Municipal infrastructure spending capacity in South Africa: a panel smooth transition regression (PSTR) approach

Mbanda, Vandudzai and Bonga-Bonga, Lumengo

University of Johannesburg, University of Johannesburg

2019

Municipal Infrastructure Spending Capacity in South Africa: A Panel Smooth Transition Regression Approach

Vandudzai Mbanda and Lumengo Bonga-Bonga

Abstract

This paper assesses the factors that contribute to underspending of the capital budget at the local government level by making use of a nonlinear model based on the panel smooth transition regression (PSTR) model. South Africa is used as a case study. Capital transfer is identified as an important threshold variable in that the degree to which municipalities spend their capital budget depends on a threshold determined by capital transfer. The results of the empirical analysis show that large amounts of capital transfers to local government contribute to underspending by municipalities in South Africa. Moreover, the results indicate that capital budget spending could be improved by ensuring that the trade-off between the current budget and capital budget is reduced, increasing the fiscal capacity of municipalities, which gives them financial autonomy to raise their own revenues,

1. INTRODUCTION

A number of studies have alluded to the importance of public infrastructure, be it for contributing to economic growth, curtailing unemployment or reducing poverty and inequality. Examples of such studies include the ground-breaking work of Aschauer (1989) and earlier works of Munnell (1992), Holtz-Eakin and Schwartz (1994) and Lau and Sin (1997). Later works include those of Calderón and Servén (2003), Jung and Thorbecke (2003), Adam and Bevan (2003), Estache, Perrault, and Savard (2009), Savard (2010); and studies specifically on South Africa include Fedderke and Bogetic (2009), Maisonnave, et al. (2013) and Mbanda and Chitiga-Mabugu (2017). Arguments for increasing public infrastructure spending commonly include social and economic benefits. Public infrastructure investment results in improvements in factor productivity, which promotes growth, increases employment and addresses existing and potential future infrastructure bottlenecks. Public infrastructure investment improves infrastructural services and improves developmental indicators such as access to electricity and clean energy, health, education, access to sanitation and safe water and transport services.

Significant progress in expanding access to services to previously disadvantaged communities, especially extending access to electricity, has been made in South Africa. However, public infrastructure remains inadequate and service delivery backlogs persist. The NPC (2011) asserts that the core national economic infrastructure is relatively good, but for many South Africans, particularly poor and peri-urban communities, access to basic services such as electricity, sanitation, safe water, public transport and telecommunications remains a challenge. The 2011 Census data shows that only 73.4% of the population have access to piped water inside a dwelling and only 71.4% have access to sanitation (National Treasury, 2013a). Access to electricity, according to the World Bank (2013), was 75.8% in 2010, far below that of South Africa's peers, like Brazil (98.7%), China (99.7%) and upper middle-income countries (97.4%). The NPC (2012) notes that municipalities, which distribute roughly 50% of South Africa's electricity, not only have inadequate investments in infrastructure but have maintenance and repairs backlogs exceeding R35 billion. Inadequate investment accompanied by expanded access to infrastructure and ineffective operation and maintenance of existing infrastructure, hinder economic performance and results in prohibitive costs that make the services unaffordable to the poor (NPC, 2012; National Treasury, 2013a).

The South African Local Government Association (SALGA) (2012) points out that upon their establishment, municipalities inherited worn-out infrastructure, some of which was more than 30

years old and in need of replacement, which required massive investments. In addition, SALGA (2012) mentions, municipalities had to provide infrastructure services to a substantial part of the population that previously had no basic infrastructure provision. Faced with these two challenges, the new government's policy response was to prioritise provision of infrastructure to the population that was not previously served instead of repairing and replacing existing infrastructure for the benefit of a few (SALGA, 2012).

Municipal capital spending is used for the provision of municipal infrastructure, which includes municipalities' electricity, roads systems, water reticulation, storm water and sewerage (National Treasury, 2011). Through capital expenditure, municipalities can achieve greater access to basic infrastructure and services which helps combat poverty more effectively (National Treasury, 2011). Thus, the main policy instruments to achieve infrastructure provision targets by municipalities are budgets and municipal infrastructure grants (Josie, 2008).

In many parts of the world the main constraint to providing adequate infrastructure is budgetary pressures and difficult access to financing, which sometimes prompts officials to scale back, delay, or cancel projects (Arimah, 2005; Copeland, et al., 2011). In South Africa, even though resources are not unlimited as in many African countries, the problem is rather different. As pointed out by the World Bank, the chief constraint to delivery of infrastructure investment initiatives, "has been capacity to spend, rather than the resources themselves" (World Bank, 2009, p. 7).

Spending capacity on capital or the infrastructure budget is one of the major challenges faced by municipalities in South Africa (Alexander, 2015). To discourage underspending, budgeted funds for infrastructure investment that are not spent are returned to the fiscus at the end of the financial year, or the underspending municipalities get reduced budgets in the subsequent year (National Treasury, 2015; Capricorn District Municipality, n.d.). The problem is that such downward fiscal adjustments can diminish the gains from government investments and contribute to economic growth slowdown (Leeper, Walker & Yang, 2010). Thus, underspending can compromise the effective provision of infrastructural services in South Africa.

The 2012 budget speech acknowledged that the state's infrastructure capacity was hampered by several weaknesses (Gordhan, 2012). Low levels of infrastructure spending may be due to various reasons, including skills shortages, problems in planning and implementation and delays in project take-off. National Treasury (2013b) alleges that for South African municipalities these factors include poorly prepared budgets, weak revenue management, over-ambitious capital programmes and non-priority spending, which is driven by the operating budget. As a result of such constraints, not only is planned aggregate infrastructure spending below the desired level (Mokgabudi, 2013), but actual infrastructure spending falls short of the budgeted amounts. The weaknesses have an impact on infrastructure spending to the extent that actual spending can be as low as 68% of the planned spending, as happened in the 2010/11 budget year.

The South African case seems to be reminiscent of Von Hirschhausen's view that "efficient infrastructure policies are much more easily 'planned' than actually carried out" (1999, p. 428). This points to the importance of implenting plans rather than having remarkable plans that are not fully carried out. The problem of underspending the infrastructure budget is not new in South

Africa. It is acknowledged both in academic and policy circles. Surprisingly, there is a lack of empirical studies, particularly from a local government perspective, on what determines the level of capital budget spending across municipalities.

A number of studies have, in one way or another, analysed the capacity to spend by subnational government. Arimah (2005) asserts that a municipality's financial capacity and the macroeconomic environment in which it operates are among the factors that explain differences in the level of infrastructure spending across cities in developing countries and emerging economies. Similarly, Mathew and Moore (2011) find that fiscal capacity is positively related to capacity to spend transfers from central government, in the case of the Bihar State of India. In a study of Italian municipalities Anessi-Pessina, Sicilia and Steccolini (2012) note that underspending is positively related to rigidity and adjustments in the current budget, but negatively related to financial autonomy.

Another important variable is the level of income received in the form of transfers, which is believed to be an important factor in affecting the fiscal behaviour of a recipient (Shah, 2007). In practice, intergovernmental transfers can have a significantly positive impact on local level capital spending capacity (Lewis, 2013) and related capital expenditure (Litschig & Morrison, 2013; Arvate, et al., 2015). However, in other instances transfers may have an insignificant impact on grant recipient's spending, as pointed out by Gamkhar and Shah (2007). There appears to be no consistency in the debate on the impact of transfers on local government spending capacity of the capital budget. This inconsistency could be explained by the existence of a nonlinear relationship (Odawara, 2010) between the level of transfers and capital spending capacity. While transfers are an important source of income, particularly from central government, there is a possibility that they may affect the capacity to spend in an undesirable way. Transfers are likely to benefit the recipient local government up to a certain level, beyond which diseconomies of scale set in. This line of thinking is supported by Prud'homme (2003) who looks at the threshold impact of transfers on raising local taxes. Prud'homme (2003) observes that municipalities that receive up to a certain threshold in transfers per capita raise more average per capita taxes than when transfers exceed the threshold. Likewise, one would not expect capital transfers from central and provincial government to local government to have an infinitely positive impact on the capacity to spend the capital budget in South Africa.

To study the capital budget spending capacity among South African municipalities, this study builds on the work of Arimah (2005), Mathew and Moore (2011) and Anessi-Pessina, Sicilia and Steccolini (2012) that assessed factors explaining the capacity to spend the municipal capital budget. However, we go a step further by adopting a non-linear methodology in order to assess the possibility of a threshold effect existing between transfers and capital budget spending capacity. Thus, our study uses panel data analysis, particularly the panel smooth transition regression (PSTR) model to establish the factors that explain the spending capacity of municipalities in terms of the level of municipal capital budget spending in South Africa, taking into account the threshold effect of capital transfers on capital budget spending capacity. To the best of our knowledge, no previous study has addressed the issue of threshold effects when analysing municipal capital budget spending capacity.

The remainder of the paper is structured as follows; section 2 discusses the spending capacity of South African municipalities, section 3 presents the literature review. Section 4 explains the methodology used. Section 5 presents and discusses the results of the paper and section 6 concludes the paper.

2. SOUTH AFRICAN MUNICIPALITIES CAPITAL SPENDING

Municipalities use a mix of revenue sources to fund their capital expenditure. These include own revenues, market credit and intergovernmental transfers, mainly in the form of conditional grants (Financial and Fiscal Commission, 2014). Municipal own revenue contributions to capital infrastructure investments are limited, resulting in municipal infrastructure being increasingly funded by intergovernmental transfers (Financial and Fiscal Commission, 2014). According to National Treasury (2011), high levels of municipal capital spending are largely driven by national government transfers to address backlogs in service delivery.

2.1. Spending Capacity of the Capital Budget

Wall, Watermeyer and Pirie (2012) point out that for many years the National Treasury has grappled every year with the challenge of the inability of a number of municipalities to spend their entire capital budgets. Unspent capital budgets reflect undelivered services (Wall, et al., 2012). Murwamuila and Lethoko (2014) concur, pointing out that capital budget underspending can affect the ability to carry out programmes and deliver services. Despite the government having in place measures such as delaying, withholding or even stopping transfers to curb underspending by municipalities, as outlined in the Department of Provincial and Local Government (2006), the problem of underspending persists. With such punitive measures in place, every municipality would be expected not to underspend. However, this is not the case, and the question that needs to be answered then is: what are the determinants of municipal capital budget spending? This paper aims to make a contribution to answering that.

Underspending is not as pronounced at national and provincial government levels as it is at the local level, particularly the infrastructure budget. According to National Treasury (2014) in 2012/13 the national and provincial governments underspent their adjusted budgets by 0.6% and 1.9% respectively, but municipalities spent only 84.6% of their infrastructure grants (up from 78.5% the previous year).

Table 1: Municipal Categories

Category	Number	Description
Metros	8[1]	Metropolitan municipalities
Secondary cities (B1)	19	All local municipalities referred to as secondary cities

[1] Prior to 2011 there were six metros and 21 secondary cities, and these numbers changed when Buffalo City and Mangaung were categorised as metropolitan municipalities in 2011.

Large towns (B2)	29	All local municipalities with an urban core. There is huge variation in population sizes among these municipalities and they do have large urban populations.
Small towns (B3)	111	Characterised by: • no large town as a core urban settlement • relatively small population, a significant proportion of which is urban and based in one or more small towns Largely agricultural-based local economies: • rural areas in this category are characterised by the presence of commercial farms
Mostly rural (B4)	70	Characterised by the presence of at most one to two small towns in their areas, communal land tenure and villages or scattered groups of dwellings and typically located in former homelands
Districts (C1)	25	District municipalities that are not water service providers
Districts (C2)	21	District municipalities that are water service providers

Source: (National Treasury, 2011; National Treasury, 2013b)

2.2. Key Municipalities

While municipal infrastructure demand spans all municipalities, it is highest in metros and secondary cities (National Treasury, 2011). In addition, this group of municipalities, 27 in total, accounts for the largest share of national economic activity, around 80%, according to the World Bank (2009). South African municipalities are grouped into seven categories, as shown in Table **1**. The categorisation is based on a number of factors, which include the proportion of poor households and the share of households with infrastructure services of electricity, water and sanitation (National Treasury, 2011). The importance of the 27 top metros is further highlighted in terms of their level of capital expenditure. In total, this group of municipalities accounts for about 70% of all municipal capital expenditure, as shown in Table 2.

Table 2: Municipal Capital Expenditure, R1000

Municipality Group	**2006-07**	**2007-08**	**2008-09**	**2009-10**
Metros	11 268 969	17 018 685	25 437 342	22 702 154
Top 21	3 337 304	4 296 708	6 559 667	6 108 148
Districts	2 078 486	2 462 794	3 455 938	4 803 502
B2	1 398 499	1 847 472	1 885 852	2 134 725
B3	1 819 811	2 340 264	2 522 034	2 726 827
B4	1 406 996	1 992 201	1 808 532	2 463 395
Total	21 310 065	29 958 124	41 669 365	40 938 752
Metros and Top 21 (% of total)	*69*	*71*	*77*	*70*

Source: National Treasury (2011)

3. LITERATURE REVIEW

Amounts of capital spending at the local government level are fairly large but, as asserted by Bates and Santerre (2015), only a few studies have researched on the main factors influencing the level of capacity to spend on local government capital infrastructure programmes. Among other factors, previous studies attribute spending capacity by government to a number of factors, which include the inadequate fiscal capacity of the underspending entities (Mathew & Moore, 2011), financial autonomy (Anessi-Pessina, et al., 2012; Bach, Blöchliger and Wallau), rigidity (Anessi-Pessina, et al., 2012), low absorption of transfers and poor control in budget implementation (Khasiani, 2007), as well as incapability to utilise additional resources, especially transfers, owing to insufficiency of

the technical capacities that are typically necessary for investment projects (Aragón & Casas, 2008). Below a review of studies that in one way or another looked at factors that contribute to local government underspending is done.

Using both quantitative and qualitative analyses, the Ugandan Ministry of Finance, Planning and Economic Development (MoFPED) (2011) carries out a study to establish and evaluate factors that constrain and undermine effective use of public funds at all levels of government in Uganda. MoFPED (2011) notes that a number of government units had consistently failed to use up their cash balances, which had a serious impact on public infrastructure investment and service delivery. Most of the underspending, MoFPED (2011) noted, was more significant in local government and reflected failure to implement planned activities. MoFPED (2011) cites poor planning as the sole chief absorption constraint.

Mathew and Moore (2011) assess factors that explain state incapacity in the Bihar State of India. Using a Panel Corrected Standard Errors regression model, Mathew and Moore (2011) analyse the determinants of capacity to spend transfers from central government, the Centrally Sponsored Schemes, by the Bihar State in comparison to the spending capacity by states with comparable income levels. They specified capacity to spend as a function of capacity to collect taxes by the state government, deficit (the Gross Fiscal Deficit of the state government as a percentage of state GDP), percentage of the state's rural poor, agriculture share (percentage contribution of the agricultural sector to state GDP), and election, which is a dummy variable to indicate whether a national parliament or general election to the state assembly had taken place in the year in question (Mathew & Moore, 2011). The results show that the capacity to collect taxes (as a measure of a state's fiscal capacity) is positively related to spending capacity, while the percentage of poor people is negatively related to spending capacity (Mathew & Moore, 2011). According to Mathew and Moore (2011), the results indicate that richer states perform relatively better in terms of spending capacity.

Arimah (2005) assesses determinants of variations in infrastructure spending across cities in Africa, Asia, the Caribbean, Latin America, the Middle East and economies in transition. Arimah (2005) argues that results indicate that differences in infrastructure spending are due to variations in municipal governments' financial capacity, urban growth rate, macroeconomic environment and quality of governance. Arimah's (2005) findings suggest that infrastructure spending across developing countries cities are explained by variations in the city governments' financial capacity, macroeconomic environment, quality of governance and urban growth rate. Similar to arguments by Arimah (2005) on financial capacity, Bach et al. (2009, p. 5) argue that autonomy indicators could help explain sub-central spending power. Bach et al. (2009) point out that it is not only the budget autonomy that affects the spending power of sub-central governments; other aspects such as policy autonomy, input autonomy and output autonomy also play important roles. These factors determine the extent to which local governments have control over (i) major policy objectives and key aspects of service delivery, (ii) salaries, management of staff and tender processes, (iii) standards of service (like deciding on what capital investment project to undertake) and (iv) financial control (Bach, et al., 2009).

In concurrence with Bach et al. (2009) and Arimah (2005), Anessi-Pessina et al. (2012) regard financial autonomy as a determinant of municipal spending capacity. Using a between-effects model and a fixed-effects model to analyse the main determinants of both current and capital spending among Italian municipalities, Anessi-Pessina et al. (2012) specify financial autonomy (measured as [tax revenues plus fee revenues]/total current revenues) as one of the explanatory variables. The other independent variables include staff size, current surplus/deficit, expenditure rigidity (calculated as [personnel plus interest expenditures]/total current revenue) as well as local socioeconomic conditions (such as geographic area, local economic conditions). For capital spending, Anessi-Pessina et al. (2012) observe that underspending is positively related to adjustments in the current budget and rigidity, but negatively related to financial autonomy. That is, municipalities with financial autonomy have spending capacity and are likely not to underspend their capital budget, while those that lack spending capacity are likely to underspend. Likewise, rigidity and adjustments in current spending are associated with inability to spend the municipal capital budget.

A panel data study using Odinary Least Squares (OLS) estimation for the period 2001 to 2010 by Bates and Santerre (2015) on the determinants of local public capital spending among Connecticut towns and cities confirms the importance of intergovernmental grants as factor explaining capital budget spending. Prud'homme (2003) assumes that transfers have a threshold effect on local government performance. The author relies on descriptive statics to reach such a conclusion.

This paper make use a nonlinear econometric technique, the PSTR model, to investigate the extent to which the level of capital transfers to municipalities explains their capacity to spend the infrastructure budget, an angle that has not been explored before in the analysis of local government spending capacity.

4. METHODOLOGY

4.1 Model Specification: Panel Smooth Transition Regression model

The above studies are important in highlighting various factors affecting subnational government's capacity to spend; however, they all rely on traditional OLS estimation. As pointed out by Karagianni and Pempetzoglou (2009), conclusions based on linear tests alone are weak and limited. Non-linear estimation, on the other hand, can uncover significant non-linearities existing in the relationships between economic variables (Hiemstra & Jones, 1994). Our study seeks to assess if a non-linear relationship exists between transfers and municipal capital spending capacity. To accommodate the possibility of different impacts of transfers on municipal capital spending we rely on Gonz´alez, Teräsvirta and van Dijk's (2005) PSTR model:

$$y_{it} = \mu_i + \beta_1' x_{it} + \beta_2' x_{it} g(q_{it}; \gamma, c) + e_{it}$$

where i=1,…,N denote the cross-section and t=1,…,T denote the time dimension of the panel. The dependent variable y_{it} (capital spending) is a scalar, x_{it} is the k-dimensional vector of time-varying independent variables (*transfers, staff, curexp, aut*), μ_t represents the fixed individual effects and e_{it} represents independent identically distributed errors. The transition function $g(q_{it}; \gamma, c)$ is a continuous function of the observable variable q_{it} bounded between 0 and 1. q_{it} is the

threshold variable (*transfers*), which is usually one of the explanatory variables. The slope parameter γ is an indicator of the smoothness of the transition between 0 and 1. c is the threshold parameter denoting where the transition takes place. The extreme values of the transition function, 0 and 1, are respectively associated with coefficients β_1' and $(\beta_1' + \beta_2')$. The value of $g(q_{it};\gamma,c)$ is determined by q_{it}.

The transition function, as given by Gonz´alez et al., (2005), takes the logistic function:

$$g(q_{it};\gamma,c) = \frac{1}{1+\exp(-\gamma\prod_{j=1}^{m}(q_{it}-c))}$$

with $\gamma > 0$ and $c_1 \leq c_2 \leq \ldots \leq c_m$; where $c_j = (c_1 \ldots c_m)'$ is a vector of m-dimensional location parameters and $\gamma > 0$ and $c_1 \leq c_2 \leq \ldots \leq c_m$ restrictions are imposed for purposes of identification. Gonz´alez, et al. (2005) point out that it is generally sufficient to consider $m = 1$ or $m = 2$ because these values allow for types of variations in the parameters that are commonly encountered.

For $m = 1$, the model denotes that the two extreme regimes are linked to low and high values of q_{it} with the coefficients changing monotonically from β_1 to $\beta_1 + \beta_2$ as q_{it} increases, with the transition centred around c_1.

4.2. Estimation and specification tests

Estimation of the PSTR model entails the following three-step procedure:

i. Test for linearity against the PSTR model
ii. Test for the number of regimes in the transition function
iii. Parameters estimation

These three steps have been comprehensively discussed by Gonz´alez, et al. (2005) Chakroun (2010), Kadilli and Markov (2012), Seleteng, et al. (2013), Thanh (2015), Majoul and Daboussi (2016) and Chiang, et al. (2017).

The linearity test uses the LM test, the F-version LMF and LR to identify the key variable that explains the nonlinearity of q_{it} (capital spending capacity). First, a linear model is tested against a single threshold model. If the test rejects the null hypothesis of linearity, it means at least one regime exists. Second, when linearity is rejected, a test to confirm no remaining non-linearity in the transition function is conducted. This entails testing the existence of a single threshold model against the existence of a double threshold model. The process is carried out until the null hypothesis of no additional threshold is not rejected. If the null hypothesis is not rejected for the test of a single threshold model against a double threshold model, it means only a single regime exists. Lastly, after eliminating the individual effects, model parameters are estimated by applying the non-linear least squares (NLS).

4.3. Data

We use a panel data set of 27 South African district municipalities over a seven-year period from 2004 to 2010. Our analysis is based on municipal budget data sourced from the National Treasury. Transfers is regarded as the threshold variable, because literature shows a possibility that the impact of transfers on capital budget spending capacity could be influenced by the level of transfers. Table 3 presents the type of variables used. It is important to note that variables such

as indebtedness, population density and Gross Value Added were considered as explanatory variables but dropped from the final estimation because they were not statistically significant.

Table 3: Summary Statistics presents the descriptive statistics. For the top 27 municipalities in South Africa, it shows that between 2004 and 2010, on average the municipalities spent 82% of their revised capital budget. The minimum recorded was 22% for Matjhabeni Municipality in 2004 and the maximum was 288% for Govan Mbeki Municipality in 2005.

Table 3: the different variables used in the PSTR model

Type	Variable	Description
Dependent variable	*Kexp*	Capital spending budget (measured as budget outcome as a percentage of the revised budget)
Transition variable	*Transfers*	Capital grants to municipalities from higher levels of government
Independent variables	*Staff*	Total spending on staff - used as a proxy for size and complexity
	Currentexp	Current spending budget outcome as a percentage of the revised budget
	Autonomy	Financial autonomy (share of current revenues accounted for by own taxes and fees)
	Kbudgetchange	% change between the initial budget and the previous year's budget outcomes (initial as % of previous year outcome)

Table 3: Summary Statistics

	Mean	Max	Min	Std. dev
kexp	0.82	2.88	0.22	0.38
currentexp	1.04	1.53	0.47	0.145
kbudgetchange	1.66	4.84	0.08	0.85
lnstaff	12.80	15.57	11.15	1.17
autonomy	0.81	1.00	0.43	0.10
lntransfers	11.52	14.96	5.64	1.42

Source: Author's representation of estimation results

The correlation matrix, given in Table 4, shows the bivariate links between all variables used in the model. It is important in indicating whether there might be a possibility of multicollinearity. There is only a single correlation coefficient above 0.8, which might not cause problems by itself. The results also suggest that capital budget spending is negatively related to capital budget change and positively related to the rest of the variables.

Table 4: Correlation coefficients of variables used in the empirical analysis

	kexp	currentexp	kbudgetchange	lntransfers	Lnstaff	autonomy
kexp	1					
currentexp	0.002059	1				
kbudgetchange	-0.37465	0.018316	1			
lntransfers	0.091487	-0.1116	-0.111732	1		
lnstaff	0.128265	0.002059	-0.242401	0.8208844	1	
autonomy	0.101211	0.002059	-0.155601	-0.39411	-0.04144	1

Source: Author's representation of estimation results

To ensure that we do not run spurious regressions which give meaningless results, we conduct unit root tests on the variables used in our estimation to ascertain whether they are stationary. A

non-stationary variable indicates non-existence of any long-run relationship between the respective variable and other variables.

Table 5: Panel unit root tests

	LLC t*-stat		IPS W-stat	
	Levels (P-value)	Differences (P-value)	Levels (P-value)	Differences (P-value)
kexp	-10.1 (0.000)	-14 (0.000)	-2.5 (0.006)	-4.9 (0.000)
currentexp	-9.8 (0.000)	-18.8 (0.000)	-2.9 (0.002)	-6.2 (0.000)
kbudgetchange	-12.7 (0.000)	-16.4 (0.000)	-12.7 (0.000)	-4.6 (0.000)
lntransfers	-11.2 (0.000)	-13.1 (0.000)	-1.2 (0.106)	-3.7 (0.000)
lnstaff	9.9 (1.000)	-15.3 (0.000)	8.3 9.9 (1.000)	-3.7 (0.000)
autonomy	-19.2 (0.000)	-13.2 (0.000)	-2.8 (0.002)	-2.8 (0.002)

Source: Author's representation of estimation results

We rely on the Im, Pesaran and Shin (IPS) and Levin, Lin and Chu (LLC) unit root tests to test the stationarity of our variables. Table 5 presents the panel unit root tests. Both the LLC and IPS indicate that all our variables are stationary, except *lnstaff* which becomes stationary in first differences.

5. RESULTS AND DISCUSSION

5.1. Linearity tests results

Table 6: Linearity and no remaining non-linearity results

	Threshold variable is not part the set of the explanatory variables		
	Wald Tests (LM)	Fisher Tests (LMF)	LRT Tests (LRT)
H0: Linear Model H1: PSTR with r = 1	15.435 (0.004)	3.513 (0.009)	16.102 (0.000)
H0: PSTR with r = 1 against H1: PSTR with at least r = 2	4.198 (0.380)	0.852 (0.495)	4.246 (0.374)

Source: Author's representation of estimation results

Table 6 gives the linearity tests results which indicate that all three tests reject, at the 1% significance level, the null hypothesis of a linear model against the alternative of a logistic (m=1) PSTR model. This implies a nonlinear relationship between capital budget spending capacity and transfers received by municipalities in South Africa.
For the test for no remaining non-linearity, the null hypothesis of the logistic specification (m = 1) against the exponent one (m = 2) PSTR model, the results show that the null hypothesis cannot be rejected. The implication is that the model has only one threshold level of transfers separating two regimes of capital budget spending capacity for South African municipalities.

5.2. Estimation results

Table 7 presents the estimated model parameters for the existence of threshold value. Considering transfers as the transition variable to estimate factors affecting municipal capacity to spend the capital budget, indeed our model robustly detects nonlinearity. Our findings are in line with the

theory on the existence of a threshold beyond which the impact of fiscal policy changes as pointed out by Prud'homme (2003) in the case of the impact of transfers on the collection of taxes. The threshold is reached at the natural log of transfers = 10.1055, which is converted to R24 343 009 (capital transfers). Therefore, the results indicate that the estimated threshold value of capital transfers is R24 343 009 and the transition parameter slope is 5.99. The value of the slope, 5.99, implies a relatively gradual transition from a low transfers regime to a high transfers regime. This suggests that higher levels of government reconsider increasing capital transfers when they near or exceed the estimated threshold. The results indicate that the spending capacity of the capital budget by South African municipalities could be improved by managing the capital transfers they receive.

Transfers received by municipalities could possibly be too high for certain municipalities' capacity to spend, resulting in them being unable to spend the entire capital expenditure budget. This could be as a result of the important role of municipalities being recognised by fiscal policy, as evidenced by the continued rapid growth of transfers to local government (National Treasury, 2011). Consistent growth in transfers to local government has been observed since the inclusion of local government in the process of division of revenue in 1999 (National Treasury, 2011). Transfers from the national budget, National Treasury (2011) points out, are dependent on the capacity of municipalities to raise revenue, but independent of their capacity to spend. As a result, municipalities with low fiscal capacity receive a higher proportion relative to those with a high fiscal capacity.

Table 7: Parameter estimates for the final PSTR

Variable	β_1	β_2
Currentexp	2.1213*** (2.7350)	-2.4568*** (-2.7883)
Autonomy	2.6340* (1.7740)	-3.1881** (-2.1421)
lnStaff	-0.6463*** (-2.6549)	0.4593** (2.4483)
Kbudgetchange	-0.2211* (-1.8206)	0.1459 (1.1564)
Transition parameters		
Threshold	10.1055	
Slope	5.9929	
Obs	270	

Source: Author's representation of modelling results

The t-statistics for coefficients in parentheses are corrected for heteroscedasticity

All coefficients are statistically significant in both regimes, except capital budget change (*Kbudgetchange*) in the high transfers regime. Current expenditure is positively (negatively) related to capital budget spending capacity in the lower (higher) transfers regime. Current expenditure (*Currentexp*), is positively (negatively) related to *Kexp* in the lower (higher) transfers regime. This finding is similar to that of Anessi-Pessina et al. (2012). This result indicates that municipalities are likely to adjust both capital and current expenditure in the same direction. However, for the higher

transfers regime model *Currentexp* is negatively related to *Kexp*, implying a trade-off between the two variables. This indicates an adjustment of the budget away from capital spending to current spending.

Autonomy is positively (negatively) related to capital budget spending capacity in the lower (higher) transfers regime. The positive relationship between financial autonomy and capacity to spend the capital budget is similar to findings by Arimah (2005). It entails that as the municipal share of own revenue increases, spending of the capital budget also increases under the lower transfers regime. This means the higher these revenue sources, the greater the ability of municipalities to finance infrastructure, thus the lower the levels of transfers. However, in the higher transfers regime *Autonomy* is negatively related to capital budget spending capacity, a finding similar to that of Anessi-Pessina et al. (2012). This implies that municipalities that experience a sudden increase in own revenue find themselves with higher incomes, which they are unable to spend. The implication is that for municipalities whose financial autonomy suddenly increases, actual capital expenditure varies much lower than the revised budget. Such municipalities apparently either do not plan their budget well or simply do not have the capacity to implement the revised budget.

Staff, a proxy for the size of the workforce, is negatively (positively) related to capital budget spending capacity in the higher (lower) transfers regime. The result implies that in the lower transfers regime, as the workforce increases *Kexp* declines, but in the higher regime further increases in the workforce lead to an increase in *Kexp*. *Kbudgetchange* for the lower regime is significantly and negatively related to capital budget spending capacity, a result that is in line with the findings of a similar study by Anessi-Pessina et al. (2012). This highlights the use of the budgeting process as a way of repealing some programmes introduced in the initial budget, which more or less reflects realignment of the budget in a particular year to that of the previous year.

6. CONCLUSION

The problem of underspending the infrastructure budget, which is acknowledged both in academic and policy circles, has been persisting in South Africa. It is central to the provision of local level infrastructure, which remains inadequate in many parts of South Africa, particularly at the local level. Yet there is a lack of empirical studies, particularly from a local government perspective, especially on South Africa, on the factors that explain capital budget underspending. This study looked at the factors that contribute to underspending of the capital budget by municipalities in South Africa. It investigated whether a nonlinear relationship exists between municipal government capital spending and capital transfers from national government for South African municipalities. The study employed a PSTR to analyse the threshold effect of capital transfers on capacity to spend the planned capital budget. No previous study has analysed the threshold effects of municipal capital budget spending.

The threshold effect of capital transfers was estimated through the use of regressors whose selection was informed by Arimah (2005), Anessi-Pessina et al (2012) and Mathew and Moore (2011), namely current expenditure, financial autonomy, size of the workforce and change in capital budget.

First, the results from this analysis confirm evidence of the existence of a nonlinear relationship between municipal government capital spending and capital transfers in South Africa. The results of the test used to estimate the number of regimes indicate that the model with two regimes or one threshold adequately captures this relationship. The threshold capital transfers for South African municipalities is R24 477 260. The results suggest that large amounts of capital transfers to local government in South Africa are, in some instances, too high for the capacity of some municipalities, which explains the persistent underspending of the capital budget.

Second, estimated coefficients of control variables are largely consistent with empirical literature. The results indicate that capital budget spending could be improved by ensuring that the trade-off between the current budget and capital budget is reduced, increasing the fiscal capacity of municipalities which gives them financial autonomy to raise their own revenues, and by increasing the staff complement commensurate with the magnitude of the capital budget.

7. References

Adam, C. & Bevan D., 2003. *Aid, Public Expenditure and Dutch Disease,* Oxford: Centre for the Study of African Economies.

Alexander, D. P., 2015. *An assessment of capital budget planning and municipal borrowing as funding source in the Overstrand Municipality in the Western Cape,* Cape Town: University of Cape Town.

Anessi-Pessina, E., Sicilia, M. & Steccolini, I., 2012. Budgeting and rebudgeting in local governments: siamese twins?. *Public Administration Review,* 72(6), p. 875–884.

Aragón, F. & Casas, C., 2008. *Local governments' capacity and performance: Evidence from Peruvian municipalities,* Caracas: CAF.

Arimah, B. C., 2005. What Drives Infrastructure Spending in Cities of Developing Countries?. *Urban Studies,* pp. 1345-1368.

Arvate, P., Mattos, E. & Rocha, F., 2015. *Intergovernmental transfers and public spending in Brazilian municipalities,* Sao Paulo: Sao Paulo School of Economics.

Aschauer, D. A., 1989. Is public expenditure productive?. *Journal of Monetary Economics,* 23(2), pp. 177-200.

Bach, S., Blöchliger, H. & Wallau, D., 2009. *The spending power of sub-central governments: A pilot study,* s.l.: OECD Publishing.

Bates, L. J. & Santerre, R. E., 2015. The Demand for Municipal Infrastructure Projects: Some Evidence from Connecticut Towns and Cities. *Public Finance Review,* 43(5), pp. 586-605.

Calderón, C. & Servén, L., 2003. The output cost of Latin America's infrastructure gap. In: W. Easterly & L. Servén, eds. *Limits of Stabilization: Infrastructure, Public Deficits and Growth in Latin America.* Washington DC: The World Bank, pp. 95-118.

Capricorn District Municipality, n.d. *CDM committed to spending all grants,* Capricorn : Capricorn District Municipality.

Chakroun, M., 2010. Health care expenditure and GDP: An international panel smooth transition approach. *International Journal of Economics,* 4(1), pp. 189-200.

Chiang, G. N., Sung, W. Y. & Lei, W. G., 2017. Regime-Switching Effect of Tourism Specialization on Economic Growth in Asia Pacific Countries. , 5(3). *Economies,* 5(3), pp. 1-14.

Copeland, C. L. L. a. W. J. M., 2011. *The Role of Public Works Infrastructure in Economic Recovery,* s.l.: Congressional Research Service.

Department of Provincial and Local Government, 2006. *Municipal Infrastructure Grant: National MIG management unit programme management processes and procedures,* Pretoria: Department of Provincial and Local Government.

Estache, A., Perrault, J. F. & Savard, L., 2009. *Impact of infrastructure spending in Mali: A CGE modeling approach,* Brussels: ECARES.

Fedderke, J. & Bogetic, Z., 2009. Infrastructure and Growth in South Africa: Direct and Indirect Productivity Impacts of 19 Infrastructure Measures. *World Development,* 37(9), pp. 1522-1539.

Financial and Fiscal Commission, 2014. *Funding of Municipal Capital Expenditure: Who Pays?,* Midrand: Financial and Fiscal Commission.

Gamkhar, S. & Shah, A., 2007. The Impact of Intergovernmental Fiscal Transfers: A Synthesis of the Conceptual and Empirical Literature. In: R. Boadway & A. Shah, eds. *Intergovernmental Fiscal Transfers: Principles and Practice.* Washington DC : The World Bank, pp. 225-258.

Gonz´alez, A., Ter¨asvirta, T. & van Dijk, D., 2005. *Panel Smooth Transition Regression Models,* Stockholm: Stockholm School of Economics.

Gordhan, P., 2012. *2012 Budget speech,* Pretoria: National Treasury.

Hameiri, S., 2007. Failed states or a failed paradigm? State capacity and the limits of institutionalism. *Journal of International Relations and Development,* 10(2), pp. 122-149.

Hiemstra, C. & Jones, J. D., 1994. Testing for linear and nonlinear Granger causality in the stock price-volume relation. *The Journal of Finance,* 49(5), pp. 1639-1664.

Holtz-Eakin, D., 1994. Public-Sector Capital and the Productivity Puzzle. *The Review of Economics and Statistics,* 76(1), pp. 12-21.

Josie, J., 2008. *The intergovernmental context of municipal infrastructure grants in South Africa,* Cape Town: University of the Western Cape.

Jung, H.-S. & Thorbecke, E., 2003. The impact of public education expenditure on human capital, growth, and poverty in Tanzania and Zambia: a general equilibrium approach. *Journal of Policy Modeling,* 28(5), pp. 701-725.

Kadilli, A. & Markov, N., 2012. *A panel smooth transition regression model for the determinants of inflation expectations and credibility in the ECB and the recent financial crisis,* New York: SSRN.

Karagianni, S. & Pempetzoglou, M., 2009. Evidence for non-linear causality between public spending and income in the European Union countries. *he Journal of Applied Business Research,* 25(1), pp. 69-82.

Khasiani, K., 2007. *Legacy systems and budget reform: The case of Kenya.* Pretoria, CABRI Secretariat, pp. 35-49.

Lau, S. P. & Sin, C., 1997. Public infrastructure and economic growth: time-series properties and evidence. *Economic Record,* 73(221), pp. 125-135.

Leeper, E. M., Walker, T. B. & Yang, S.-C. S., 2010. *Government investment and fiscal stimulus,* s.l.: International Monetary Fund.

Lewis, B., 2013. Local government capital spending in Indonesia: Impact of intergovernmental fiscal transfers. *Public Budgeting & Finance,* 33(1), pp. 76-94.

Litschig, S. & Morrison, K. M., 2013. The Impact of Intergovernmental Transfers on Education Outcomes and Poverty Reduction. *American Economic Journal: Applied Economics,* 5(4), pp. 206-240.

Maisonnave, H., Mabugu, R., Chitiga, M. & Robichaud, V., 2013. *Analysing Job Creation Effects of Scaling Up Infrastructure Spending in South Africa,* Laval: CIRPÉE.

Majoul, A. & Daboussi, O. M., 2016. Nonlinear Effects of the Financial Crisis on Economic Growth in Asian Countries: Empirical Evaluation with a PSTR Model. *Asian Economic and Financial Review,* 6(8), pp. 445-456.

Mathew, S. & Moore, M., 2011. State incapacity by design: understanding the Bihar story. *IDS Working Papers.*

Mbanda, V. & Chitiga-Mabugu, M., 2017. Growth and employment impacts of public economic infrastructure investment in South Africa: a dynamic CGE analysis. *Journal of Economic and Financial Sciences,* 10(2), pp. 235-252.

Ministry of Finance, Planning and Economic Development, 2011. *Absorptive capacity constraints: The causes and implications for budget execution,* Kampala: Ministry of Finance, Planning and Economic Development.

Mokgabudi, T., 2013. *South Africa: Planned infrastructure expenditure and the NDP: Mind the gap.* [Online]
Available at:
http://www.mondaq.com/southafrica/x/266734/government+policy+public+finance/Planned+Infrastructure+Expenditure+And+The+NDP+Mind+The+Gap
[Accessed 8 September 2015].

Munnell, A. H., 1992. Policy watch: infrastructure investment and economic growth. *Journal of Economic Perspectives,* 6(4), pp. 189-198.

Murwamuila, R. & Lethoko, M., 2014. Budget underspending in Limpopo province: Is corruption to blame?. *Journal of Public Administration,* 49(3), pp. 779-793.

National Planning Commission, 2011. *Diagnostic Report,* Pretoria: National Planning Commission.

National Planning Commission, 2012. *National Development Plan – 2030,* Pretoria: National Planning Commission.

National Treasury, 2008. *2008 Local Government Budgets and Expenditure Review,* Pretoria: National Treasury.

National Treasury, 2011. *2011 Local Government Budgets and Expenditure Review ,* Pretoria: National Treasury.

National Treasury, 2011. *Local Government Budgets and Expenditure Review: 2006/07 - 2012/13.* Pretoria: National Treasury.

National Treasury, 2013a. *Budget Review,* Pretoria: National Treasury.

National Treasury, 2013b. *The state of local government finances and financial management as at 30 June 2013 ,* Pretoria: National Treasury.

National Treasury, 2014. *Budget Review: Chapter 7 - Provincial and local government,* Pretoria: National Treasury.

National Treasury, 2015. *National Assembly: Question for Written Reply Question Number: 3924 [NW4789E],* Pretoria: National Treasury.

National Treasury, 2015. *Unpacking infrastructure development spending in local government,* Pretoria: National Treasury.

Nhlanhla, N., 2015. *2015 Budget speech,* Pretoria: National Treasury.

Odawara, R., 2010. *A Threshold Approach to Measuring the Impact of Government Size on Economic Growth,* Washington DC: The George Washington University.

Prud'homme, R., 2003. Fiscal decentralisation in Africa: A framework for considering reform. *Public Administration and Development,* Volume 23, pp. 17-27.

SALGA, n.d. s.l.: s.n.

Savard, L., 2010. Scaling up infrastructure spending in the Philippines: A CGE top-down bottom-up microsimulation approach. *International Journal of Microsimulation,* 3(1), pp. 43-59.

Seleteng, M., Bittencourt, M. & Van Eyden, R., 2013. Non-linearities in inflation–growth nexus in the SADC region: A panel smooth transition regression approach. *Economic Modelling,* Volume 30, pp. 149-156.

Shah, A., 2007. A Practitioner's Guide to Intergovernmental Fiscal Transfers. In: R. Boadway & A. Shah, eds. *Intergovernmental Fiscal Transfers: Principles And Practice* . Washington DC: The World Bank, pp. 1-53.

Solé-Ollé, A. & Bosch, N., 2005. On the relationship between authority size and the costs of providing local services: lessons for the design of intergovernmental transfers in Spain. *Public Finance Review,* 33(3), pp. 343-384.

South African Local Government Association, 2012. *Session 4: "sustainable human settlements and infrastructure",* Pretoria: South African Local Government Association.

Thanh, S. D., 2015. Threshold effects of inflation on growth in the ASEAN-5 countries: A Panel Smooth Transition Regression approach. *Journal of Economics, Finance and Administrative Science,* 20(38), pp. 41-48.

The World Bank, 2013. *Data: Access to electricity,* s.l.: The World Bank.

Von Hirschhausen, C., 1999. What Infrastructure Policies for Post-Socialist Eastern Europe? Lessons from the Public Investment Programmes (PIP) in the Baltic Countries. *Europe-Asia Studies,* 51(3), pp. 417-432.

Wall, K., Watermeyer, R. & Pirie, G., 2012. *'Wagging the dog': How service delivery can lose its way in the procurement maze -- and could find it again,* Pretoria: CSIR.

World Bank, 2009. *The South African urban agenda: Municipal infrastructure finance - summary report,* Washington, DC: World Bank.