Sustainable municipal finance and spatial transformation: understanding the relationships between space, costs and municipal finance

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ABSTRACT

Spatial transformation is a key strategy underpinning both the National Development Plan and the Integrated Urban Development Framework. The notion of spatial transformation, although poorly defined, incorporates ideas of densification, social integration and the economic benefits of agglomeration. Included in this melange of positive outcomes of spatial transformation is an assumption around the efficiencies that are achievable through spatial transformation, and specifically densification around transit corridors. These efficiencies are also assumed to reduce the costs of municipal service provision and thus improve municipal financial sustainability. However, urban systems are complex, and the relationships between space, costs and municipal finance are poorly understood.

This paper draws on research undertaken for the Financial and Fiscal Commission, National Treasury, provincial government and specific municipalities, to highlight some of the, sometimes unexpected, relationships between space, costs and municipal finance. It uses the results of complex modelling, using a range of fiscal impact tools, to highlight which services are most sensitive to space (and which are not) through the identification of the specific spatial drivers of cost. It illustrates that while overall cost is an important consideration, cost is not evenly distributed between the various actors, with national grants and operating subsidies playing a significant role in shifting the incidence of cost. In many cases, it is this incidence of cost, and not the overall quantum of cost, that impacts on spatial decision-making. While spatial transformation is not a solution to municipal financial sustainability, there are a number of factors that should be carefully considered in designing spatial strategy.

INTRODUCTION

Spatial transformation is a key strategy underpinning both the National Development Plan and the Integrated Urban Development Framework. The notion of spatial transformation, although poorly defined, incorporates ideas of densification, social integration and the economic benefits of agglomeration. Included in this melange of positive outcomes of spatial transformation is an assumption around the efficiencies that are achievable through spatial transformation, and specifically densification around transit corridors and more balanced mixes of land uses (often linked to the concept of 'Transit-Oriented Development' (TOD)). These efficiencies are also assumed to reduce the costs of municipal service provision and thus improve municipal financial sustainability. However, urban systems are complex, and the relationships between space, costs and municipal finance are poorly understood.

THEORETICAL FRAMEWORK FOR THE LINK BETWEEN SPACE AND MUNICIPAL FINANCIAL SUSTAINABILITY

Municipalities incur cost in the provisions of services – the capital required to build infrastructure and the on-going costs to operate and maintain them. In return, municipalities collect property rates and tariffs from paying customers and receive national transfers from the fiscus to subsidise those customers who do not pay. So how might spatial decisions and transitions impact on municipal costs and revenues?

First, the majority of municipal expenditure goes into the capital and operating costs of engineering service provision – roads, water, sanitation, electricity, solid waste and stormwater. The location and density of development mean that these services get provided in particular places and technical configurations, which, in theory could require more or less capital investment and operating costs than service provided to an alternative spatial configuration.

Second, a small but increasing number of municipalities (mainly metros) operate their own bus and bus rapid transit (BRT) systems. The location and form of development impacts on the length (and thus cost) of public transport routes and the ongoing financial viability of operating these services due to densities and its relationship to ridership.

Third, municipalities, to a greater or lesser extent (depending on their level of housing accreditation) are involved in service provision to state-subsidised housing development. At a minimum this involves the provision of bulk services to these developments, but can extend to the 'topping up' of state housing subsidies for the provision of internal services and land. The spatial location of these developments could therefore result in municipalities having to contribute more or less of their own land, funds or grant revenue. Municipalities will then incur ongoing engineering services costs for state-subsidised housing development, which may vary by location.

On the revenue side, space potentially has a direct and an indirect impact on municipal finances. Property rates revenue is directly linked to property values, which in turn are spatially specific. High value development, or a constraint in the supply of land which pushes up property values in general, results in greater property rates revenue for municipalities. However, the indirect impact is that the location and form of development can potentially create a cost burden for individual households, primarily through transport costs, but also through housing related costs. Increases in these household costs can impact on household ability to pay for municipal rates and service charges and municipal revenue may decrease.

Capital grants are somewhat spatially sensitive in that the Urban Settlements Grant is spatially targeted at integration zones in metros, and the Public Transport Network Grant is influenced by the layout and cost of the Integrated Public Transport Network. An indirect impact on grants is that higher cost development (and specifically land and bulk services for state-subsidised housing) has the potential to divert grants away from other uses. Development charges are only spatially sensitive to the degree to which these charges are spatially differentiated. Where the charge is not spatially differentiated, a higher cost growth pattern results in higher development charges. However, if correctly applied, these costs are absorbed by the private sector, with no impact on municipal finance.

The dynamics between space, cost and municipal finance are clearly complex. Little empirical work has been undertaken to try and quantify exactly how, and to what degree the location and density have on these identified costs: the provision of engineering services, transport, land and housing, and subsequently what this might mean for municipal revenues and sustainability. This paper draws on research undertaken for the Financial and Fiscal Commission (PDG, Stephen Berrisford and African Centre for Cities, 2012), National Treasury (South African Cities Network and National Treasury, 2015), provincial government (Western Cape Department of Environmental Affairs and Development Planning, 2014) and specific municipalities, to highlight some of the, sometimes unexpected, relationships between space, costs and municipal finance.

HOW DOES SPACE IMPACT ON THE RELATIVE COST OF ENGINEERING SERVICES, TRANSPORT, LAND AND HOUSING?

In many cases, the impact of low density development and thus greater land consumption on cost is obvious: longer travel distances, longer infrastructure networks, etc. Ewing et al's three year study of urban sprawl in 83 metropolitan areas in the USA concluded that "People living in more sprawling regions tend to drive greater distances, own more cars, breathe more polluted air, face a greater risk of traffic fatalities and walk and use transit less" (Ewing et al, 2002:5). However, the converse, that increased density *saves* on cost, is not necessarily true. An analysis of the manner in which space impacts cost requires us to consider the capital investment required to grow cities, as well as the operating costs associated with providing the services. The discussion on costs relates to the cost incurred by the entity providing the service (the 'primary cost'), not the cost to the entity that subsequently pays the primary service provider to access the service ('secondary cost')[1].

How capital costs of engineering services infrastructure vary with spatial form

In order to understand how the capital cost of engineering infrastructure varies in space, one must separate infrastructure networks into bulk infrastructure (i.e. large scale infrastructure serving multiple households or areas), internal infrastructure (the small scale reticulation found in suburbs from which individual properties are supplied), and connector infrastructure (the medium scale infrastructure connecting internal and bulk networks).

In general, technical requirements and economies of scale dictate the location of bulk infrastructure networks and facilities. These networks therefore tend to be insensitive to the spatial pattern of a settlement: they are large, located where they are required, and are required to serve a particular volume of service (as opposed to individual customers). Internal infrastructure is somewhat sensitive to density and building typology (i.e. property size and height), but is insensitive to location. For example, a block of flats requires less road, cable and pipe length per dwelling unit than large single-storey properties, but a block of flats in location A will require the same internal infrastructure as an identical block of flats in location B. The component of infrastructure that is most sensitive to spatial form is connector infrastructure. Where development 'leapfrogs' city boundaries, connector infrastructure is typically required to tie these developments into the urban network. This is fairly large infrastructure with high cost which would not exist with, for example, infill or re-development.

The typical composition of infrastructure capital costs for a single high-income residential unit are illustrated in Figure 1 in a range of spatial configurations. Infrastructure costs may be

[1] This distinction is necessary because of the impact of fiscal transfers (grants and subsidies) and internal cross subsidisation. Municipalities incur costs in the first instance, which may or may not be passed onto consumers in the form of rates, tariffs and fares. We are interested in the cost implications of space and must therefore analyse costs prior to the application of subsidies.

marginally reduced through elimination of connector infrastructure. The impact of density is greater, where both the internal reticulation lengths are reduced, and the size of bulk infrastructure required is reduced due to lower consumption patterns in higher density typologies. Connector infrastructure costs can dramatically increase if leapfrog development needs to be connected to the existing bulk infrastructure network.

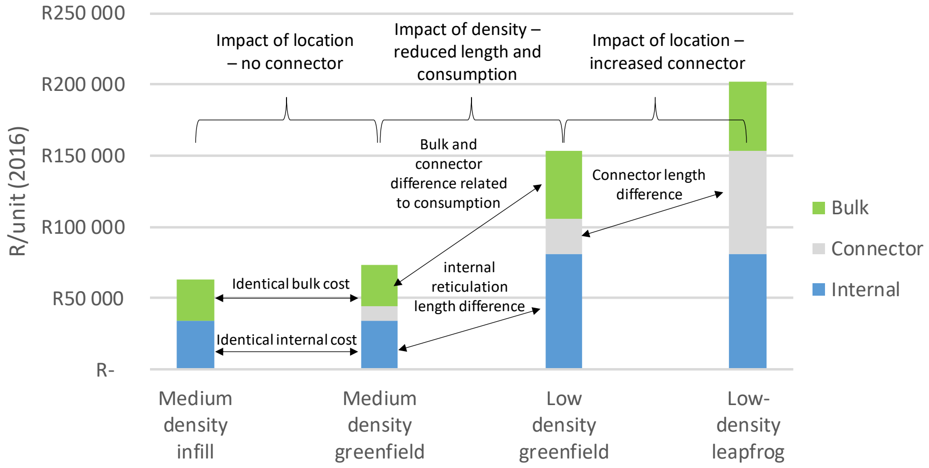

Figure 1: Indicative infrastructure costs by component in different locations (Source: Municipal Services Financial Model default costs)

How capital costs of public transport infrastructure vary with spatial form

Capital requirements for public transport are impacted by density, as this affects the length of dedicated public transport routes, and the frequency of stations. In addition, the specific mode or modes that are provided, are affected differently by space. In a hypothetical public transport costing model, Cooke (2016:5-18) found that "At population densities of less than 20 p/ha, the capital costs of vehicles, stations and other associated infrastructure result in a very high cost per passenger trip for most modes. The exceptions, minibus and conventional bus, can utilize existing roadways and require very little additional infrastructure."

How capital costs of land and housing vary with spatial form

The cost of land varies significantly across space in cities, as is expected in terms of bid rent theory. The price of land also impacts on the density of development: density can be increased in order to maximise property value and minimise the unit cost of land. For this reason, it is practical to measure the cost of land and building together, assuming a cost minimising relationship between the two[2]. A previous study (PDG, Stephen Berrisford and African Centre for Cities, 2012) concluded that the increased cost of building dense typologies outweighs the savings in land costs, and hence the perpetuation of low cost housing on cheap land on the urban periphery. This dynamic is illustrated in Figure 2, which presents theoretical costs[3] for a 40m^2 low income unit constructed on land ranging in value from R 100/m2 to R 25 000/m2. Despite higher densities reducing the land cost per m^2 of dwelling, the overall cost continues to climb with increasing land price, but at a decreasing rate.

[2] Although this assumption does not hold in the high income residential market, it is sufficiently true in other markets to be used as a general market assumption.
[3] Includes coverage assumptions (30%-80%), common areas for multi-storey units (10%-20%), professional fees (10-20%), and profit (10%-20%). Assumptions vary within the stated range by building height.

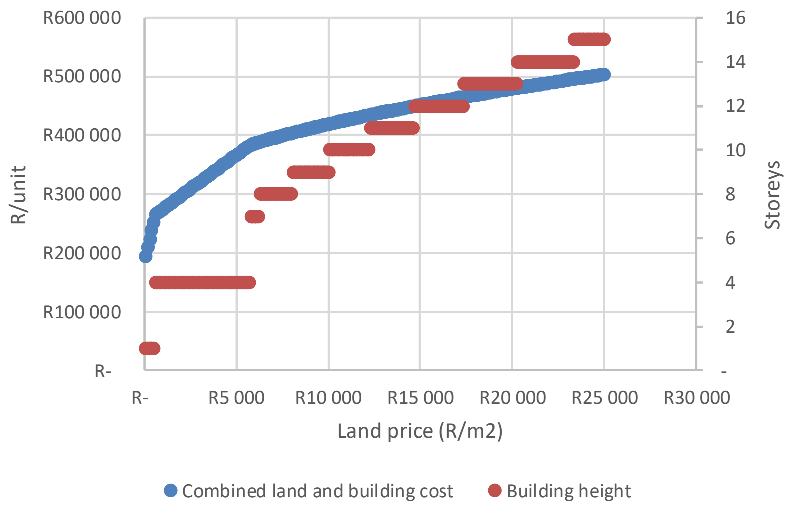

Figure 2: Cost and height of lowest cost 40m2 unit at various land prices (Source: Derived from AECOM (2016) supplemented by author's calculations from local and international literature review[4])

What the above figure illustrates is that increasing land price will always make a standard sized low income housing unit more expensive, regardless of increased density through multi-storey units. The only way to reduce the unit cost on higher value land is to reduce the unit size. What this means for municipalities is that if capital housing subsidies are fixed per unit, then any location of housing projects on higher value land or at higher densities, will likely require a contribution from municipal own funds or other grant sources. The question then becomes: can this additional capital cost be offset by savings on other services?

Relative impact of space on the combined cost of engineering services, transport, land and buildings

An important advantage of fiscal impact models is that they can combine all the components of capital cost to assess the relative importance of each. Two case studies undertaken in a South African metro illustrate the relative composition of capital costs between infrastructure, public transport, land and buildings costs for two identical developments of 527 low cost housing units in two different sites in the metro. Site A is located on cheap land outside the urban edge, 39 km from the CBD, but is close to a passenger rail station. In contrast, Site B is a relatively well-located infill development on expensive land 16 km from the CBD near a major highway. Figure 3 indicates that while capital costs of engineering services for the two sites is almost identical, the public transport capital costs for Site A are higher. However, this cost difference is outweighed by the capital required for the purchase of the land and construction of the units.

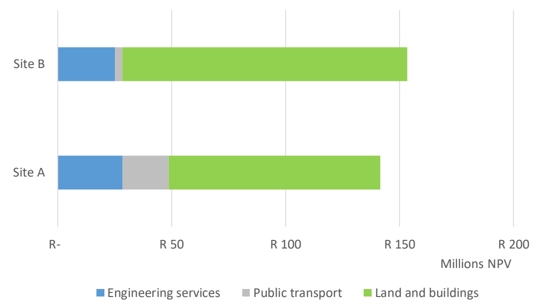

Figure 3: Capital costs by component for two low income case study sites

[4] The author acknowledges Claus Rabe for developing the original costing methodology.

Similar results have been achieved with modelling undertaken at a local municipal or metro scale, indicating that, barring excessive public transport investments, the capital costs of land and housing outweigh the impact of other capital cost variations.

How space impacts on engineering service[5] operating costs

There is little or no empirical research on the variation of infrastructure operating costs across space in South African municipalities, so an exercise was undertaken in one South African metro to understand this phenomenon. First, a theoretical framework for such analysis was created to isolate costs that are spatially variable from those that are spatially neutral. Spatially neutral costs can either be fixed (such as head office admin costs, IT, etc.) or based on the volume of service delivered (such as bulk infrastructure operations and maintenance). Spatially variable costs can be either based on the number of units served in a given location (such as for repairs and maintenance of pipe networks) or on the volume of a service provided in a particular location (such as for water pumping costs).

The analysis of the operating cost structure in a single metro in terms of the above framework produced interesting results. There is considerable variation between the proportions of spatially neutral and spatially variable operating costs per service, as illustrated in Figure 4. For example, it was found that 92 per cent of stormwater costs were spatially variable, while only 5 per cent of electricity costs were spatially variable (where the majority of the cost is the bulk purchase of electricity).

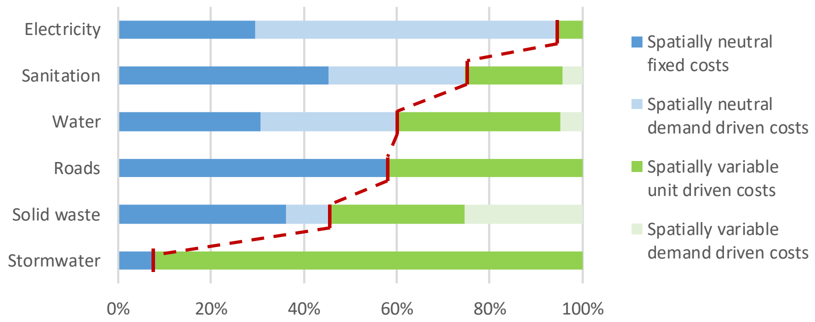

Figure 4: Spatial variability in municipal engineering services operating costs

Second, in order to understand the spatial drivers of the spatially variable unit driven costs, a set of spatial cost drivers were assumed, based on interviews with officials and consulting engineers and the availability of spatial data sets. Examples of assumed spatial cost drivers include land use, density, distance to a municipal depot, age of infrastructure, slope, outsourcing, and elevation.

Third, a statistical correlation was run to assess and weight the contribution of each assumed spatial costs driver to the observed cost variation and the observed correlations were used to produce maps of operating cost variation in space for each service. The results showed that the difference in infrastructure operating cost between the most expensive area in the city to service (from an operating cost perspective) and the least expensive area was approximately 20 per cent for all of the four income groups[6] assessed. While the maximum variation of the operating costs was approximately 20 per cent, the coefficient of variation (standard deviation divided by the mean) was only two per cent for all four income groups, indicating very little variation in operating costs across the metro. This analysis indicates that the majority of

[5] Including road maintenance, as opposed to the operating cost of transport, which is included in the next section.

[6] Monthly household income of income group 1: <R3 200 per month; income group 2: R3 201-R6 400; income group 3: R6 401-R12 800; income group 4: >R12 801

infrastructure operating costs are *not* spatially sensitive, and thus the location of development does not have a significant impact on overall operating costs of engineering services.

How space impacts on transport[7] operating costs

Transport operating costs include the operating and maintenance costs of all modes of public transport, but also the costs of operating and maintaining private vehicles (fuel, insurance, maintenance, etc.). Private vehicle operating costs are clearly not a municipal cost but are included in the analysis because to the impact that the proportion of income that households spend on transport may have on municipal revenue. Similarly, the costs of rail, minibus taxis and most conventional bus services are not municipal costs but have an impact on modal choice and city efficiency, which in turn affects any municipal-run transport service.

Transport operating costs are directly related to spatial form: travel patterns are dictated by the location of people, businesses and services relative to one another and costs increase directly with increased distance. The operating costs per passenger kilometre varies considerably from one mode to another. These costs can be expressed as costs per passenger kilometre or costs per passenger trip. Although data on the actual costs in different cities is difficult to obtain, indicative figures from 2014 are provided in Table 1.

Table 1: Operating costs, fares and relative subsidies (Source: Hunter Van Ryneveld, 2014:16)

	Operating cost/passenger carried (R)	Fare revenue/passenger carried (R)	Subsidy/passenger carried (R)	Deficit/passenger carried (R)
Minibus taxi	8.09	8.09	0	0
Metrorail	9.20	3.62	3.73	1.74
Bus Rapid Transit	20.9	7.77	12.84	0
Conventional bus	22.00	8.60	13.40	0
Municipal bus	24.42	4.39	18.41	0.90
Gautrain	140.11	77.75	60.03	0
Average	10.82	7.62	2.76	0.39

The costs above indicate that minibus taxis are the cheapest mode by passenger trip, but if average trip distance by mode is taken into account, then rail becomes the cheapest cost per passenger km. In comparison to the above modes, private car usage has been calculated (using AA rates) as being the second most expensive mode (per passenger km) after a BRT feeder bus. The transport operating cost (which will be incurred by a combination of commuters, the municipality and the state) is determined by two factors: the mode of transport available, and the distances that the commuter is required to travel. Figure 5 shows the result for the engineering service and transport operating costs (to all actors) for the two case studies mentioned in Figure 3.

[7] Excluding road maintenance, which is included in the previous section.

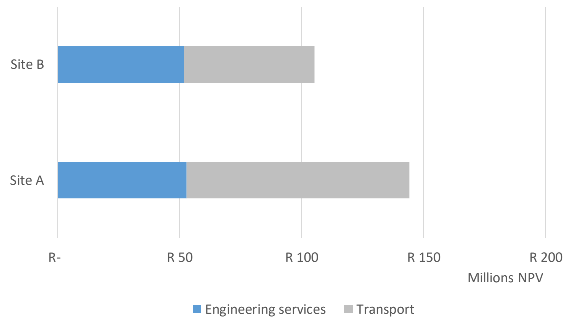

Figure 5: Operating costs by component for two low income case study sites

Site A is peripherally located, had the advantage of access to the cheapest public transport mode (rail). Figure 5 indicates that for these two sites the engineering service operating costs are almost identical, but considerable variation exists in the long-term transport operating costs, where Site A is more expensive, despite access to the cheapest travel mode (rail). A similar analysis of a whole metro indicated that transport operating costs dominate all other operating costs in the long term, comprising between 54 per cent and 69 per cent of total operating cost over 20 years. At a metro scale, and considering all passenger and goods movement, the cost of *private* transport contributes the majority of the total transport operating cost.

Relative proportion of capital and operating

A further benefit of fiscal impact models is that the overall long-term costs can be estimated, incorporating both capital and operating costs. This comparison is typically undertaken through reducing capital and operating costs incurred over time to a Net Present Value. This is useful because spatial decisions that have a high up-front capital costs may save on operating costs in the long term or vice versa. This split between capital and operating costs will vary from site to site and depending on the time frame over which the comparison is done. The results for the two case studies referred to in Figure 3 and Figure 5 indicate that the operating costs and the capital costs vary between the sites. The capital and operating costs for Site A are roughly equal, while the operating costs for Site B are 27 per cent lower than the capital costs.

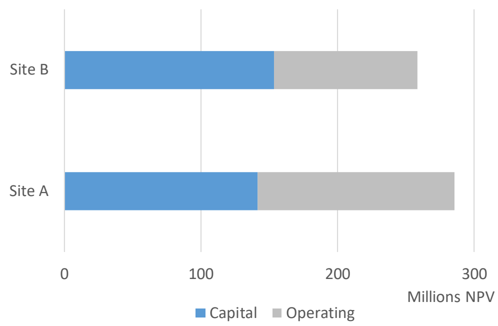

Figure 6: Combined capital and operating costs over 20 years for two low income case study sites

When one disaggregates the capital and operating costs for the two sites into the various components (Figure 6), it is clear that the trade-off that is being made if comparing the relative costs and benefits of the two sites, is that the higher capital costs of land and buildings in Site B (due to its better location) are being offset be the reduced transport operating costs over the long term, as illustrated in Figure 7. On balance, Site B has a lower total cost over 20 years, despite the higher up-front capital costs.

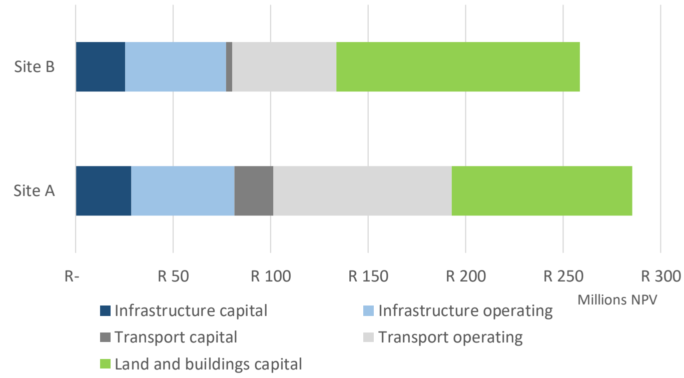

Figure 7: Breakdowns of combined capital and operating costs for two low income case study sites

WHO BEARS THE COST OF SPATIAL DECISIONS?

While overall cost of spatial form is an important consideration, the incidence of cost is not evenly distributed between the various actors, these being households, businesses, municipalities and the state (combining provincial and national government and state-owned entities). Costs are also unevenly distributed between households in different income bands, relative to their income.

The impact of spatial decisions on households

Fiscal impact studies undertaken by PDG indicate that the largest portion of the cost of growth is carried directly by households and businesses because of the direct costs of transport and the capital cost of property. National grants and operating subsidies play a significant role in shifting the burden of cost away from the poor and onto tax payers via the national fiscus and municipalities use the equitable share together with their own revenues to subsidise indigents through local policies. However, two factors weigh heavily in determining whether low income households incur a net cost or a net benefit from city growth. The first is whether or not they are allocated a subsidised house. Households that benefit from the national housing programme not only have all capital costs covered, they also receive and implicit benefit of owning the house they live in (imputed rent). Municipal services to these houses are also often fully or partially subsidised by the municipality. Poor households that do not receive a subsidised house do not receive these benefits and incur the cost burden of alternative housing, often in informal settlements. This can be partially offset through reduced travel costs if the alternative accommodation allows for shorter trip distances, and free basic (but often sub-standard) services, but this may not always be the case.

The second factor impacting on low income cost burden is the available transport modal choice. Public transport subsidies apply unequally to different modes (see Table 1), resulting in subsidised rail and bus services being cheaper than unsubsidised minibus taxis. However, residents without access to rail and bus services are thus forced to use more expensive transport modes. As is well documented in the literature, the spatial location of this housing can heavily impact on these households due to long average trip distances (Venter, 2011; venter, Biermann and Van Ryneveld, 2004; Mtantato, 2012)..

The impact of spatial decisions on municipal revenue

The three main components of municipal operating revenue are property rates, service charges and operating grants. Property rates are agnostic to spatial location (the same rate is charged everywhere), but the revenue is linked to property value. Therefore, spatial instruments that limit the supply of land (such as urban edges) have the potential to raise land values in general and thus increase property rates revenue. However, increasing land values affect household affordability and has an exclusionary effect, particularly on the poor. While developers may argue that any future rate-paying development will add to municipal coffers because of property rates revenue, the net revenue of any development must be assessed in light of the relative costs. Property rates are linked to property value and not cost, and service charges (tariffs) are generally fixed across the municipality and thus spatially blind. However, the analysis shows that operating costs vary in space (albeit in a limited way) and capital costs can vary considerably. The negative impact that this may have on municipal revenue can be mitigated to a large degree if the capital cost burden of non-subsidised development is transferred to the developer through a spatially-differentiated, cost-reflective development charge.

IMPLICATIONS FOR MUNICIPAL PLANNING

Fiscal impact modelling indicates that the focus of spatial decisions should be on the two largest, and most spatially sensitive sectors: housing and transport. In contrast to the impact of housing and transport, both the capital and operating costs of engineering infrastructure have been shown to be relatively spatially insensitive. Therefore, densification should not be justified on the expected savings that can be achieved through reduced infrastructure costs. The net financial cost or benefit is determined in the relative trade-off between the capital cost of land and housing and the operating cost of transport.

Well located housing (in terms of minimising travel distances) for the poor requires considerably more capital for land and buildings than is currently being allocated per unit. Given fiscal constraints, capital subsidies are unlikely to increase, and a revised approach is therefore required that either lowers the size and standard of subsidised housing to reduce cost, or provides implicit subsidies through the aggressive release of well-located state-owned land for low income housing. These approaches are not mutually exclusive.

Municipalities should also focus on reducing the unit cost of public transport operations. Densification in the wrong places can increase overall expenditure if it increases the number of trips from a distant location using an expensive mode of transport. This emphasises the need for integrated land use planning, land use management (development approvals focussed on reaching density targets) and transport planning. However, the accessibility of the cheapest mode for a particular spatial context is also important.

In many cases, it is the incidence of cost, and not the overall quantum of cost, that impacts on spatial decision-making. Municipalities, with whom the responsibility for municipal spatial planning lies, need to understand how spatial decisions impact on the life cycle cost of providing services to residents and businesses. One mechanism for making this trade-off more tangible is the devolution of the housing function and all public transport functions to metros. A further mechanism could be the introduction of a land-based financing instrument that captures the national economic benefits of spatial decisions for funding infrastructure investment. However, even if the instrument of this type of instrument is not immediately possible, municipalities should be empowered to make spatial decisions in the interests of businesses and households (and particularly poor households) and other spheres of government, even if it costs the municipality more in the short term.

CONCLUSION

The transformation of urban space in South Africa has the potential to improve municipal finances, but, due to the many other factors at play, will not necessarily result in municipal financial sustainability. At best improved spatial arrangements can reduce municipal cost to a limited degree but can reduce the cost burden on individual households considerably. However, at worst, a combination of continued spatial exclusion, low densities, fragmented planning decisions and heavily subsidies public has the potential to stifle the economy and drag municipalities into financial distress.

Local government has to ensure the provision of services to communities in a sustainable manner and to promote social and economic development. If spatial transformation is interpreted through the social justice lens of redressing the negative impacts of spatial exclusion on poor urban residents, then the focus of municipal interventions should also be on interventions that reduce the *overall* cost to these targeted households. This avoids simplistic assumptions around the benefits of (yet undefined) 'well located' land and quantifies a long-term cost to households for all services that are spatially sensitive. Transforming urban space involves difficult trade-offs and will not be realised unless a deliberately different strategy is employed.

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