

THE SPATIAL DISTRIBUTION OF PARKING POLICY AND USAGE: A CASE STUDY OF MELBOURNE, AUSTRALIA

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ABSTRACT

Few cities have a Metropolitan wide parking policy. More often than not the planning of parking is undertaken by decentralised urban local governments with broad central guideline on parking supply rates. The provision of parking is thus generally opportunistic, aimed at facilitating and encouraging the decentralisation of travel and urban development. This paper documents the spatial distribution of policy and usage for parking in Melbourne, Australia, in order to obtain an indication of the spatial variations in parking policy and usage. The paper focuses on two aspects of parking. The first is parking supply policy in Metropolitan Melbourne. Parking pricing policy is focused only on the central city area and has been studied elsewhere. The data used in this section is metropolitan planning guidelines and local government parking strategies. The second is parking usage. The parking usage data is extracted from the metropolitan travel survey (VISTA 2007) and represents a study of daily travel in Metropolitan Melbourne. The paper reviews the spatial pattern of existing parking policy in Melbourne showing the increase in parking rate with distance from the central city. Parking supply policy is related strongly to land use and in the case of retail parking there is a strong decreasing relationship between parking rates and retail complex size. Parking usage was also related to distance from the central city and number of jobs in each local government. The act of parking a vehicle (a parking event) and the duration of parking are seen to increase with the number of jobs in each local government. Parking events and the duration of parking per job are also found to increase with distance from the central city. Parking events and the duration per square kilometer are found to decrease with distance from the central city. This study reinforces conventional wisdom in that parking usage and provision are related to the land use activity and distance from the central city. They cater and react to the decentralisation of activities encouraging a more decentralised urban area. The paper calls for further research on parking usage across metropolitan areas in other cities to confirm these trends.

Keywords: Parking supply, Spatial Distribution, Parking Policy

1. Introduction

Parking policy relates to the management of the price, duration, supply and location of parking to enhance the urban environment. Parking pricing and supply policy often focuses on the central city and areas of high levels of employment and retail activity. However the supply and price of parking influence the desirability of all locations in a city. The spatial distribution of the price, supply and demand for parking needs to be understood. This paper documents the spatial distribution of policy and usage for parking in Melbourne, Australia, in order to obtain an indication of the spatial variations in parking policy and usage. The paper focuses on two aspects of parking. The first is parking supply policy in Metropolitan Melbourne. Parking pricing policy in Melbourne focuses only on the central city area and has been studied in detail elsewhere (Hamer et al 2011). The data used in this section is metropolitan planning guidelines and local government parking strategies. The second is

parking usage. The parking usage data is extracted from the metropolitan travel survey (VISTA 2007) and represents a study of daily travel in Metropolitan Melbourne.

The paper looks at the spatial distribution of the supply and usage of parking in three parts. The first briefly outlines existing approaches to parking supply policy. The second examines and analyses the existing parking policy across Metropolitan Melbourne. It will cover the Metropolitan Planning Scheme and variations to this scheme. The third section looks at the distribution of parking usage across Metropolitan Melbourne. This overview points to variations in parking demand across the urban area and the relationship to parking policy. The paper closes with a call for similar research to be carried out in other urban areas to confirm the relationship between parking, land-use and transport policies.

2. Literature review

Parking policy tends to fall into two camps. The first looks at the supply of parking and the second its price. These aspects will be discussed. Parking policy focuses almost entirely on passenger vehicles. Parking for people with disabilities gets some mention due to legislation on discrimination, but multi-use and high occupancy parking along with motorbikes, bicycles and freight vehicles parking are rarely considered in policy statements. This paper therefore focuses primarily of parking for passenger vehicles.

Urban planners and parking policy formulators generally focus on setting of a rate (parking spaces per activity level) at which parking should be provided (Shoup, 1999). A surrogate measure of activity (eg floor area, number of beds, student numbers etc.) which is relatively easily measured is used to form a base for calculating the number of required parking spaces. Willson (1996) surveyed a number of planners in the United States and found that most surveyed a nearby city and consulted the ITE (2004) handbooks in order to gain an indication of parking requirements. Such approaches are still used, however, the data base upon which parking decisions can be made are broader and the inclusions of multi-use parking has been investigated. Recent parking policy research (Litman 1996, Cuddy, 2007, VTPI, 2008) suggest the proposition that the relationship between parking rates and the land-use they service is not always constant. Such factors as geographic location, demographics, economic factors, land use planning, transport planning, and parking access design may influence them. There is a clear view that the provision of high levels of parking in outer suburbs contributes to decentralization of urban activities (Litman 1996), but there has been little work which quantifies this trend. The parking rate can be specified as a minimum (Wendt and Levinson, 1990), required (Victorian Planning Scheme 2009) or maximum (Adam Millard Ball, 2007) rate depending on the jurisdiction. Whatever the parking rate specified there is still a negotiation process between developers, planning institutions and local residents which influences the final decision.

Another approach to control parking is through its price (Willson and Shoup, 1999). This has received more consideration in the literature than supply policy, however, its application generally relates only a small section of the city, primarily the central city (Shoup 2005; VCEC 2006; Litman 2006; Verhoef, Nijkamp & Rietveld 1995). Parking pricing policy has been introduced through a parking levy (*Parking Space Levy Act (NSW) 1992; Perth Parking Management Act (WA) 1999; Hamer et al 2009*), workplace parking levy (*Transport Act (UK) 2000; Parking Forum 2005; Enoch & Ison 2006*), commercial parking tax (Litman 2006), fringe benefit for income tax purposes (*Fringe Benefits Tax Assessment Act (Australia) 1986; Income Tax Act (NZ) 2004*), 'cashing out' of parking policy (Morris, 2005; Shoup 1997; Shoup 2005).

There has been considerable research into the relationship between parking policy and travel. Parking policy in city centres can have a strong influence on travel behaviour. Data shows that providing an abundant supply of relatively cheap parking makes it difficult to

persuade drivers to leave their cars and use public transport (Pourbaix 2005). Indeed, some studies suggest that levels of parking price can be more significant than levels of public transport provision in determining means of travel (particularly for the journey to work) even for trips that are very well served by public transport (Department of Communities and Local Government 2001). While governments at all levels can continue to expand infrastructure to meet actual and perceived access needs, Brown *et al.* (1999, p371) suggest that parking controls (both supply and cost) are 'the single most effective local tool to manage and limit traffic'.

Parking policies and planning practices are also changing in response to fundamental changes in planning objectives. In the past, transport planning tended to assume that "transportation" means driving and the primary goal is to accommodate automobile travel. That justified efforts to maximise parking supply. Transport planning is now more comprehensive and multi-modal. It recognises other modes, other planning objectives, and negative impacts that result from excessive automobile travel and sprawl.

Rarely do researchers look at the spatial distribution of parking policy nor the usage of parking. This study does just that, it looks at the spatial distribution of parking over Melbourne, Australia, and investigates how parking policy is implemented and the consequent result of this on parking usage.

3. Parking supply policy in Melbourne

The previous section has shown that parking policy tends to focus on the supply of parking across urban regions and pricing of parking in the central city. This section looks at Melbourne in order to confirm this view. This section will look at the spatial distribution of these policies in Melbourne.

3.1 Parking supply

Parking supply policy is possibly the most firmly planned spatial parking policy in Melbourne. The Victorian Planning Scheme (2009) was developed in order to provide a consistent planning basis across all of Victoria. Within the Planning Scheme, Clause 52.06 governs the parking standards in terms of rates, dimensions and related considerations. Specifically, Clause 52.06's purpose is to ensure that car parking facilities are provided in accordance with the State Planning Policy Framework and the Local Planning Policy Framework, including the Municipal Strategic Statement and local policies such as a Local Parking Precinct Plan (Melbourne 2030, 2000). Clause 52.06 aims to ensure that the design and location of car parking areas does not adversely affect the amenity of the locality; achieves a high standard of urban design; enables easy and efficient use; and protects the role and function of nearby roads.

Generally speaking, new developments must provide parking based on Clause 52.06-5. Table 1 below provides some of the standardized land uses that have a predetermined parking standard as set out in the Victorian Planning Scheme (2009). The parking rates specified in the Scheme is that required for development. Rarely do developers in the inner suburb provide more parking than that required by the Scheme due to the cost of providing a parking space. In outer suburbs where the cost of land is lower some developers may exceed that required by the Scheme.

When a dispensation from the Scheme is sought, Clause 52.06-1 provides a number of decision guidelines, which provide guidance in ascertaining a reduced parking provision. In order for the development to gain a reduction or complete waiver in the car parking requirement, one, or a number of the decision guidelines must be explained and adhered to. Developers who require traffic impact reports to be submitted to local governments in order

to gain a permit, often sub-contract out the task to traffic engineering company. Traffic engineers assess and analyse the parking, along with other traffic and transport related aspects within the area and specific to the development site, to try and achieve a parking dispensation or complete waiver for their respective client. The application involves submitting a report to council as well as advertising the proposed development to the local community, including directly notifying people in the area that may be directly affected by the development. A report is submitted to council at the Town Planning Stage. Council's traffic department examines this report and a decision is made. The development, based on parking maybe accepted, declined or accepted subject to specific conditions. If any party objects to the decision made by Council in regard to granting a permit for a proposed development, they can appeal the decision to the Victorian Civil and Administrative Tribunal (V.C.A.T.).

Table 1 – Victorian Car Parking Requirements, Clause 52.06 Victorian Planning Scheme (2009)

Land Use	Car Space Measure	Parking Rate
Shop, other than specified in this table	Car spaces to each 100m ² of leasable floor area	8
Office other than specified in this table	Car spaces to each 100 m ² of net floor area	3.5
Restaurant	Car spaces to each seat available to the public	0.6
Hotel or Tavern	Car spaces to each 100 m ² of bar floor area available to the public	60
	Car spaces to each 100 m ² of lounge floor area available to the public	30
Post Office	Car spaces to each 100 m ² of net floor area	3.5

In regards to parking, Clause 52.06 of the Victorian Planning Scheme (2009) governs the typical rates required for different land uses. Many municipalities across Metropolitan Melbourne have their own governing parking rates, whether it be Schedule Clause 52.06-6 to Clause 52.06, an individual Clause within the Municipalities Planning Scheme that differs to the general Victorian Scheme or a Planning Document produced by council. All these documents provide alternate rates to the Victorian Planning Scheme's (2009) Clause 52.06.

The metropolitan Melbourne Municipalities that are solely governed by Clause 52.06 and have no other parking policy documents or Schedule 52.06-6 are shown on Figure 1. There are 24 councils that use the Scheme as the basis for specifying parking requirements. There are 32 Municipalities in Melbourne. Within Metropolitan Melbourne, there are currently 8 Local Government areas that incorporate alternate parking rates to those specified within Clause 52.06 of the Victorian Planning Scheme (2009) (See Figure 1). These rates are provided in the form of a Schedule to Clause 52.06-6, Clause 22.03, a Town Planning Policy or some form of alternate Parking Management Plan.

The overall distribution of parking rates is shown in Figures 2 and 3. It can be seen that the rate reductions are more common in the inner to middle suburbs with the consequent provision of more parking in outer suburban areas. The impact of this on decentralisation of cities was explored by Young and Currie (2006).

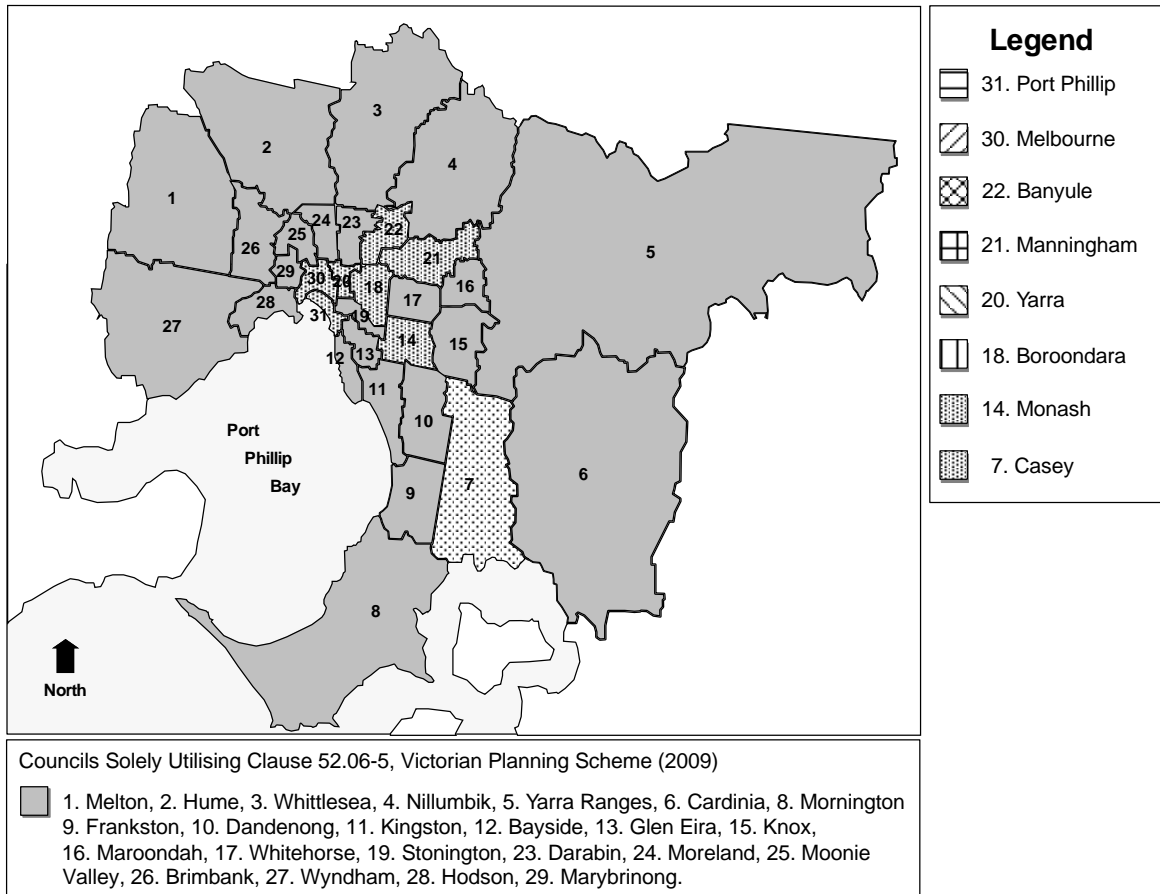


Figure 1: Local Governments that differ from general parking requirements.

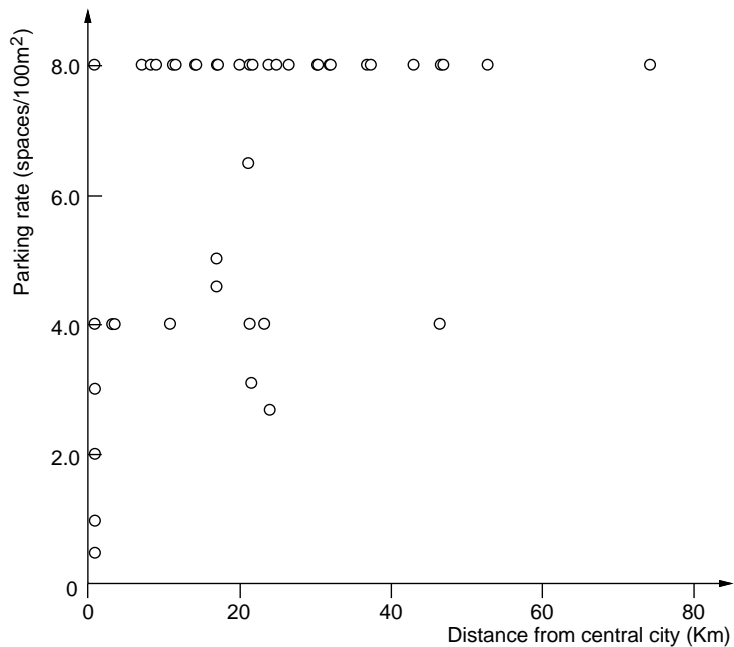


Figure 2: Parking rates for shopping

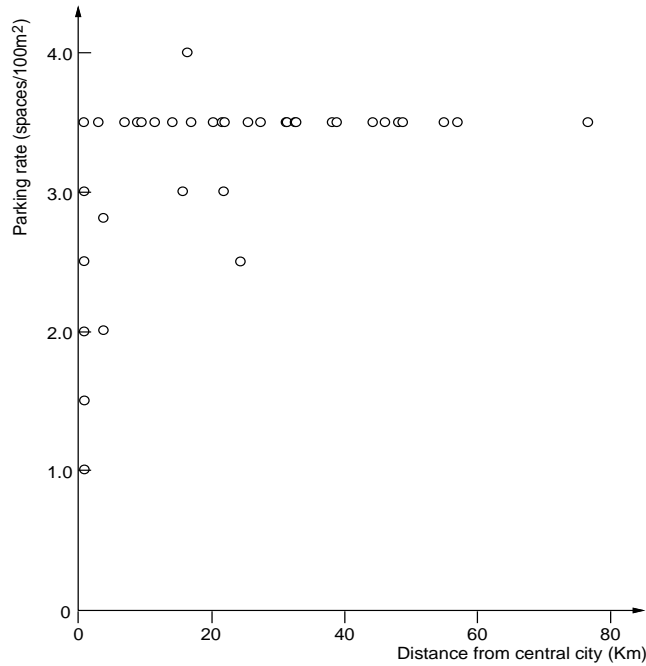


Figure 3: Parking rates for office

In the previous discussion, parking rates from the Victorian Planning Scheme (2009) and alternate documents or Clauses have been introduced. There is a need to compare the statutory requirement with what is actually provided. In many cases, developments are granted a reduction or complete waiver of on-site parking provision. This is especially evident in areas with large amounts of existing parking and in areas of high public transport accessibility. There is for this reason a need to identify what parking provisions are actually provided in a pre-determined precinct in order to gauge if the amount of parking matches the land-use in the area. To gain some indication of the implementation of parking rates the distribution of parking at shopping centres is studied. Figure 4 shows the distribution of

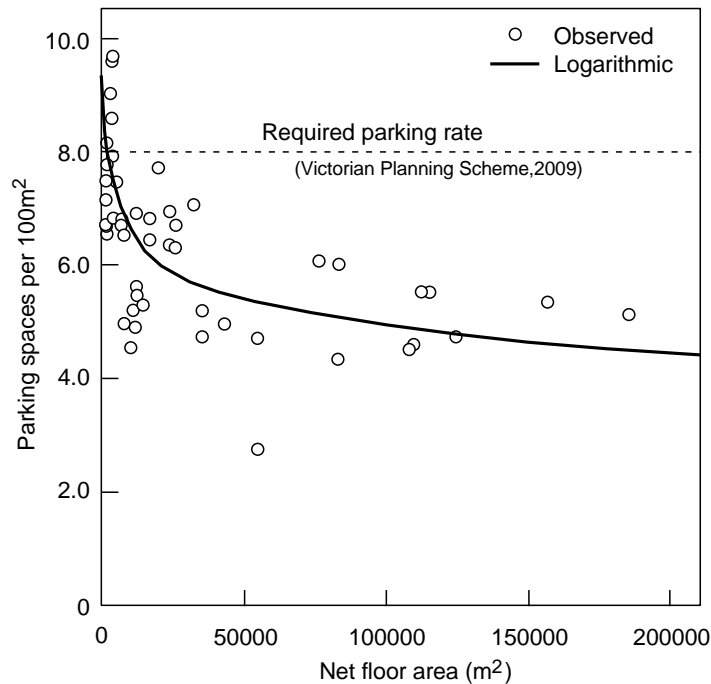


Figure 4: Relationship between parking lot size and parking rate

parking in relation to the size of the shopping centre. It can be seen that the actual parking rate is considerably lower than that in the parking scheme for medium to large shopping centres (ie above 30,000 m²). For small shopping centres there is more agreement between the parking scheme and the parking provided.

The trend is quite clear (see Table 2). There is a decrease in parking rate with increasing size of land use. There is a slight trend towards increasing parking provision with distance from the centre of city but this is not statistically significant.

Access to the final destination from the parking lot is shown in Figure 5. The travel distance from the lot to the final destination decreases with distance from the central city.

3.2 Pricing policy

Pricing policy in Melbourne is firmly focused on the central city. Figure 6 shows the proportion of people paying for parking. It can be seen that it is primarily in the inner suburbs. The strength of the relationship is shown in Table 2.

Table 2: Trends in parking provision

Relationship	Mathematical relationship	T-Statistic		Standardised R ²
		Constant	Independent variable	
Parking rate and net floor area (Figure 4)	Parking rate = 12.8 – 0.70 * Ln(Net floor area)	12.93 (sig 0.00)	-6.78 (sig 0.00)	0.48 (sig 0.00)
Average walking time and distance from Central city (Figure 5)	Average walking time = 0.77 + 1.21 / (Distance from central city)	39.115 (sig 0.00)	14.29 (sig = 0.00)	0.87 (sig 0.00)
Proportion not paying for parking and distance from the central city (Figure 6)	Proportion not paying for parking = 99.98 – 28.07 / Distance from central city)	314.87 (sig 0.00)	-20.78 (sig = 0.00)	0.93 (sig 0.00)

Parking pricing policy is rather ad hoc in most parts of Melbourne. Only in the central city of Melbourne has a parking levy been introduced. The *Congestion Levy Act 2005* (Vic) applies a levy on all long-stay parking spaces in the Melbourne CBD and adjacent inner city area. The congestion levy covers an area of approximately 14.6 km² of inner Melbourne. The total area of Greater Melbourne is 8806 km². Under the Act, a long stay parking space is defined as a parking space in a private car park and a parking space in a public car park that is set aside or used for ongoing parking by the owner of the space (or another person under lease or licence), or used for the parking of a motor vehicle for a period of at least 4 hours on a working day, commencing at or before 9.30a.m. and ending at or after 9.30a.m. Under the definition provided in the legislation, a private car park simply refers to any car park that is not a public car park. Subject to the levy exemptions and concessions set out in the legislation, all parking spaces in a private car park attract the congestion levy. Many car park operators within the levy area offer patrons a discounted 'early bird' rate (McGuigan 2009), provided that they arrive prior to 9:30 a.m. and stay for a minimum time period. All of the parking spaces used for 'early bird' parking are considered to be long stay parking spaces (State Revenue Office 2007). Where parking is charged by the hour but the fee is capped at a set multiple of the hourly rate, an operator must include all parking spaces occupied for the maximum fee as long stay parking spaces, unless the operator can distinguish between those used for no more than four hours and the rest (State Revenue Office 2007). If parking

is charged as a fixed fee with no restrictions on the length of stay and no ability to determine the time of departure, the parking space must be treated as a long stay parking space (State Revenue Office 2007).

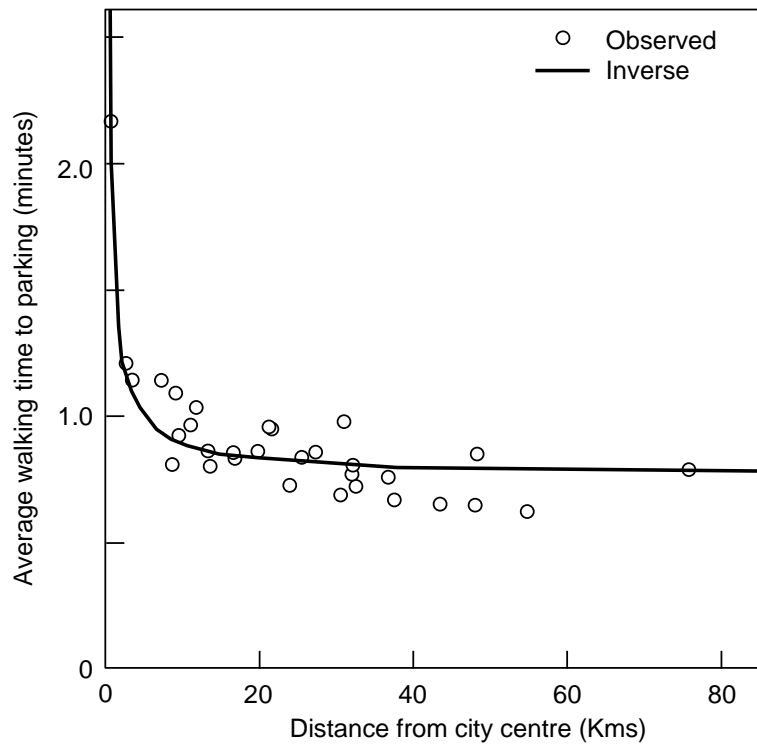


Figure 5: The relationship between average walking time and distance from the central city

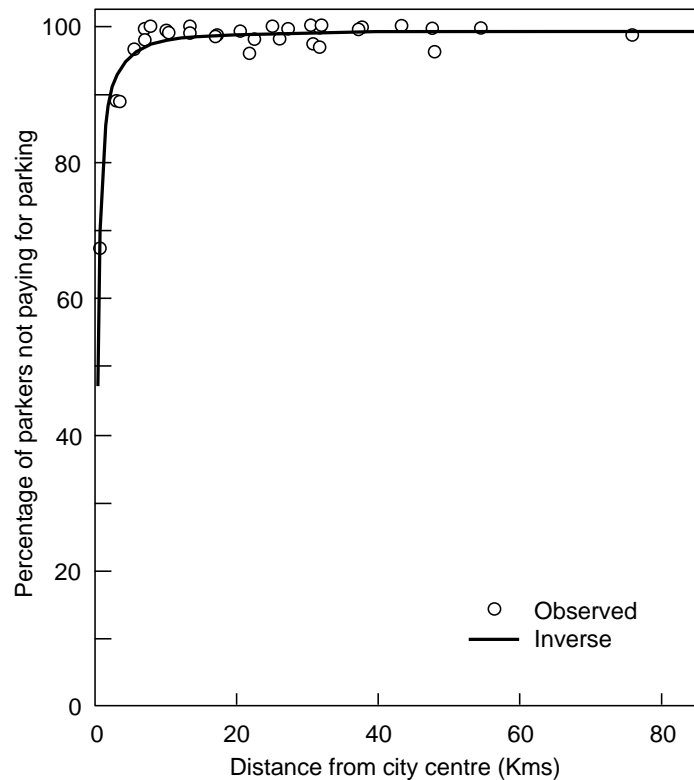


Figure 6: Proportion of non-paid parking by distance from the central city

4. Parking usage

4.1. Introduction and data

Consequent on the distribution of the supply policies there is the provision of parking. Drivers demand for parking combines with this supply to result in parking usage. The previous sections have outlined parking policy and shown the increasing supply for developments with distance from the central city. This section investigates the distribution of parking use in Melbourne in order to determine the patterns of usage. Parking usage is the consequence of the interaction between parking demand and supply and is what is usually used as a surrogate for parking demand.

The study uses the Victorian I Study of Transport Activity (VISTA, 2008) as a basis for comparison of parking. This study is a sample study of travel in Melbourne. It collects linked data over an entire day for all members of a household. This linked data is broken up into a number of base files for study. One of these files is a stops file. This file forms the basis for this study. Car stops were extracts for study. The sample file has weighting factors which allow it to be expended to represents the entire population of Melbourne. The all day weightings were used in this study.

VISTA-07 (2008) indicates that approximately 16.2% of vehicles do not make a trip on an average day. Of those vehicles that make a trip, the average vehicle spends about 71 minutes travelling each day. It is parked on average 351 minutes per at the end of periods of travel. The remainder the day, 1018 minutes, it is parking at its home residence. These are relatively 4.9%, 24.4% and 70.7% of the day. On average, vehicles are parked 95.1% of the day.

For those household vehicles that travel, there are approximately 4.24 million parking events in the city of Melbourne per day. Given that there are approximately 2.05 million passenger vehicles registered in the city, this represents about 1.82 parking events per vehicle, or if only vehicles that travel are included 2.43 parking events per day.

4.2. Parking events

This section will look at the relationship between parking and activity levels. Figure 7 and Table 4 shows the distribution of parking events in the city. The highest concentration of parking events is in the middle suburbs. The trend with distance from the central city is not significant ($R^2 = 0.034$), with the variation in the suburbs due to different levels of activity.

One measure of the level of activity in an area is the number of jobs. Figure 8 and Table 4 show the relationship between the number of parking events and the number of jobs in each local government. It is a relatively strong trend ($R^2 = 0.541$) indicating a good relationship between level of activity and parking. An extreme value to the right of the graph is the central city where there is a large number of jobs but a lower number of parking events. The strength of the relationship clearly shows the use of parking rates (parking supply per level of land use activity) as a basis for parking supply policy results in a strong relationship between the level of activity and parking.

The previous section showed that parking rates varied with distance from the central city. Dividing the number of parking events by the number of jobs and relating it to distance from the central city resulted in the distribution shown in Figure 9 and Table 4. The trend in parking per job shows a general increase with distance from the central city ($R^2 = 0.365$). The increase is high in the inner suburbs and flattens of in the middle to outer suburbs.

Dividing the number of parking events by the area of the local government provides an indication of the concentration of parking in inner and outer suburbs. The relationship between this concentration and distance for the central city is shown in Figure 10 and Table 4. The trend in parking density is a relatively strong showing a general decrease with distance from the central city.

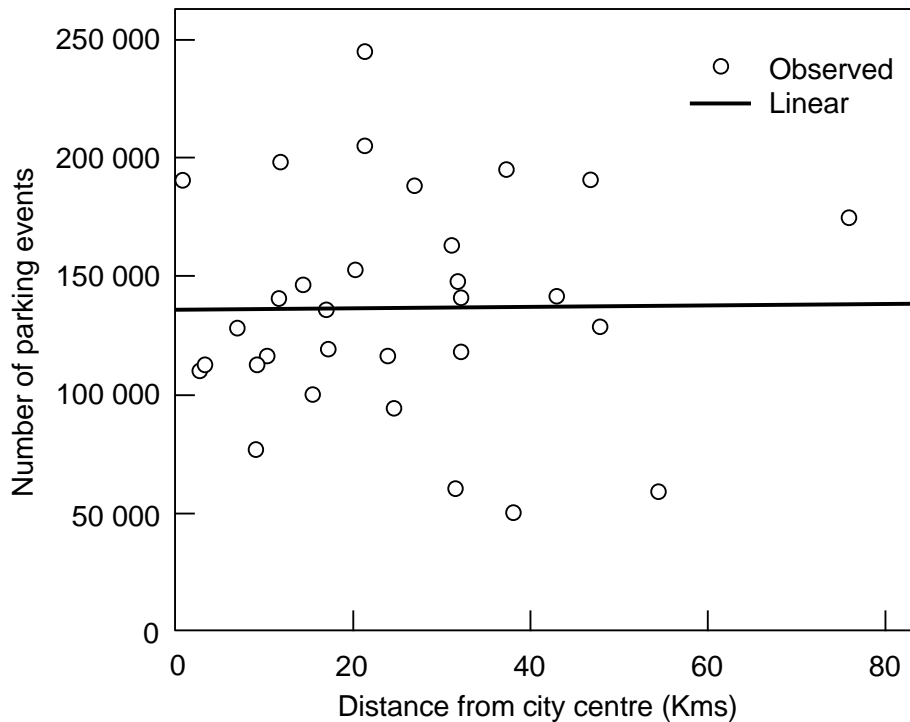


Figure 7: Spatial distribution of parking events by LGA

In summary this section shows that the parking usage is strongly related to the level of activity and distance from the central city even though the density of parking usage decreases with distance from the central city. The decentralization of parking usage is clearly shown by these relationships.

4.3. Parking utilisation

Parking events are but one measure of parking usage. Parking also has a time dimension, that is, the duration of parking. The duration of parking influences the required supply of parking. The duration and number of parking events can be combined into the total time vehicles are parked. It is the sum of the durations of each parked vehicle and is termed space minutes. Space minutes do not measure the maximum accumulation of parking directly but provides an estimate of parking utilisation.

The average number of space minutes vehicles are parked in each of the local governments in Melbourne for non-home activities are shown in Table 4. It is clear that the largest parking demand is in the central city but there is no real trend in the other local government areas. The introduction of space minutes does however increase the level of fit of the relationship from parking events, showing parking space minutes or parking utilisation is a better measure of parking usage.

The space minutes related to the number of jobs is shown in Table 4. It can be seen there is a strong relationship ($R^2 = 0.893$). This is again an improvement on the fit of the relationship from parking events. The space minutes increases with increased number of jobs, then levels out for areas with a large number of jobs, that is the central city.

Again the relationship between distance from the central city and the number of space minutes per job provides an indication of the level of decentralisation of parking usage. The average space minutes per job in each local government is presented in Table

Table 4: Usage of parking

Relationship	Mathematical relationship	T- Statistic		Standardised R ²
		Constant	Independent variable	
Parking events and distance from the central city (Figure 7)	Parking events = 135297.5 + 63.10 * Distance from the central city	9.03 (sig 0.00)	0.13 (sig 0.90)	0.04 (sig 0.90)
Parking events and number of jobs (Figure 8)	Parking events = - 439657.6 + 54446.3*Ln(Number of jobs)	-4.58 (sig 0.00)	6.03 (sig = 0.00)	0.54 (sig 0.00)
Parking events per job and distance from central city (Figure 9)	Parking events per job = 1.41 + 0.71*Distance from central city	2.80 (sig 0.00)	4.27 (sig 0.00)	0.37 (Sig 0.00)
Parking events per square kilometre and distance from central city (Figure 10)	Parking events per square kilometre = 6506.7 – 1530.2*Ln(Distance from the central city)	11.67 (sig 0.00)	-8.38 (sig 0.00)	0.70 (sig 0.00)
Parking space minutes and distance from central city	Parking space minutes = 17.60 + 22.55 / Distance from central city	11.57 (sig 0.00)	3.48 (sig = 0.00)	0.27 (sig 0.00)
Parking space minutes and number of jobs	Parking space minutes = -119.99 + 13.21*Ln(X)	-11.78 (sig 0.00)	13.76 (sig = 0.00)	0.89 (sig 0.00)
Parking space minutes per job and distance from the central city	Parking space minutes per job = 253.80 + 74.65*Ln(X)	42.70 (sig 0.00)	13.99 (sig 0.00)	0.48 (sig 0.00)
Parking space minutes per square kilometre and distance from central city	Parking space minutes per square kilometre = 1190744.35 – 302254.34*Ln(Distance from the central city)	15.57 (sig 0.00)	-12.07 (sig 0.00)	0.82 (sig 0.00)

4. It shows that there is an increase in parking demand per job as the distance from the central city increases. This is expected given the guidelines used in the Victorian Parking Scheme (2009), lower levels of public transport provision in outer suburbs and the greater land available for parking provision.

The average space minutes per square kilometre in each local government area is provided in Table 4. It can be seen that there is a progressive decrease as the distance from the central city increases. This indicates the parking demand per unit area, or parking concentration, is lower in the outer suburbs.

In summary this section shows that parking utilization, as measured by space minutes, is more strongly related to parking supply policy and distance from the central city than parking events. The inclusion of parking duration therefore gives a better measure of parking usage than just events. This measure of parking usage is strongly related to the level of activity and distance from the central city even though the density of parking space minutes decreases with distance from the central city. The decentralization of parking usage is clearly shown by these relationships.

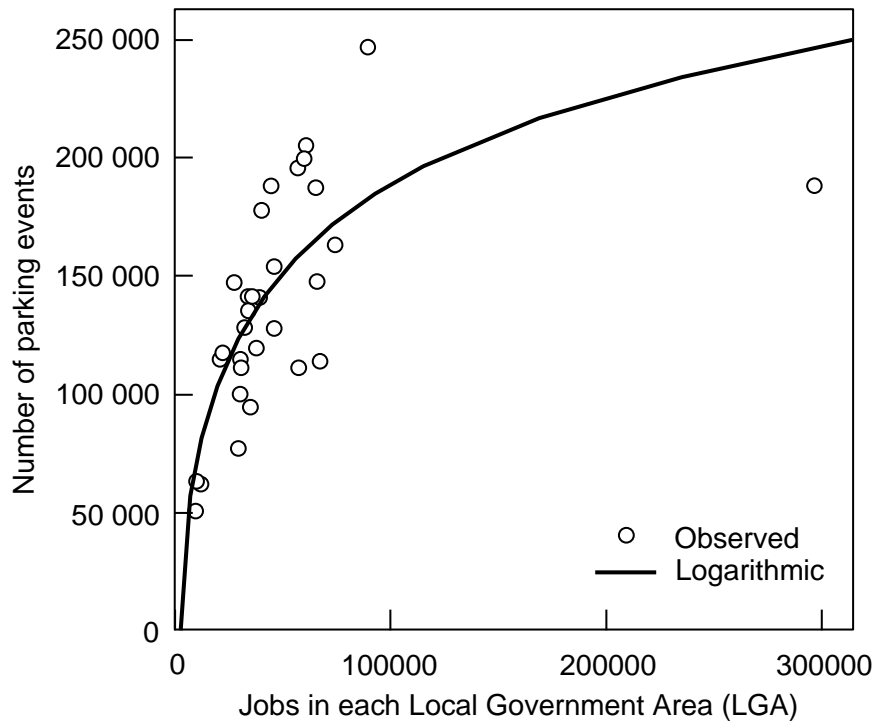


Figure 8: Number of jobs and parking events

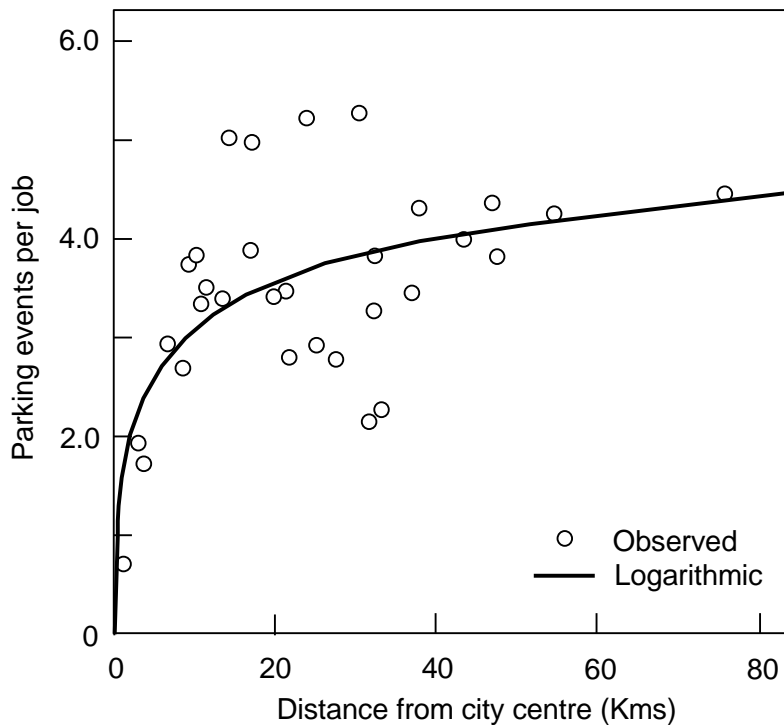


Figure 9: Spatial distribution of parking events per job

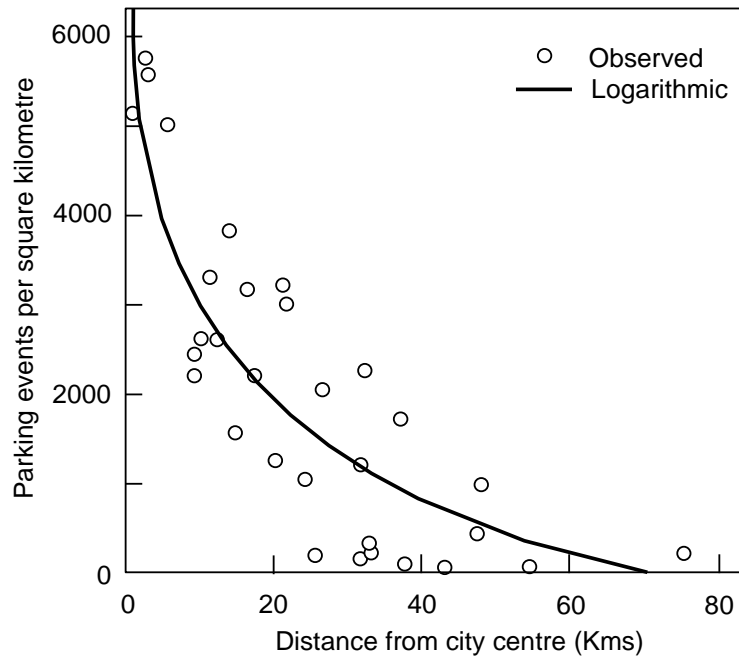


Figure 10: Spatial distribution of parking events per area

5. Conclusion

This paper has looked at two related perspectives of parking in Melbourne: parking policy and use. It points to the need to consider parking at a metropolitan level, rather than focusing parking policy in particular parts of a city.

A review of the literature shows that most recent studies of parking focus on pricing and its relationship to travel demand. Parking supply is however a major policy tool and relates very much to city development. It is clearly the major metropolitan parking policy tool used in many urban areas.

The initial investigation of parking in Melbourne covered parking supply and pricing. The majority of municipalities are governed by Clause 52.06 of the Planning Scheme with further rates and definitions provided within Clause 52.06-6 and Clause 22.03. Aside from specific Clause' within the Planning Scheme's, some municipalities have produced rates within Town Planning Policies or specific Car Parking Guides. A study of the application of these guidelines showed that parking was generally supplied at a lower rate than specified and in the case of retail parking it was strongly related to the size of developments. This is expected to be the case due to the reduction or complete waiver of parking often granted to developers, by council in regions where there are large developments. Pricing policy is focused on the central city region with the primary tool a parking levy.

The second aspect reviewed was the distribution of parking usage. The paper shows that parking provision for areas outside the central region are strongly related to the level of activity, as measured by the number of jobs, and distance from the central city. The use of parking space minutes, or parking utilisation, as a measure of usage provided stronger relationships than parking events. The form of the relationship between, parking space minutes and events, with the number of jobs, distance from the central city and concentration were similar. The concentration of parking appeared to decrease by distance from the central city but the parking rate per number of jobs increased, showing a higher provision of parking with distance from the central city. The decentralization of parking usage is clearly shown by these relationships.

This study has shown the general trends in parking policy and parking use. It showed a link between parking policy and usage with the amount of activity and distance from the central city. The relationship between parking policy and usage is strong since parking provision is related to the development of land use which is clearly showing decentralisation trends in Melbourne. This study reinforces conventional wisdom in that parking usage and provision are related to the land use activity and distance from the central city. They cater and react to the decentralisation of activities encouraging a more decentralised urban area.

Clearly the finding in this study relate primarily to one city, Melbourne. There is a need to generalise them by undertaking similar studies in other cities to obtain a clearer indication of the link between parking, land use development and decentralisation of urban activities. The paper calls for further research on parking usage across metropolitan areas in other cities to confirm these trends.

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