THE IMPACT OF BASIC AND SOCIAL INFRASTRUCTURE INVESTMENT ON ECONOMIC GROWTH AND SOCIAL DEVELOPMENT IN SOUTH AFRICA's URBAN AND RURAL MUNICIPALITIES

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Abstract:

South Africa is characterised by widespread inequality and divided societies, which impede economic growth and social development. Basic and social infrastructure investment can assist in addressing these challenges by promoting economic growth and social development. The aim of this study is to determine if basic and social infrastructure investment differently effect economic growth and social development indicators of urban and rural municipalities respectively. We use a balanced panel data set containing infrastructure, economic, demographic and social indicators for rural and urban municipalities for the period from 1996 to 2012. To address the research question we construct synthetic indices of basic and social infrastructure, using principal component analysis, to be used in panel regression estimations. To estimate our economic growth and social development functions we make use of restricted within LSDV estimation techniques. We use the results on the respective elasticities to evaluate whether the differences between urban and rural municipalities are statistically significant. Our results show that the elasticities of basic and social infrastructure investment generally are more pronounced for economic growth and social development indicators in rural municipalities than in urban municipalities. These findings could potentially influence policy decisions in terms of infrastructure investment in favour of rural municipalities to increase economic growth and social development in these regions, which could contribute to the reduction of spatial inequalities in South Africa.

Keywords: basic and social infrastructure, economic growth, social development, principal component analysis.

JEL Classification: I130, I250, I380, O110

1. Introduction

The main aim of this research paper is to analyse the effect of basic and social infrastructure investment on economic growth and social development and to compare the returns of these investments in urban and rural municipalities. The choice of basic and social infrastructure indicators to measure infrastructure investment has been somewhat contentious. The literature uses various physical or expenditure approximations of infrastructure (Calderón & Servén, 2004; Romp and De Haan, 2007), but concerns about the validity of such measures has swayed researchers in more recent studies to use physical measures of basic- and social infrastructure (Straub, 2008). Therefore in this study, in line with recent literature, we use electricity, water and sanitation provision as indicators of basic infrastructure investment and the provision of schools, hospitals and police stations as indicators of social infrastructure investment.

The Bill of Rights of the Constitution of the Republic of South Africa (RSA Constitution, Chapter 2, Section 27.1 (a, b, c)) envisages sustainable human settlements including housing, education, health and access to cultural and leisure activities. This can be described as '*social development'* which is the prioritisation of human needs in the growth and progression of society (Ryan and Deci, 2000). The focus is on improving the lives of citizens, especially the poor, and to improve the wellbeing of each individual.

The post-democratisation period was marked by significant decentralisation of economic decision making and service delivery, resulting in a system of local government that are constitutionally responsible for the economic and social development of their areas (Krugell & Naudé, 2005). However, during the past two decades limited progress has been made to in this regard, with widespread inequality and divided societies inherited from the previous governmental dispensation and spatial policies still being prevalent in the country (Adams, Gallant, Jansen & Yu, 2015; Tregenna & Tsela, 2012; Booysen, 2003b). South Africa's economy is still characterised by low economic growth, poverty and inequality.

To address the socio-economic challenges and inequalities in the country the government of South Africa has implemented various programmes, the most recent being the National Development Plan (NDP) (2012). The NDP aims to create a more equal and inclusive economy and social society. It recognises poor education outcomes, a divided community, uneven public service performance, divided spatial patterns and a crumbling infrastructure as some of the challenges that have to be addressed in order to overcome persistent poverty and inequality in South Africa. Central to the aforementioned challenges identified by the NDP are infrastructure delivery constraints that inhibit economic growth, social development and the reduction of poverty and inequality across the country (NPC, 2011:19). Given the different levels and concentration of inequality and poverty in rural and urban areas, it is likely that basic and social infrastructure investment could impact economic growth, the disposable income of households and social development in these regions differently and warrants in depth analyses.

Research has found that insufficient infrastructure in informal settlements is a key obstacle to economic development (McRae, 2015:36; Dinkelman, 2011). Furthermore it has been shown that infrastructure investment and economic growth have a strong positive relationship (De la Fuente & Estache; 2004:5; Foster & Briceño-Garmendia, 2009:10), while the exact impact of infrastructure investment on social development remains inconclusive. In saying this, we deduce that sustained economic growth and social development is a necessary if not sufficient condition to reduce poverty and inequality. Consensus has therefore been reached that, under the right conditions, basic and social infrastructure investment do contribute to increased economic growth, social development and the reduction of inequality and poverty (Calderón & Servén, 2008:1). The collective impact of basic and social infrastructure investment on economic growth and social development in rural and urban municipalities, respectively, has remained largely understudied, mainly due to a lack of data availability and quality (Bogetic & Fedderke, 2005:12; Svendson, 2009:25; Jerome & Ariyo, 2004:39). Furthermore there is little empirical evidence of the direct impact that infrastructure investment has on income. Related studies has investigated the relationship between the demand for infrastructure investment and income (Komives et al. 2001), the relationship between infrastructure investment and savings (Estache et al. 2002) and the relationship between infrastructure investment and poverty alleviation (Brenneman & Kerf 2002

This paper contributes to the existing literature by addressing the previously mentioned gaps in the literature by (i) measuring the effect of basic and social infrastructure investment on economic growth and social outcomes in urban and rural municipalities respectively and furthermore comparing these effects to determine if the returns to urban and rural municipalities are similar. This, according to the authors' knowledge, is the first paper of its kind; (ii) the analysis is done at a sub-national (municipality) level which is often a challenge due to data constraints; (iii) the study investigates the direct relationship between basic and social infrastructure investment and the disposable income of households in rural and urban municipalities, respectively not analysed before; (iv) the study uses panel data analysis not often used in these types of studies, which has the advantage over cross sectional data, that it can address endogeneity issues.

The method followed is to compare the derived basic and social infrastructure investment elasticities of urban and rural municipalities with regard to various economic growth and social development indicators. To derive the elasticities we make use panel estimations techniques. and a balanced panel data set. We use a panel data set sourced from the Information Handling Services (IHS) Information and Insight Regional explorer databank for the period from 1996 to 2012 (IHS, 2013). The study focuses on local municipalities in South Africa using the National Department of Corporative Governance and Traditional Affairs (COGTA) classification for the urban and rural groupings.

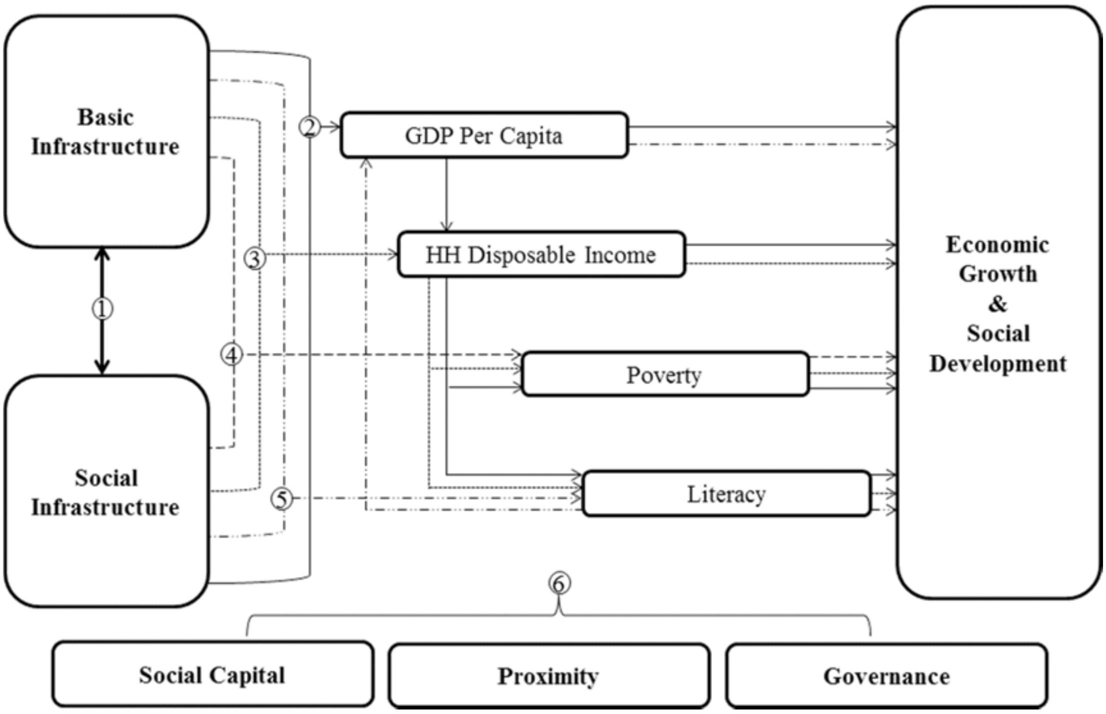
Being able to quantify the impact of basic and social infrastructure investments on economic growth and social development in urban and rural areas, respectively, can contribute to the development of policy to reduce overall and spatial inequality and furthermore direct investment spending to those spatial regions with prioritised needs (Calderón & Servén, 2004:26; López 2003). The rationale for this argument is the indirect positive relationship between increased levels of economic growth and social development and the reduction of spatial inequality.

The rest of the paper is set out as follows: in section 2 literature on the effects of basic and social infrastructure investment on various socio-economic indicators is reviewed. In section 3 the methodology and data used in the research paper are discussed. In section 4 we report the results and in section 5 we discuss the results and draw conclusions.

2. Literature review

An increasing body of literature studies the social and economic impact of advances in physical infrastructure in developing countries (McRae, 2015). Increasing investment in basic infrastructure should improve economic growth and social development (DBSA, 2006:15). Chong et al. (2007:344) confirm 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 infrastructure services are missing. Metwally et al. (2007:61) add that the basic infrastructure also lays the foundation for effective social infrastructure delivery such as schools, hospitals and police stations. Social infrastructure in itself also has the ability to increase the economic growth and social development of a nation's citizens and ensures that the basic infrastructure is better utilised (ESCAP, 2006:5). Economic growth and social development in turn can play an important role in addressing long term growth challenges in South Africa, including double digit unemployment and the poor quality of human capital (Simo–Kengne, 2016).

Understanding the channels through which basic and social infrastructure impact on economic growth and social development is essential in order to optimise infrastructure investment efforts. The literature review presents the research conducted on the impact that basic and social infrastructure investment have on economic growth and social development, utilising various empirical studies, and it will be discussed according to the following conceptual framework:



Source: Authors' own construct

social capital, proximity and governance

Figure 1: Conceptual framework for literature review

2.1 Interaction between basic and social infrastructure investment

The addition of basic and social infrastructure service not only has a direct economic growth and social development effect on a household, but also allows for the better utilisation of other infrastructure services (Chong et al., 2007:344). Electrification reduces indoor air pollution, allow for safer food storage and cooking practices, which in turn increases health (Barnes et al., 2004:16). Electricity, water and sanitation connections also increase the learners' ability to attain an education by reducing incapacity due to illness. In addition, less time is spent on collecting wood, while the lighting itself enables students to study well into the night (Brenneman & Kerf, 2002:5). The benefits of this for human capital accumulation, economic growth and social development are obvious.

2.2 Interaction between basic and social infrastructure investment, economic growth and social development

Consensus has been reached that, under the right conditions, basic infrastructure investment contributes to reducing inequality and poverty via the channel of economic growth and social development (Calderón & Servén, 2008:1). There are various ways in which basic and social infrastructure have been found to impact on economic growth and social development. For example: increasing electricity infrastructure has a strong impact on the productivity of a business by reducing the loss of output resulting from power outages and surges. Water and sanitation infrastructure has a lesser but still significant impact on the productivity of a business by protecting and even improving the health of the employees, thus increasing their productivity. Increased access to electricity, water and sanitation also saves time and effort amongst the poor (collecting wood, water etc.), thus allowing for increased time allocation towards productive activities including investing in human capital. A number of studies have also found basic infrastructure to have a strong impact on the efficiency of education and health facilities (Brenneman & Kerf, 2002:5). This is important given the fact that urban-rural disparities regarding access to health care services have a persistent and more pronounced adverse effect on the poor (Booysen, 2003b).

Expanding infrastructure investment to the poor has been credited to have a larger marginal effect on the welfare and income of poor citizens resulting from the increased value of the assets they hold after infrastructure investment (Estache et al., 2000:20). López (2003:4). Calderón & Servén (2008:16) add that basic and social infrastructure investment is also associated with reduced income inequality. In order for basic and social infrastructure investment to achieve such socially desired outcomes it has to be accompanied by additional pro-poor policies.

2.3 Basic and social infrastructure investment and its impact on disposable income

There is little empirical evidence of the direct impact that infrastructure investment has on income. Estache (2004:5) confirms that little evidence even exists on the direct impact of infrastructure on household income, and cites only two other empirical studies in his research (2004). The first is the work of Komives et al. (2001:20), who comments on how the demand for infrastructure changes as the income increases, as opposed to the mere impact of infrastructure on income The second is a study by Estache et al. (2002:90), which focuses on savings, rather than increases in income, that resulted in higher disposable income levels. Brenneman & Kerf (2002:5) summarised research that focused on the topic of infrastructure investment and its impact on income. Their study also comments on how basic and social infrastructure increases the disposable income of households as opposed to increasing household income itself. Basic and social infrastructure investment was credited with saving time and increasing savings resulting in increased disposable income. This study will therefore also investigate the impact of basic and social infrastructure investment on disposable income.

2.4 Basic and social infrastructure investment and its impact on poverty through increased economic growth and social development

More research attention has been directed towards to the impact of basic infrastructure investment on poverty and inequality in recent years (Estache et al., 2002:15). De la Fuente and Estache (2004:2) note that basic and social infrastructure could reduce poverty and assist in achieving the Millennium Development Goals (MDGs), even though empirical literature has been noted to be far from conclusive on the exact impact that basic infrastructure investment has on poverty and inequality. Nevertheless, consensus has been reached that, under the right conditions, basic infrastructure investment does contribute towards alleviating inequality and poverty through higher levels of economic growth and social development (Calderón & Servén, 2008:1).

2.5 Basic and social infrastructure investment and its impact on education

Increasing the availability and quality of basic infrastructure services for the poor in developing countries has a significant and positive impact on the education of the poor and, therefore, potentially their income and welfare (Leipziger et al., 2003:7). Seethepalli et al., (2008:13) confirm that there is a high and statistically significant correlation between basic infrastructure investment and education levels (even though the causal relationship is not clear).

Basic infrastructure investment affects literacy through a number of channels. Brenneman & Kerf (2002:5) indicate that increased water and sanitation infrastructure improve education performance due to the reduction of water related diseases, thus also decreasing absenteeism in schools. Electricity infrastructure also increases literacy due to lighting that enables students to study into the night in addition to making use of technology (Bond, 1999:47). Increasing water, sanitation and electricity infrastructure also reduces the time needed to collect wood for lighting, heating and cooking, which increases the available time to study in addition to increasing the likelihood of children attending school (Brenneman & Kerf, 2002; Bond, 1999). Attending school is of course a prerequisite for improved levels of human capital and consequently higher economic growth and poverty reduction.

2.6 Concluding remarks on the literature review

The results on the impact of basic and social infrastructure on economic growth and social development varies across studies due to the respective infrastructure indicators used, methodologies employed and according to the country or group of countries on which the analyses focus. However, the literature rarely comments on whether the basic and social infrastructure investment would impact differently on economic growth and social development in urban and rural areas, respectively. In some of the reviewed studies, the authors did comment that basic and social infrastructure could theoretically have a proportionately different effect on the rural poor as opposed to those from the urban areas (ADB, 2012:68). This forms the rationale for the research question for this research. What are the impact of basic and social infrastructure investment on economic growth and social development in urban and rural areas respectively?

Furthermore the impact of basic and social infrastructure investment on outcome variables such as social capital (the value added by investing in schools, hospitals and policing)); the benefits of proximity of social infrastructure delivery; and improved governance, implying the establishment of effective and efficient policy to address socio-economic challenges and spatial inequalities and and implementation and the monitoring of these policies are rarely discussed. These matters will be argued in the conclusion section of this paper (see section ^^^^) .

3.Research design and methodology

3.1. Data

The selected basic and social infrastructure, demographic, economic growth and social development indicators will be sourced from the IHS Information and Insight Regional explorer databank which contain infrastructure, economic, demographic and socio-economic data for each of the municipalities in South Africa from 1996 to 2012 (IHS, 2013). The respective municipality boundary sets are in accordance with the Demarcation Board revision used for the 2012 municipal elections. The urban/rural municipality classifications will be done according to information obtained from the National Department of Corporative Governance and Traditional Affairs (COGTA).

The basic infrastructure index will be based on the number of households that have access to water, electricity and sanitation, while the social infrastructure index will use proxy variables for health, education and safety, due to the lack of direct measures on a municipal level, for each of the municipalities from 1996 to 2012. The number of households are used to normalise the synthetic index (Straub, 2010; Calderón & Servén, 2004; Romp & De Haan, 2007). Infrastructure and its impact on economic growth have been noted as one of the most widely covered themes on the topic of infrastructure investment (Estache, 2006:7). Taking direction from a number of mentionable studies such as Calderón (2009:9) and D´emurger (2001:97) real output per capita are used to determine economic output.

Household disposable income as opposed to household income will be used for the purposes of this empirical analysis. This will allow for not only capturing the direct cost saving stemming from the lower unit costs of receiving service, but also the increased potential to earn higher incomes resulting from higher education, productivity and the increased availability of hours per day to actually work (see Brenneman and Kerf (2002) for a summary of the interactions). Household disposable income (*HHINC*) is derived from total income for all households in a municipality, excluding taxes.

Research on the impact of infrastructure on poverty by Estache et al., (2000) and Jerome & Ariyo (2004:1) relied on standard $2 a day and $1 a day income poverty lines for their empirical analysis, respectively. This study will however employ an income poverty estimate as calculated by IHS Regional eXplorer for the sake of consistency and the lack of availability of the dollar estimates at a municipal level. The % of people in poverty (*PPOV*) is defined as the number of people living in households that have a combined household income which is less than the respective household poverty income divided by the total population.

Jerome & Ariyo (2004:38) use variations of literacy (adult, male and female) when analysing the impact of infrastructure investment on education. We use a similar approximation of education in the form of functional literacy, which is similar to adult literacy. Functional literacy (*PLIT*) is defined as the literacy level of people older than 20 who have completed their primary education (grade 7).

3.2. Calculating the basic and social infrastructure indices

Principal Component Analysis (PCA) is used to construct synthetic basic and social infrastructure indices. The respective infrastructure stock indices will provide an indication of the extent to which basic and social infrastructure is delivered in each of the municipalities in the country. While the method has been used in cross-country analysis, and in a few sub-national studies, it has not been deployed to analyse urban and rural differences on a sub-national level. The estimations of the synthetic basic infrastructure index are as follows:

$$\text{BINF} = 0.567 * ln\left(\frac{SAN}{HH}\right) + 0.594 * ln\left(\frac{WATER}{HH}\right) + 0.571 * ln\left(\frac{ELEK}{HH}\right)$$

Where:

BINF	Synthetic index of basic infrastructure
SAN	Number of households with hygienic toilets
WATER	Number of households with water connections above RDP-level
ELEK	Number of households with electricity connections
HH	Number of households

Each of the three basic infrastructure indicators carries approximately the same weight in the newly generated synthetic basic infrastructure index. The first principal component accounts for 85% of the total scaled variance in the synthetic index and is highly correlated with the underlying infrastructure measures. The correlations with dependent variables conform to the expectations detailed in the literature review.

The estimated synthetic social infrastructure index, as the first principal component, was calculated as follows:

$$\text{SINF} = 0.715 * ln\left(\frac{Functional\ Lit}{Pop\ aged + 20}\right) + 0.691 * ln\left(1 - \frac{Nr\ Crimes}{HH}\right) + 0.103 * ln\left(\frac{Med\ Spending}{HH}\right)$$

Where:

SINF	Social infrastructure synthetic index
Functional Lit	Number of people over the aged of 20 with Grade 7 completed
Nr of crimes	Actual number of crimes reported
Med spending	Medical expenditure per household in nominal rand values
HH	Number of households

The education and safety components of the social infrastructure carry approximately the same weights in the social infrastructure index, while health carries a smaller weight. The first, principal component accounts for 41% of the overall variance and is highly correlated with the underlying infrastructure measures. The synthetic social infrastructure index also correlates strongly with all dependent variables and conforms to the expectations detailed in the literature review.

3.3. Model estimations and validation

Choosing the correct model estimation technique would involve testing whether restrictions (dummy variables) and fixed effects are statistically significant. The use of dummy variables in the unrestricted (between) Least Square Dummy Variable (LSDV) estimation in favour of unrestricted Ordinary Least Square (OLS) models will be conducted. The use of the restricted (between) LSDV estimation would then be compared to the FE within LSDV estimation to determine if period and/or cross-section effects are significant (Hausman, 1978; 2002:288; Baltagi, 2005:66). The respective models and validation tests are detailed below:

Unrestricted OLS regression estimation:

$$Y_{it} = \alpha + \beta_1 * BINF_{it} + u_{it}$$

$$Y_{it} = \alpha + \beta_1 * SINF_{it} + u_{it}$$

Where Y represents the respective development indicators, i indicates the specific municipality (1 to 234) and t indicates the period (1996-2012). $BINF$ represents the synthetic index for basic infrastructure, while *SINF* denotes the synthetic index of social infrastructure. The error term, which varies over i and t, is denoted by u_{it}. The dependent variables will comprise of the log of Gross Domestic Product per capita (*LGDPPC*), household income (*LHHINC*), % of people in poverty (*LPPOV*) and functional literacy (*LPLIT*).

The restricted (between) LSDV regression estimations are detailed below:

$$Y_{it} = \alpha + \beta_1 * BINF_{it} + \beta_2 * RUDUM_{it} + \beta_2 * BRU_{it} + u_{it}$$

$$Y_{it} = \alpha + \beta_1 * SINF_{it} + \beta_2 * RUDUM_{it} + \beta_2 * SRU_{it} + u_{it}$$

Where $RUDUM$ represents the dummy variable for rural (1) and urban (0) municipalities, with BRU representing the basic infrastructure interaction dummy variable calculated as $BINF * RUDUM$ and SRU being the social infrastructure interaction dummy variable calculated as $SINF * RUDUM.$

The restricted/unrestricted t-test performed on the efficiency and validity of use of the slope and dummy variables is defined as follows (Greene & Hensher, 2010:363):

$$F[(K-1),(NT-K-1] = \frac{(\text{RSSR} - \text{USSR})/\#Restrictions}{(\text{USSR})/d.f.}$$

K indicates the number of restrictions, while N represents the number of pooled cross-sections and T the number of years. RSSR would be the restricted sum of square residuals and USSR the unrestricted sum of square residuals, while $d.f.$ indicates the degrees of freedom. The hypothesis being tested is defined as follows (δ being the coefficient of the dummy variables):

$$H_0: \delta = 0$$

$$H_1: \delta \neq 0$$

The FE within LSDV two-way error component estimation is detailed as follows (Baltagi, 2005:33):

$$Y_{it} = \alpha + \beta_1 * BINF_{it} + \beta_2 * RUDUM_{it} + \beta_2 * BRU_{it} + u_{it}$$

$$\text{Where: } u_{it} = \mu_i + \lambda_t + v_{it}, \; v_{it} \sim idd(0, \sigma^2)$$

$$Y_{it} = \alpha + \beta_1 * SINF_{it} + \beta_2 * RUDUM_{it} + \beta_2 * SRU_{it} + u_{it}$$

$$\text{Where: } u_{it} = \mu_i + \lambda_t + v_{it}, \; v_{it} \sim idd(0, \sigma^2)$$

μ_i represents unobserved individual effects, λ_t represents unobserved time effects and v_{it} represents the stochastic disturbance term, with u_{it} being the sum of the three components. The average of the error term is zero, its variance is fixed and distributed normally, independent and identically, or $idd\ (0, \sigma^2)$. In order to determine if the restricted (between) LSDV or FE within LSDV models provide better estimates, it is required that the joint Chow fixed effect test (F-test) be conducted. The null hypothesis for a two way-error component model is defined as follows (Baltagi, 2005:33):

$$H_0: u_1 = u_2 = \cdots = U_i = 0 \ \& \ \lambda_1 = \lambda_2 = \cdots = \lambda_t = 0$$

$$H_1: u_1 \neq u_2 \neq \cdots \neq U_i \neq 0 \ \& \ H_1: \lambda_1 \neq \lambda_2 \neq \cdots \neq \lambda_t \neq 0$$

The Chow test statistic for a two-way error correction model, assuming Gaussian errors, is defined below (Thomas 2004:32):

$$F[(n-1)+(T-1),(n-1)(T-1)-K] = \frac{(\text{RSSR}-\text{USSR})/\#Restrictions}{(\text{USSR})/d.f.}$$

Should the null hypothesis be rejected, it can be assumed that cross-section and/or time effects exist between the municipalities and that the within LSDV estimation will produce more efficient and precise estimates. However, the test is only valid if individual cross-section and time effects are judged to be individually significant. The individual cross-section specification is defined as follows Thomas (2004:32):

$$H_0: u_1 = u_2 = \cdots = u_i = 0$$

$$H_1: u_1 \neq u_2 \neq \cdots \neq U_i \neq 0$$

The Chow test statistic for the one-way fixed effects model with cross-section effects is defined as in Thomas (2004:32):

$$F[(n-1),((n-1)(T-1)-K] = \frac{(\text{RSSR}-\text{USSR})/\#Restrictions}{(\text{USSR})/d.f.}$$

The individual period specification is defined as follows (Thomas, 2004:32):

$$H_0: \lambda_1 = \lambda_2 = \cdots = \lambda_t = 0$$

$$H_1: \lambda_1 \neq \lambda_2 \neq \cdots \neq \lambda_t \neq 0$$

The Chow test statistic for the one-way fixed effects model with period effects is defined as:

$$F[(T-1),((n-1)(T-1)-K] = \frac{(\text{RSSR}-\text{USSR})/\#Restrictions}{(\text{USSR})/d.f.}$$

Rejecting the null hypothesis that joint and individual period and cross-sectional effects are significant, will signal the use of the FE within the LSDV model.

The validated estimation will then undergo specification tests for serial correlation, heteroskedasticity, and endogeneity in order to assess if measurement concerns, collinearity among infrastructure assets, identification and heterogeneity concerns have been addressed (Romp & de Haan, 2007; Calderón & Servén, 2008; Straub, 2010; Pereira & Andraz, 2013).

Regressing the economic growth and social development variables against basic (*BINF*) and social infrastructure (*SINF*) will provide the coefficients needed to compile the respective urban and rural basic and social infrastructure equations for each of them on the economic growth and social development variables.

4 Results

The respective restrictive (OLS), unrestricted (between) Least Squares Dummy Variable (LSDV) and Fixed Effect (FE) within LSDV two-way error correction estimation results, the respective model validation tests and the specification tests are presented in Tables 1 and 2 below. The validated model and its corresponding values are used to construct the respective urban and rural economic growth and social development equations for the ensuing basic and social infrastructure (Table 3). The results will be used to indicate if, and to what extent basic and social infrastructure impacts on urban and rural Gross Domestic Product per capita (*LGDPPC*), household disposable income (*LHHINC*), % of people in poverty (*LPPOV*) and functional literacy (*LPLIT*).

Table 1: Summary of basic infrastructure regression results

Row	Dependent Variable	LGDPPC			LHHINC			LPPOV			LPLIT		
	Modelling Technique	**OLS**	**Between LSDV**	**Within LSDV**	**OLS**	**Between LSDV**	**Within LSDV**	**OLS**	**Between LSDV**	**Within LSDV**	**OLS**	**Between LSDV**	**Within LSDV**
A	C	9.6874 *11313.18* (0.000)	9.6079 *1005.11* (0.000)	9.6913 *3825.02* (0.000)	10.9352 *1835.10* (0.000)	10.8936 *1615.05* (0.000)	10.9410 *4286.40* (0.000)	-0.7341 *-209.18* (0.000)	-0.6901 *-182.24* (0.000)	-0.7587 *-66.07* (0.000)	-0.5636 -243.788 (0.000)	-0.6028 *-255.53* (0.000)	-0.5446 *-128.57* (0.000)
B	Basic Infrastructure (BINF)	0.3905 *72.8107* (0.000)	0.3612 *62.7905* (0.000)	0.0874 *18.3913* (0.000)	0.2332 *62.5024* (0.000)	0.2112 *52.0178* (0.000)	0.04340 *9.06318* (0.000)	-0.1521 *-69.1967* (0.000)	-0.1293 *-56.727* (0.000)	-0.1217 *-26.186* (0.000)	0.11518 *79.4868* (0.000)	0.0994 *72.9024* (0.000)	0.0295 *19.3944* (0.000)
C	Urban Rural Dummy (RUDUM)		0.3868 *13.7612* (0.000)			0.1045 *5.2684* (0.000)			-0.1179 *-10.5890* (0.000)	0.1087 *2.1571* (0.031)		0.1734 *33.3210* (0.000)	-0.0646 *-3.71501* (0.000)
D	Interaction variable (BRU)		-0.0348 *-1.7068* (0.090)	-0.0172 *-1.8665* (0.062)		0.0781 *5.4313* (0.000)	-0.0254 *-2.7239* (0.000)		-0.0749 *-9.2780* (0.000)				-0.0187 *-5.9971* (0.000)
E	R2 Adj	0.5713	0.6000	0.9889	0.4955	0.5159	0.9745	0.5462	0.60423	0.9379	0.61368	0.6979	0.9860
F	F-Stat	5301.39	1989.51	1423.32 (0.000)	3906.55	1413.52	568.07 (0.000)	4788.19	2024.95	224.580 (0.000)	6318.15	4595.59	1118.04

		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
	Model Validation & Specification tests												
G	Restricted/Unrestricted t-test CV $F(2{,}3974)_{(critical\ 1\%)}$		143.5291 4.6105			84.7342 4.6105			292.4047 4.6105			555.0050 4.6105	
H	Chow two-way test CV $F(249{,}3725\backslash 6)_{(critical\ 1\%)}$			592.0962 1.2294			271.2847 1.2294			82.5489 1.2294			331.1312 1.2294
I	Chow cross-section test CV $F(233{,}3975\backslash 6)_{(critical\ 1\%)}$			615.8460 1.2371			107.5373 1.2371			74.4449 1.2371			335.25989 1.2371
J	Chow period test CV $F(16{,}3725\backslash 6)_{(critical\ 1\%)}$			49.7675 2.0048			1231.2304 2.0048			1906436 2.0048			341.1893 2.0048
K	Serial correlation given fixed effects CV:$N(0,1)_{(critical\ 1\%)}$			48.8123 2.326			48.7697 2.326			46.9653 2.326			46.5778 2.326
L	Heteroskedasticity CV: $X^2(233)_{(critical\ 1\%)}$			3974.8326 286.1389			2712.0122 286.1389			3035.0114 286.1389			2876.2384 286.1389
M	Hausman test for endogeneity CV: $X^2(2/3)_{(critical\ 1\%)}$			18.11598 9.2103			264.1117 9.2103			3.2077 9.2103			4.8682 9.2103

Row A-F: Coefficient, *t-stat*, (..) Probability

Table 2: Summary of social infrastructure regression results

Row	Dependant Variable	LGDPPC			LHHINC			LPPOV			LPLIT		
	Modelling technique	**OLS**	**Between LSDV**	**Within LSDV**	**OLS**	**Between LSDV**	**Within LSDV**	**OLS**	**Between LSDV**	**Within LSDV**	**OLS**	**Between LSDV**	**Within LSDV**
A	C	9.6973 *855.651* (0.000)	9.5995 *769.884* (0.000)	9.7060 *4609.398* (0.000)	11.0004 1432.62 (0.000)	10.9382 *1272.56* (0.000)	10.9320 *1992.13* (0.000)	-0.7246 -*173.83* (0.000)	-0.6797 *-148.50* (0.000)	-0.7334 -*378.859* (0.000)	-0.5521 *-178.21* (0.000)	-0.5960 -*188.1260* (0.000)	-0.5970 -*202.4447* (0.000)
B	Social Infrastructure (SINF)	0.4312 *2.2821* (0.000)	0.4181 *35.7245* (0.000)	0.0692 *13.5245* (0.000)	0.2172 *31.4375* (0.000)	0.1966 *24.36512* (0.000)	0.1677 *32.3911* (0.000)	-0.1790 -*47.716* (0.000)	-0.1563 -*36.3808* (0.000)	-0.0787 -*16.7290* (0.000)	0.1270 *45.57664*(0.000)	0.1146 *38.5383* (0.000)	0.1099 *39.4923* (0.000)
C	Urban Rural dummy (RUDUM)		0.5995 *19.7923* (0.000)			0.3330 *15.9468* (0.000)	0.3201 *243.0000* (0.0260)		-0.2120 -*19.0619* (0.000)			0.2431 *31.5900* (0.000)	0.2404 *33.5356* (0.000)
D	Interaction variable (SRU)		-0.2289 *-9.1939* (0.000)	-0.0534 *-5.2922* (0.000)		-0.0809 *-4.7154* (0.000)	-0.0245 *-2.2273* (0.000)		0.0185 *2.20249* (0.000)	0.0536 *5.7769* (0.000)		-0.0681 -*10.7641* (0.000)	-0.0570 *-9.8188* (0.000)
E	R2 Adj	0.3374	0.4038	0.9911	0.2196	0.2729	0.7038	0.393582	0.4563	0.94913	0.3717	0.5116	0.5769
F	F-Stat	1787.77 (0.000)	793.116 (0,000)	1571.286 (0.000)	988.3181 (0.000)	440.0593 (0.000)	491.4256 (0.000)	2276.793 (0.000)	982.7116 (0.000)	263.9667 (0.000)	2077.230 (0.000)	1226.0360 (0.000)	282.490 (0.000)
	Model Validation & Specification tests												
G	Restricted/Unrestricted t-test CV $F(2,3974)_{(critical\ 1\%)}$		222.4682 4.6105			146.9876 4.6105			231.1745 4.6105			570.2751 4.6105	
H	Chow two-way test CV $F(249,3725)_{(critical\ 1\%)}$			1044.5964						154.2475			

		1.2294		1.2294	
I	Chow cross-section test CV $F(233,3975)_{(critical\ 1\%)}$	1089.36 36 1.2371		114.627 3 1.2371	
J	Chow period test CV $F(16,3725)_{(critical\ 1\%)}$	318.547 8 2.0048	365.268 2 2.0048	301.143 4 2.0048	39.7010 2.0048
K	Serial correlation given fixed effects CV:$N(0,1)_{(critical\ 1\%)}$	0.06283 2.326	59.9917 2,326	42.0981 2.326	56.2817 2.326
L	Heteroskedasticity CV: $X^2(233)_{(critical\ 1\%)}$	4522.40 04 286.138 9	1513.78 93 286.138 9	3043.28 74 286.138 9	1599.28 74 286.138 9
M	Hausmann test for exogeneity CV: $X^2(3)_{(critical\ 1\%)}$	7.9528 9.2103	17.5266 9.2103	24.5197 9.2103	3.8097 9.2103

Row A-F: Coefficient, *t-stat*, (..) Probability

The Levin et al. (2002) t*, test for unit roots was conducted on level with individual intercept and trend included in the test equation. Given that: *BINF* (-8.1207, p = 0.000), *BRU* (-4.99627, p = 0.000), *LGGDP* (-15.8509, p = 0.000), *LHHINC* (-16.5707, p = 0.000), *LPPOV* (-15.4276, p = 0.000) and *LPLIT* (-16.2228, p = 0.000), the results indicate that the calculated test statistic is smaller than the critical value t_p^* ~ N(0,1) (one–tail) of -1.645, additionally all p-values were < 0.05. However, the *SINF* (-1.6402, p = 0.0505) and *SRU* (-1.6588, p = 0.0486) test statistics resulted in the null hypothesis being rejected in favour of the alternative null hypothesis, at a 10% and 5% level of significance, respectively,. The individual series in levels form are therefore stationary.

Each of the calculated restricted/unrestricted t-test values (rows G) were greater than the critical value, resulting in the null hypothesis being rejected in favour of the use of the restricted (between) LSDV regression results. The test therefore confirms that basic infrastructure investment has a statistically significant and different effect on economic growth and social development in urban and rural development, respectively.

The Chow specification F-test for two-way error correction models was used to determine if fixed (period and/or cross-section) effects are significant. The calculated F-stat (rows H) is greater than the critical value in each of the respective regressions. Period and cross-section effects are therefore present that should be controlled for. Testing for individual cross-section effects individually also rejects the null hypothesis of no individual cross-section. Cross-sectional heterogeneity should therefore be controlled for. Lastly, testing for individual period effects individually resulted in the null hypothesis also being rejected (rows J). It is therefore necessary to control for period effects with dynamic adjustments over time. The Chow specification tests comply with all three requirements of rejecting the joint and individual null hypothesis of no period and/or cross-sectional effects in favour of using the FE within LSDV model.

The FE (within) LSDV is then subjected to specification tests for serial correlation (rows K), heteroskedasticity (rows L) in addition to endogeneity (rows M) in order to determine if the model is correctly specified and produces unbiased and consistent estimates. Each of these specification tests are discussed below.

The joint LM test for serial correlation confirmed that the FE within LSDV basic infrastructure (Table 1) regression is not stationary. All calculated F-stats (rows K) were smaller than the cited critical values. The joint LM test for serial correlation confirmed that the social infrastructure within LSDV *LGDPPC* regression presented in Table 2 is stationary. All other calculated F-stats (rows K) were greater than the respective critical values. Therefore the null hypothesis of no serial correlation is rejected. Serial correlation is not expected to affect the unbiasedness or consistency of the estimates, only their efficiency.

Heteroskedasticity was tested as suggested by Greene (2013:714) with the joint LM test being distributed as Chi-square with N-1 degree of freedom. The calculated LM statistic (rows L) was greater than the critical value of in each of the estimations. This resulted in the null hypotheses of homoscedasticity being rejected, indicating the presence of heteroskedasticity in the residuals. The presence of heteroskedasticity in the residuals can be corrected with the white period coefficient covariance method to correct for regular residual heteroskedasticity in light of $N > T$ (Arellano, 1987:431; White, 1980:817).

Exogeneity of the explanatory variables was tested using the Hausman specification test, which is distributed Chi-Square with $m - k$ degrees of freedom. Within Table 1 (basic infrastructure) the calculated Chi-square statistic (row M) was greater than the critical value in the *LGDPPC* and *LHHINC* estimations resulting in the null hypothesis of exogeneity being rejected. Therefore the two models are either miss-specified or correlation exists between individual effects and exogenous variables in the respective economic growth and social development estimations. However, the calculated Chi-square statistic was smaller than the critical value in the case of the *LPPOV* and *LPLIT* estimations resulting in the null hypothesis of exogeneity being accepted. In Table 2 (social infrastructure) the calculated Chi-square statistic (row M) was greater than the critical value in the case of *LHHINC* and *LPERPOV* resulting in the null hypothesis of exogeneity being rejected. The calculated Chi-square statistics (row M) for *LGDPPC* and *LPLIT* are smaller than the critical value, resulting in the null hypothesis of exogeneity being accepted.

Following on comments made by Baltagi (2005) and Kiviet (1995), which indicate that if the *T* in the estimations is sufficiently large, the coefficients are considered to be consistent and sufficiently unbiased, and this would validate the use of the FE within LSDV estimates, even though it might not be optimal. Therefore, the coefficients produced in the within LSDV estimation will be used to estimate the respective urban and rural economic growth and social development equations. Additionally, the FE within LSDV estimation sweeps out individual and/or time specific effects. The estimates should therefore not be biased in the presence of endogeneity of the explanatory regressors. Hence the coefficients will be used to calculate the urban and rural economic growth and social development equations detailed in Table 3 below.

Table 3: Urban-Rural municipality results

Variable:	Area	Result:
Basic infrastructure		
LGDPPC	Urban	$\text{LGDPPC} = 9.6913 + 0.0702\text{BINF}$
	Rural	$\text{LGDPPC} = 9.6913 + 0.0874\text{BINF}$
LHHINC	Urban	$\text{LHHINC} = 10.956 + 0.0180\text{BINF}$
	Rural	$\text{LHHINC} = 10.9410 + 0.0434\text{BINF}$
LPPOV	Urban	$\text{LPPOV} = -0.6500 - 0.1217\text{BINF}$
	Rural	$\text{LPPOV} = -0.7587 - 0.1217\text{BINF}$
LPLIT	Urban	$\text{LPLIT} = -0.6092 + 0.0108\text{BINF}$
	Rural	$\text{LPLIT} = -0.5446 + 0.0295\text{BINF}$
Social infrastructure		
LGDPPC	Urban	$LGDPPC$=9.7060+ 0.0158$SINF$
	Rural	$LGDPPC$=9.7060+0.0692$SINF$
LHHINC	Urban	$LHHINC$=11.2521+0.1432$SINF$
	Rural	$LHHINC$=10.9320+0.1677$SINF$
LPPOV	Urban	$LPPOV$=−0.7334−0.0251$SINF$
	Rural	$LPOV$=−0.7334−0.0787$SINF$
LPLIT	Urban	$LPLIT$=−0.3566+0.0529$SINF$
	Rural	$LPLIT$=−0.5970+0.1099$SINF$

The results conform to expectations detailed in the literature review that basic and social infrastructure delivery has a positive impact on economic growth and social development. It also conforms to the view that the impact of basic and social infrastructure economic investment on economic growth and social development would be greater in rural municipalities. However, the results provide empirical evidence that support the sentiment that was previously only normatively postulated.

5. Discussion and conclusion

It is noteworthy that the empirical results of basic and social infrastructure investment in South Africa generally indicate lower economic growth and social return elasticities when compared to other countries as cited in the literature review. Economic growth elasticities of infrastructure have been found to range between 0.05 and 0.39 as indicated in the literature review. The results obtained from the respective *BINF* and *SINF* (Table 3) urban and rural equations range between 0.02 and 0.09. A study by Sahoo & Dash (2008:19) suggests income elasticity of infrastructure (*BINF and SINF*) investment to be between 0.20 and 0.25. The calculated elasticities range between 0.02 and 0.17. Suescún (2007) indicates the infrastructure elasticity of poverty to be -0.32 using a $2/day poverty estimate. The *LPPOV* results obtained in *BINF* and *SINF* (Table 3) suggest elasticities ranging from -0.02 to -0.12 for urban and rural municipalities. Literacy induced elasticities of infrastructure of 0.12 calculated by Suescún (2007) are also higher than the derived urban and rural *BINF* and *SINF* elasticities, which range between 0.02 and 0.11.

The generally lower economic growth and social development returns could be accounted for by including quality of investment measures for basic and social infrastructure, respectively (Calderón & Servén, 2008). The lower elasticities could also underline governance concerns (Hemson, 2004:17; Khosa, 2003:48), ill-considered spatial implementation (Luo & Wang, 2003:876; Perry & Gesler, 2000:1182) and the inability of planners to understand the cultural aspects required to optimise social capital returns (Putnam, 1993; 1995), resulting in a general lower economic and social return of infrastructure investment when compared to other countries. Many of these factors have been identified by the NPC as binding constraints for South Africa becoming a growing and inclusive society. The NPC also identified infrastructure delivery constraints in addition to spatial inequality as factors preventing the reduction of poverty and inequality across the country (NPC, 2011:19). The fact that the public sector has a central role in providing collective goods, places them in an ideal position to influence infrastructure policy and planning programmes aimed at inclusive economic growth and social development. Using detailed economic growth and social development elasticities of basic and social infrastructure investment for urban and rural municipalities, respectively, would assist such planning initiatives and optimise investment returns.

The empirical research confirms that basic and social infrastructure impact urban and rural economic growth and social development differently. The economic growth and social development return would be greater in rural municipalities than in similar infrastructure investments in urban municipalities. The government should therefore consider this finding in its basic and social infrastructure delivery plan as a means to reduce the economic growth and social development inequality experienced between urban and rural municipalities.

The presented results should be interpreted in light of a number of limitations experienced in conducting the research. Basic and social infrastructure quality indices should preferably be included in the analysis as suggested by Calderón & Servén (2008). The qualitative information is, however, not available and will most likely not be compiled in the foreseeable future. Straub (2010:692) also suggests that inside (lagged and differenced) instrumental variables should be used in a GMM framework to correct for endogeneity. The complicity of finding valid instruments in addition to the restricted modelling methodology (restricted (within) LSDV) unnecessarily complicates the estimation of results for the purpose of the research.

This study lays the foundation for further research on the topic. A modelling framework that estimates the combined impact of basic and social infrastructure on economic growth and social development in urban and rural municipalities, respectively, needs to be constructed. This could empirically validate the hypothesis of Metwally et al. (2007:61) and ESCAP (2006:5) that basic infrastructure lays the foundation for effective social service infrastructure implementation and that social infrastructure is necessary for the optimal utilization of basic infrastructure. The model should also be integrated into a municipal planning framework that calculates the economic growth and social development returns of planned basic and social infrastructure investment. Such a return on investment estimation could, firstly, ensure the optimal utilization of available resources and, secondly, serve as an indicator of where basic- and social infrastructure should be increased to create a more inclusive and equal society on a spatial level in order to provide the practical realisation of the vision of the South Africa's Constitution.

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