	31	1048.18	54.42	3744.5	1698.29	4773.98	1837.08	1.61%	4.35	48.47
Inner suburbs	57	1058.49	35.74	2521.73	811.05	2907.39	812.73	0.71%	9.9	24.63
Middle ring	80	1053.92	37.22	1991.87	430.76	2161.12	414.6	0.36%	17.24	7.46
Outer suburbs	65	1028.71	50.35	665.18	437.54	873.89	303.34	2.52%	30.61	4.37
Disadvantaged areas	53	885.33	63.79	1619.2	856.08	1839.99	835.28	1.13%	18.24	13.04
Emerging urban growth boundary	40	1038.65	45.62	327.04	355.91	1767.49	556.9	11.82%	28.3	3.15
Peri-urban areas	190	1050.74	46.15	58.06	76.55	94.55	113.27	1.60%	47.6	2.34

Measuring the infrastructure investment level

Analysis included the total volumes of investment spending and a population-growth adjusted average annual per capita spending in each cluster. To account for the uneven changes in population over the years, we estimated the cumulative residence population figures accumulated between 1999 and 2015 for the analysis. We designed a ratio index, Relative Expenditure Index (REI), to compare expenditure in each of the clusters to the metropolitan average (excluding the CBD and peri-urban zone) as a benchmark (see Table 2).

Table 2. Relative Expenditure Index (REI)* by Metropolitan Subregion and by Category

	Public Housing	Community services	Education	Health	Policing, Fire and Emergency	Justice	Roads and traffic	Public transport	Amenities	Urban development	Utilities	Other**	Total
CBD	55.13	0	3.68	2.57	32.44	433.71	7.02	72.02	172.59	122.27	17.57	1249.03	38.97
Inner city	.15	2.50	1.09	3.55	1.88	3.04	.01	.78	11.80	.24	.48	8.87	2.06
Inner suburbs	.75	2.33	.68	1.93	1.31	1.60	.53	.32	.01	.03	.78	0	.87
Metropolitan average ***	1	1	1	1	1	1	1	1	1	1	1	1	1

Note: *REI is calculated by dividing the average annual per-capita expenditure in each region, by the average annual per capita expenditure for the metropolitan area.
** The 'Other' category includes government services, government office accommodation and facilities for government management (such as IT facilities).
*** The calculation of metropolitan average excludes CBD and peri-urban zone.

Results
Central Business District ('City')

Melbourne's Central Business District (CBD) ('City') experienced the most rapid level of population growth since 1986, largely due to the City of Melbourne's 'Postcode 3000' planning policy initiated in 1992. With 134 per cent growth in population from 1986 to 2011, at an annual rate of 5.53 per cent, per-capita investment levels in the CBD have remained very high relative to the rest of the metropolitan area. Total state government expenditure on infrastructure and services in the City was 39 times higher than the average for the rest of the metropolitan area.

However, services and infrastructure in the CBD cater not only to local residents, but also those who work in the CBD, commute through the CBD to get elsewhere, or visit the CBD for leisure. When including in the calculation of per capita investment not only the residential population, but also workers and visitors to the CBD on an average weekday, average annual per capita investment in Melbourne CBD drops significantly to levels that are closer to the metropolitan average (see Table 3).

Table 3. Adjusted Annual Per Capital Spending ($) in Melbourne CBD, by Usual Residents, Workers and Visitors

Population count	Melbourne CBD	Melbourne Metropolitan Area
Usual residents	18791.43	603.63
Usual residents and daily workers	980.03	372.21
Weekday population*	403.87	-
Note: *Weekday population was a combination of residents, students, workers, commuters and visitors (City of Melbourne, 2015, p. 13).		

Melbourne CBD attracted particular types of infrastructure and services, including: government services (includes office accommodation and government IT services) (1249 REI, i.e., 1249 times higher than the metropolitan average); justice facilities (434 REI); amenities (173 REI); urban development (122 REI); public housing (55 REI); and police and emergency services (32 REI). Public housing expenditure involved, primarily, investment in the Commonwealth Games Village. Education infrastructure expenditure in Melbourne's CBD expenditure was 4 times higher than the metropolitan average, a substantial proportion of it going to selective K-12 schools located in the CBD. While infrastructures such as amenities and selective school in the CBD serve a wider population living well outside the CBD, there are obvious advantages for residents living in the CBD or its immediate surrounds in accessing these facilities. Furthermore, while government facilities serve the whole state, their location within the CBD is advantageous to local residents in terms of access to public sector jobs.

The only category where state government expenditure in the CBD was below the metropolitan average is community services. This is concerning given the relative high presence of socially disadvantaged groups, such as homeless people, in the CBD. However, underinvestment in community services by the state government is possibly offset by relatively high levels of investment by the City of Melbourne.

Inner city

Much of Melbourne's population growth and densification since the mid-1980s took place in the 'inner city' cluster consisting of 31 suburbs that form an almost perfect ring surrounding Melbourne's CBD. From 1986 to 2011, the population of these suburbs grew by 41per cent, at an annual growth rate of 1.61 per cent. In 2011, over half (53%) of the housing stock in the inner-city cluster were non-detached dwellings (e.g., flats). Relative to the growth in population, per capita expenditure levels in the inner-city cluster remained very high, 2.06 times higher than the metropolitan average (excluding the CBD).

Per-capita expenditure in the cluster was particularly high in the categories of amenities (11.80 REI); government services (8.87 REI); Health (3.55 REI); and Community services (2.5 REI). These can be seen as direct benefits for the local resident population, with good access to services as well as jobs associated with them. Per capita expenditure was below the metropolitan average on roads and traffic (0.01 REI); public housing (0.15 REI); urban development (0.24 REI); utilities (0.48 REI); and public transport (0.78 REI). In particular, the low level of public transport expenditure in this cluster appears counter-productive to a 'compact city' development pattern.

Inner suburbs

The inner suburbs category refers to a cluster of 57 suburbs surrounding the inner city, although disproportionally located to its east. The cluster includes some of Melbourne's most affluent suburbs, with a mean IRSD score of 1058.49, higher than any other cluster in our analysis. The cluster includes long established affluent suburbs (e.g., Toorak, Hawthorn and Balwyn), gentrified (e.g., Abbotsford) and gentrifying suburbs (e.g., Northcote and Coburg). With 28 per cent of the housing stocks in the form of attached dwellings, these suburbs are sparse in comparison with the CBD and inner-city, but significantly denser than most other parts of metropolitan Melbourne. Densification in these suburbs– 15 per cent population growth from 1986 to 2011, at an annual growth rate of 0.71 per cent – has often faced highly effective local resistance (Taylor, Cook and Hurley, 2016). Inadequacy of infrastructure and services is often a major argument raised by those opposing further densification in the inner suburbs (Troy, 2017). Indeed, our analysis points to relatively low per-capita investment in the inner suburbs cluster, approximately 13 per cent lower than the metropolitan average (excluding the CBD).

Expenditure was particularly low in the categories of government services (nil); amenities (0.01 REI); urban development (0.03 REI); public transport (0.32 REI); roads and traffic (0.53 REI); education (0.68 REI); public housing (0.75 REI); and, utilities (0.78 REI). The low level of investment in some of these categories could be seen as compensated by the affluence of these areas, which ensures access to privately funded (e.g., private schools). Well-resourced local government in these affluent areas are also in advantageous position for local provision of services and amenities (e.g., parks). Like with the case of the inner-city, the low levels of public transport expenditure in Melbourne's inner suburbs appears counter-productive to a 'compact city' development pattern, and to some extent offsets the advantages of geographic proximity to the CBD. Low level of expenditure in urban development, public housing, roads and utilities could be interpreted as the outcomes of local NIMBYism towards such projects; although this does not wholly account for the low expenditure on public transport. At the same time, residents of the inner suburbs directly benefit from relatively high levels of expenditure on community services (2.33 REI), health (1.93 REI), Justice (1.60 REI) and emergency services (1.31 REI). Expenditure on justice facilities in the inner suburbs involved courthouses and neighbourhood justice centres rather than correctional facilities (which could have potentially raised NIMBY opposition, see, e.g., Dear, 1992).

Conclusion

Despite the critical role that physical infrastructure plays in cities, it is often invisible or taken-for-granted (Graham, 2010). Yet, processes of densification in Melbourne and Sydney appear to have broken the spell. No longer hidden, the infrastructure question has surfaced to the fore of public debates about metropolitan planning and development in both cities. On the one hand, residents of areas undergoing or targeted for densification flag concerns about the failure of infrastructure investment to meet the demands of a growing population (Productivity Commission, 2011; Troy, 2017). On the other hand, proponents of densification and the 'compact city' agenda, envisage revitalized urban precincts where the dividends of densification are reinvested in local infrastructure and services that benefit the local community undergoing densification, as well as the wider metropolitan population (see, Gurran and Lawler, 2016). And yet, to date, the absence of substantial empirical data on the actual spatial distribution of infrastructure, has made it difficult to evaluate the merits of either claim, for or against, densification.

This paper takes a first step towards addressing the empirical gap looming over this debate, through analysis of spatial patterns in the allocation of state government funding for 'capital projects' in greater Melbourne, across a wide range of infrastructures and services, and over a significant time period. The paper finds that when accounting for the residential population only, during the period 1999-2015 infrastructure expenditure levels in Melbourne's CBD and inner city, not only caught up with increased population growth, but exceedingly surpassed it. However, when accounting also for the daily population of 'visitors' working in or passing through the CBD, per capita expenditure levels drop substantially. This suggests that any excessive demand pressures on infrastructure in central Melbourne are more likely to be associated with the centralized patterns of Melbourne's transport system and labour market, rather than residential densification in the CBD itself.

As for the inner suburbs, although residential densification has been highly contested in recent years, actual population growth has been unremarkable at an annual rate of 0.71 per cent. Our findings on relatively low levels of state government expenditure, to some extent affirm concerns raised by local activists and planners about inadequate infrastructure investment. Yet, over a sixteen year time-frame, the data shows no direct relationship between low levels of infrastructure investment and residential densification in the inner suburbs. Indeed, low level of expenditure in urban development, public

housing and utilities could be interpreted more readily as the outcomes of local NIMBY forces by Melbourne's most affluent communities, rather than a form of disadvantage. Given Melbourne's centralised labour and transport patterns, inner suburbs also experience the combined impact of population growth in outer suburban areas. Urban structure as much as densification then, is likely to be a key source of increased demand for urban transport services in inner suburbs.

As such, in contrast to the claims of local anti-densification campaigners, our data shows that Melbourne's most rapidly densifying areas benefit from high levels of local infrastructure expenditure. At the same time, our data also refutes suggestions that the dividends of densification were reinvested in local infrastructure and services that will eventually produce a more compact city. On the contrary, the low level of public transport expenditure identified in Melbourne's inner city and inner suburbs, as well as Melbourne's highly centralized structure, both point to development patterns that undermine the operation of a compact city. More sophisticated thinking, and a stronger evidence base, are needed to begin to unpack the complex relationship between infrastructure and density in cities. Perhaps the next step in this direction would be to combine state with local government spending accounts, to produce a more wholesome empirical picture of public infrastructure expenditure patterns.

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