Basic infrastructure delivery and its welfare impact on rural and urban municipalities in South Africa

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Abstract:

Access to a comprehensive set of quality basic infrastructure services is essential in supporting social development goals and ensuring equal opportunity to participate in a country's economy. South Africa's political history has, however, created an unequal society underpinned by a spatial element, as indicated by the Diagnostic Overview. This study aims to investigate whether basic infrastructure delivery has a statistically significant effect on growth and development and if that effect differs between urban and rural municipalities. Understanding the collective welfare implications could assist government in optimising the social benefit of basic infrastructure delivery in South Africa. A balanced panel dataset of the basic infrastructure and welfare indicators of the respective municipalities was compiled in order to complete this study. Constructing a basic infrastructure index, utilising the Principal Component Analyses (PCA) method, and a rural/urban dummy allowed for the restricted/unrestricted regression method to be used in the analysis. Overall, it was found that increased basic infrastructure delivery has a significant effect on household income, poverty, human development, literacy and Gross Domestic Product per capita for citizens in the respective municipalities of South Africa. It was also found that the growth and development effect was greater in urban municipalities when compared to rural municipalities. The research found basic infrastructure investment to be another contributing factor to spatially inclusive welfare creation in South Africa.

JEL Classifications: R11, I31 (Regional Economic Activity: Growth, Development, Environmental Issues, and Changes General Welfare)
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1 Introduction

The South African government, through the three tiers of government, is mandated with providing collective goods, such as basic infrastructure, education, health and security. This is considered a basic human right irrespective of a citizen's geographical location, race, and gender or income level. The three tiers of government therefore have to plan accordingly to ensure that the basic human rights of the nation's citizens are met (Constitution, Chapter 2, Section 27.1 a, b, c).

In order to achieve these socially desired goals the South African government tasked the National Planning Commission (NPC) to determine a vision of what South Africa should look like in 2030 and how it could be achieved. A diagnostic overview was released, which suggested that poverty can be eliminated and inequality reduced if attention was given to the following nine causes: Poor education outcomes, a high disease burden, divided community, uneven public service performance, divided spatial patterns, low employment levels, corruption, a resource-intensive economy, and crumbling infrastructure. The nine causes was also noted to be underpinned by the location of citizens, with general welfare levels being lower in rural municipalities when compared to urban municipalities. (NPC, 2011:7).

The nine causes of inequality and poverty are interlinked in various ways. Targeting any single cause would have various direct and indirect impacts on the other causes in addition to impacting the problems of poverty and inequality directly. Prud'homme (2004:11) noted, for instance, that infrastructure investment benefits households and business directly by increasing access to markets and lowering costs, which leads to growth and ultimately improved welfare. Seethepalli et al. (2008:1) state that equal access to basic infrastructure plays a key role in reducing income inequality. Similar results were confirmed by Calderon and Serven (2004:4) and Estache et al. (2003:10). Bogetic and Fedderke (2005:1) also report the relationship between basic infrastructure and economic growth to be well established, for example. Addressing the cause with the most linkages could therefore yield the best results in alleviating poverty and inequality directly in addition to the other mentioned causes.

The diagnostic continues to state that the nine causes of poverty and inequality are underpinned by the location of citizens with levels in rural municipalities being more depressed. The differences in basic infrastructure in urban and rural municipalities, in addition to challenges in rural infrastructure reform, inhibit economic and social inclusion of rural communities (NPC, 2011:24*)*. Bogetic and Fedderke (2005:12) confirms that while South African urban areas are generally well-serviced in terms of water, sanitation and electricity infrastructure, their rural counterparts fall significantly short in terms of access. Seethepalli et al. (2008:4) found that respective basic infrastructure services (water, sanitation, electricity, roads and telecoms) can reduce income inequality in addition to a higher than proportionate increase in the income of the rural poor in East Asia. Addressing basic infrastructure inequality between urban and rural municipalities in South Africa could theoretically therefore yield similar results for the country.

The impact of selected basic infrastructure services on growth and development has been well researched in recent years. Basic infrastructure investment and growth are shown to have a strong relationship, while the impact on development remains inconclusive. These findings are discussed in more detail in the literature review. The collective impact of basic infrastructure investment in rural and urban municipalities respectively has however remained largely understudied in terms of empirical analysis. The question therefore presents itself: Would total basic infrastructure delivery impact differently on the growth and development of citizens in rural and urban municipalities? In essence, the research aims to establish whether basic infrastructure (water, sanitation and electricity) investment increases growth and development of citizens in urban and rural municipalities in South Africa differently.

The research is divided into four sections. The first section details the literature review that lays the foundation of the research. The second section comments on the methodology and data used in the analysis. The third section highlights the empirical results, followed by the conclusion and recommendation.

2 Literature Review

Comprehensive access to quality basic infrastructure should increase economic and development growth that will lead to an equitable increase in welfare and the reduction of poverty (Heymans & Thome-Erasmus, 1998:663 and Bogetic & Fedderke, 2005:1). Basic infrastructure investment reduces the cost of production and consumption for business and citizens alike. Increasing investment in infrastructure should therefore improve economic growth and development (DBSA, 2006:15). It allows citizens to interact with society, to communicate and to participate in the community in addition to having sufficient access to resources to obtain a decent living (Ilhamdaniah et al., 2005:2). Chong et al. (2007;344) confirms that when a community has access to a comprehensive set of basic infrastructure services the welfare effect is greater when compared to communities where certain components of basic services are missing. Metwally et al. (2007:61) adds that basic infrastructure also lays the foundation for effective social infrastructure delivery such as schools, hospitals and police stations. Social infrastructure, in turn, ensures that basic infrastructure is also better utilised (ESCAP, 2006:5). Comprehensive basic infrastructure investment in itself and as a necessary precursor to further economic and welfare creation is therefore essential for economic growth and development.

It is now generally well established that there is a strong relationship between basic infrastructure and growth (e.g. Aschauer, 1989:197; Easterly & Robelo:442, 1993; Sanchez-Robles, 1998:106), De la Fuente and Estache (2004) summarised findings on infrastructure investment on productivity or growth conducted in the fifteen years leading up to 2004. The results showed that all of the studies conducted in developing countries indicate that basic infrastructure had a positive effect on productivity and growth. Bogetic and Fedderke (2005:1) also mention that this is especially the case for countries in Sub-

Saharan Africa. The relationship also holds true for South Africa, as discussed in research by Fedderke, Perkins and Luiz (2006:1052). Cognisance should, however, be taken of endogeneity and direction of causality in such an analysis. Basic infrastructure may affect growth and productivity, while economic growth may increase the demand for basic infrastructure (Eshfahani and Ramirez 2003:443).

More attention has also been directed to the impact of basic infrastructure investment on poverty and inequality (Estache et al., 2002:15; World Bank, 2003:147, 2006:14). Empirical literature results are far from conclusive on the exact impact that basic infrastructure investment has on poverty and inequality. Consensus has, however, been reached in that, under the right conditions, basic infrastructure investment does contribute to alleviating inequality and poverty (Calderón & Servén 2008:1). A recent report by UN HABITAT, however, states explicitly that that there will be no poverty alleviation in Africa without significant increases in basic infrastructure (UN HABITAT:66). Research conducted by Leipziger et al. (2003:7) shows that increasing the availability and quality of basic infrastructure services for the poor in developing countries has a significant and positive impact on education of the poor and therefore, potentially, their income and welfare. Seethepalli et al. (2008:13) confirms that there is a high and statistically significant correlation between basic infrastructure and education even though the causal relationship is not clear.

The impact of basic infrastructure investment on growth and development has been well researched in recent years as mentioned earlier. The research that follows will now aim to establish if collective basic infrastructure investment has a different effect on rural and local municipalities with specific reference to South Africa

3 Methodology

The research first aimed to establish whether there is a statistically significant difference between basic infrastructure investment between urban and rural communities. This was done by compiling a synthetic index of basic infrastructure stock (water, electricity and sanitation) using the Principal Component Analysis (PCA) method for each of the municipalities in South Africa. Constructing the PCA can reduce the measurement error associated with only taking a single-infrastructure indicator in the empirical analysis. The method also aims to solve the problem of high colinearity among the different types of infrastructure assets (Calderon, 2009). The method yields a new synthetic index (principal component) that captures information off all the respective basic infrastructure components which are mutually uncorrelated (Theil, 1970).

$$\text{INFSTOCK} = 0.571 * ln\left(\frac{SAN}{HH}\right) + 0.594 * ln\left(\frac{WATER}{HH}\right) + 0.571 * ln\left(\frac{ELEK}{HH}\right)$$

The constructed synthetic indices (PCA) are used along with an urban-rural intercept and slope dummy using Least Square Dummy Variable (LSDV) regression in order to account for heterogeneity in the data. Using restricted and unrestricted regression techniques will determine whether the relationship

between basic infrastructure and social welfare indicators are statistically different in rural and urban municipalities. The general model is specified as:

$$Y = \alpha + \beta_1 * INFSTOCK_{it} + \beta_2 * RUDUM_i + \beta_3 * INFRU_i + U_{it}$$

i	=	Municipality
t	=	Period (1996–2012)
Y	=	Social variable
$INFSTOCK$	=	PCA of infrastructure stock
$RUDUM$	=	Dummy variable for rural and urban municipality (1=urban, 0=rural)
$INFRU$	=	$INFSTOCK * RUDUM$ (creating a slope dummy)

A balanced panel dataset was constructed to include information for all of the municipalities in South Africa from 1996 to 2012. A log transformation of each of the social variables was used to allow for a log-log interpretation of the regression results. Variables include: Number of households (HH), Human Development Index (HDI), percentage of people in poverty (PERPOV), functional literacy (PERLIT), household income (HHINC), Gross Domestic Product per capita (GDPPC), the number of households, the number of households with hygienic toilets (SAN), water provision in households above RDP-level (WATER), and households with electricity connections (ELEK). The variables where sourced from a propriety databank compiled by IHS Information and Insight (IHS 2013).

The National Department of Corporative Governance and Traditional Affairs (COGTA) classification of rural and urban municipalities is used in this analysis. Urban municipalities will comprise of categories A (large urban complexes with populations over 1 million), B1 (local municipalities with large budgets and containing secondary cities) and B2 (local municipalities with a large town as a core). Rural municipalities comprise B3 (local municipalities with small towns, with a relatively small population) and B4 (local municipalities that are mainly rural with communal tenure and with, at most, one or two small towns in their area) municipalities (COGTA 2009: 16).

4 Empirical results

Regressing each of the indicated social variables against infrastructure stock (INFSTOCK) will aim to indicate the collective impact of basic infrastructure on each of the on the growth and development indicators listed below.

LGDPPC	Log – GDP per Capita
LHHINC	Log – Household Income
LPERPOV	Log – Percentage of people in poverty
LDHDI	Log – Human Development Index
LPERLIT	Log – Literacy rate

The inclusion of an urban-rural intercept (RUDUM) and slope (INFRU) dummy variable will facilitate construction of the respective urban and rural regression results for each of the growth and development indicators.

Table1: Summary of regression results

VARIABLE	C	INFSTOCK	RUDUM	INFRU	R2 Adj	F-Stat
LGDPPC	9.608	0.361	0.387	-0.035	0.600	1989.512
		*62.791**	*13.761**	*-1.707**		
		(0.000)	*(0.000)*	*(0.088)*		*(0.000)*
LHHINC	10.894	0.211	0.105	0.078	0.516	1413.521
		*52.018**	*5.268**	*5.431**		
		(0.000)	*(0.000)*	*(0.000)*		*(0.000)*
LPERPOV	-0.690	-0.129	-0.118	-0.075	0.604	2024.953
		*-56.727**	*-10.590**	*-9.278**		
		(0.000)	*(0.000)*	*(0.000)*		*(0.000)*
LHDI	-0.702	0.091	0.092		0.729	5353.749
		*86.773**	*23.013**			
		(0.000)	*(0.000)*			*(0.000)*
LPERLIT	-0.603	0.099	0.173		0.698	4595.549
		*72.902**	*33.321**			
		(0.000)	*(0.000)*			*(0.000)*

* T-Statistic
** R-Square
(..) Probability

Generally, it was found that the explanatory variables in the respective equations are statistically significant at a 5% level of significance. Overall, the explanatory variables are found to be collectively significant at a 5% level of significance in explaining the respective social variables.

The above results will be used to construct restricted and unrestricted equations that will aim to firstly explore whether there is a statistically significant difference in infrastructure-induced growth and development between rural and urban municipalities. Secondly, it will be used to determine what marginal effect infrastructure investment has on growth and development in both rural and urban municipalities. The critical value for LHHINCOME, LPERPOV and LGDPPC at the 1% F(2,3973) was calculated to be 4.611. Seeing that all of the calculated F-statistics are larger than the critical value we can reject the null hypothesis stating that basic infrastructure does not have a statistically significant different effect on rural and urban municipalities. The critical value for LHDI and LPERLITER at the 1% F(1,3974) was calculated to be 6.641. Seeing that all the calculated F-statistics are larger than the critical value we can reject the null hypothesis stating that basic infrastructure does not have a statistically significant different effect on rural and urban municipalities. The respective regression results are detailed below.

Table 2: Urban-Rural municipality results

Variable:	***Urban:***	***Rural:***
LGDPPC	$LGDPPC = 9.995 + 0.326 * INFSTOCK$	$LGDPPC = 10.062 + 0.361 * INFSTOCK$
LHHINC	$LHHINC = 10.998 + 0.289 * INFSTOCK$	$LHHINC = 10.894 + 0.211 * INFSTOCK$
LPERPOV	$LPERPOV = -0.765 - 0.247 * INFSTOCK$	$LPERPOV = -0.690 - 0.129 * INFSTOCK$
LDHDI	$LHDI = -0.061 + 0.091 * INFSTOCK$	$LHDI = -0.702 + 0.091 * INFSTOCK$
LPERLIT	$LPERLIT = -0.429 + 0.099 * INFSTOCK$	$LPERLIT = -0.603 + 0.099 * INFSTOCK$

When increasing basic infrastructure by 1%, LGDPPC would increase by 0.36% in rural and 0.33% in urban municipalities. A 1% increase in basic infrastructure leads to a 0.21% and 0.29% increase in rural and urban HHINC respectively. Increasing basic infrastructure by 1% will also decrease rural PERPOV by 0.19% and urban poverty by 0.25%. Increasing basic infrastructure by 1% has a similar effect on both HDI and LPERLIT in urban and rural municipalities respectively due to the slope dummy being statistically insignificant and being omitted from the results. The null hypothesis ($H_0: \beta_2 = \beta_3 = 0$) was rejected in both instances, indicating that basic infrastructure is statistically different in urban and rural municipalities. The differences in urban and rural infrastructure most likely result from basic infrastructure stock levels being different in the two respective areas. While the elasticity's of LHDI and LPERLIT are similar for urban and rural municipalities, rural municipalities would typically be on a higher level (intercept).

Although the results conform to the broad view that basic infrastructure delivery has a positive impact on growth and welfare, as defined in the literature review, it was expected that the impact would be greater in rural municipalities. The only instance of basic infrastructure yielding a greater return in rural municipalities was for LGDPPC.

5 Conclusion

It was expected that increasing basic infrastructure delivery would yield statistically significant results on all the identified social welfare indicators and that the impact, or return, on basic infrastructure investment, would be greatest in rural municipalities. The results did, however, show that the impact of basic infrastructure delivery was greater in rural as opposed to urban municipalities (with the exception of LGDPPC). The slightly lower results in the respective rural welfare variables could possibly be attributed to fact that the quality of service delivery, time lags of the impact of basic infrastructure delivery, planning and implementation, costs and productivity are different in urban and rural municipalities. Further analysis would be recommended to fully understand the differences between urban and rural municipality's basic infrastructure investment returns.

6 References

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