Fiscal Illusion at the Local Sphere: An Empirical Test of the Flypaper Effect using South African Municipal Data

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Fiscal Illusion at the Local Sphere: An Empirical Test of the Flypaper Effect using South African Municipal Data*

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Abstract

Despite South Africa's relatively decentralized governance and administrative structure, an important feature of the country's intergovernmental fiscal relations system is the gap that exists between the expenditure responsibilities of sub-national authorities and their assigned revenue bases. The resulting vertical fiscal imbalance is mainly addressed via significant intergovernmental transfers to provinces and local governments. This factor presents strong a priori grounds in assuming that in the South African context, the heavy dependence of many local governments on intergovernmental transfers may generate fiscal illusion. Despite this, no significant effort has been geared towards an empirical investigation of the issue of fiscal illusion. This paper extends existing literature on the empirical analysis of fiscal illusion by using the fiscal year 2005/06 financial and expenditure data from 237 local government authorities in South Africa to evaluate the flypaper variant of the fiscal illusion hypothesis. Empirical results indicate that the marginal effects of municipal own-source revenues on local expenditure exceed those of intergovernmental transfers. This outcome yields no statistical evidence in support of the flypaper hypothesis within the context of municipal expenditures in South Africa.

JEL Classification: C20, H20, H71, H72, H77

Keywords: Intergovernmental Transfers; Fiscal Illusion; Flypaper Effect; South Africa. .

1 Introduction

The median voter theorem of public choice posits that under a under a majority-rule voting system, the effects of any system of revenue sharing can be duplicated by a set of grants (of the same amount) to individuals in a community or jurisdiction (Hotelling, 1929; Black, 1948; Downs, 1957; Brandford and Oates, 1971; Congleton, 2002) From a quantitative viewpoint, this theorem implies that where increases in non-matching, non-categorical grants to a community are appropriately weighted by the median voter's tax share, then the increase in public spending should be proportional to the increase in the median voter's income, that is, that intergovernmental block aid and voter income should have identical effects on local government expenditure (Turnbull, 1991; Wyckoff, 1988). However, empirical evidence in a number of studies has found that the median-voter model prediction of equivalence is consistently rejected by the data (see for example Gramlich, 1977; Fisher, 1982; and Hamilton, 1983). Instead, the empirical results report a phenomenon in which increases in lump sum intergovernmental grants effects a larger increase in local government expenditures than an

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equivalent change in residential incomes (Megdal, 1987; Courant *et al.*, 1979). This empirically observed asymmetry between the income and grant effects on local government expenditures is termed the "flypaper effect" to explain the observed tendency for local government authorities to spend intergovernmental grant transfers rather than pass on such transfers to constituents/residents through, for example, tax cuts.

The flypaper effect of intergovernmental grants can be traced back to the concept of fiscal illusion. This concept is premised on the proposition that in a given fiscal jurisdiction, the separation of taxing and spending powers blurs local taxpayers' judgment of the 'true' costs and benefits of public expenditure and/or publicly provided goods and services (Dollery and Worthington, 1999). According to Grossman (1990), the obfuscation of costs stems from the perception that grants received by a particular jurisdiction will not be paid for by higher tax payments of equal value to the grantor government. Such grants will therefore cause both income and price effects on local demand for public goods and services, effects that result in the size of government expenditure (or the local public sector) being larger than what will obtain in a system of fiscally independent local authorities. The empirical analysis of fiscal illusion involves the examination of five underlying but distinct hypotheses of fiscal illusion, namely: (i) the *revenue complexity*, (ii) *revenue-elasticity*, (iii) the *flypaper paper effect*, (iv) *renter illusion* and, (v) the *debt illusion* hypothesis, respectively. According to Dollery and Worthington (1996), the common trend across these hypotheses is that they each attempt to model a process in which fiscal illusion causes citizens to underestimate the tax-price of a public good (or services), the consequence of which is the oversupply of that good (or service).

An empirical evaluation of the concept of fiscal illusion is important to decentralization policies in South Africa for several reasons. First, in the context of South Africa's intergovernmental fiscal relations, the notion of fiscal illusion is likely to become an important theme in research geared towards understanding local public choice and the process of public expenditures at sub-national spheres. Recent reforms to the financial and management systems of local governments, increased demand for service delivery at the local government sphere and growing concerns about the capacity of the local governments to implement critical service delivery initiatives has not only led to the re-examination of the fiscal relationships between the three spheres of government in South Africa but also, a growing need to align intergovernmental grants allocations with the true costs of providing local public goods and services. Second, the legislative assignment of relatively broader revenue sources (including rates on property and utility user - fees on water, electricity and sanitation services provided by a municipality) to the local sphere ensures that at an aggregate level, South Africa's municipalities are able to generate over 90 percent of their revenues from own-sources. However, disparities in population size, income distribution, revenue base as well as varying degrees in the levels of urbanization and administrative capacity means that the actual distribution of responsibilities and revenue collection varies widely within and across types of local governments. (Bahl and Smoke, 2003). As a way of equalizing services across municipalities as well as filling the gap between constitutionally mandated responsibilities and revenue functions, intergovernmental fiscal transfers (or grant allocations) play a crucial role in the expenditure functions of relatively poor municipalities. As Wyckoff (1991) has noted, lump-sum intergovernmental grants represent one of the few observable exogenous variables impacting on real world public finance decisions – a reason that allows for the construction and testing of consistent models estimating the effects of intergovernmental grants on spending decisions of local authorities.

This paper makes two contributions to the literature on the fiscal behavior of local authorities in Africa. First, to the best of our knowledge, there is no parallel work in South Africa, and indeed in the rest of Africa that has quantitatively analyzed the concept of fiscal illusion and by extension, the role of intergovernmental transfers on spending decisions of local governments.[1] Second, our analysis

[1] *Dalamagas (1993) empirically analyzed the effects of government deficit (and debt) on private consumption using a sample of 51 countries that included South Africa. Of some relevance to this paper is that the study utilized the fiscal illusion hypothesis as a means of reconciling the conventional Keynesian theory on the macroeconomic effects*

is carried out within the framework of the median voter model, a model that underpins the flypaper effect hypothesis of fiscal illusion. Unlike national and provincial spheres where multi-sectoral issues (like macroeconomic stability, defence and social welfare) are priorities, the South African constitution mandates that local authorities focus on providing public goods and this most likely adheres to the classical unidimensional assumptions of the median-voter model, thereby justifying the application of the flypaper effect hypothesis to the analysis of fiscal illusion in the case of South Africa.

The rest of the paper is structured as follows: Section 2 provides a review of relevant theoretical and empirical literature on assessing fiscal illusion using the flypaper effect hypothesis. Section 3 provides an overview of South Africa's local government grant process and is followed by Section 4 which elaborates on the data and methodological issues. Section 5 presents the empirical results and their interpretation. Section 6 concludes the paper.

2 Literature Review

2.1 The Theory

Following Dollery and Worthington (1996), the starting point in analyzing the flypaper effect is the illustration of the theoretical framework underpinning the empirical evaluation of the fiscal illusion phenomenon. This is illustrated using the simple diagram developed by Wagner (1976) and presented in Figure 1.

Assuming perfect competition, $X_2$and P_2 represent the desired output and tax-price of the public good in the absence of fiscal illusion, with total budget corresponding to the area OP_2aX_2. According to public finance theory, fiscal illusion is likely to cause the oversupply of a public good owing to citizens' underestimation of the price of that good and the characteristics of the good, that is, whether it has positive or negative externalities associated with it. From Figure 1, when there is fiscal illusion, the perceived price of the public good declines to $P_{1,}$causing an increase in desired output to rise to X_1 with the corresponding (perceived) budget equivalent to the area $OP_1cX_{1.}$However, in since the actual price of the good is still $P_{2,}$the actual budget corresponds to the area $OP_2dX_{1.}$Along with the four other hypotheses utilized in explaining the concept of fiscal illusion, the "flypaper effect" theory is used to construct empirical models in evaluating the area $X_2adX_{1,}$which denotes the excess budget attributable to fiscal illusion.

Having outlined the theory of fiscal illusion, the paper now turns its attention to the theoretical equivalence of the flypaper effect examining the impact of lump-sum grants on governments and residents as developed by Bradford and Oates (1971) and adapted from the studies of Fisher (1982) and Wyckoff (1988). This is illustrated in Figure 2 below.

In the illustration above, an unconditional or unrestricted grant equal to the amount Bpushes out the median voter's budget constraint (from $BC\ I$ to $BC\ II$) but leaves the slope unaffected, i.e. the slope of $BC\ I$ and $BC\ II$ are equal to T. If T is equivalent to the median voter's tax share, then an income increase equal to an amount TB will result in exactly the same final budget constraint as that which occurs under a grant/aid increase (Wyckoff, 1988). Assuming that the voter's preferred choices are independent of the elements of the budget constraint, one can expect the same equilibrium expenditure on public and private goods to occur, and thus, that an increase in unconditional grants to a particular region (or government jurisdiction) of amount B to have the same effect as an income increase (or the transfer of an equivalent lump-sum amount to citizens of that jurisdiction) of amount TB). Lump-sum grants change spending patterns by altering the median voter's effective income. With the median voter assumed to have the ability to vary local public spending to suit her tastes, then that voter's share of lump-sum grants can be considered to be a fungible asset which could be utilized for either private or public purposes, thus forming part

of a debt-financed tax cut with the effects postulated by the alternative Ricardian equivalence hypothesis.

of the voter's total income.[2] In the median voter model, the flypaper effect happens when increases in the share of lump-sum aid coincides with a larger level of local expenditures than increases in the median voter's income (Wyckoff, 1991; Heyndels and Smolders, 1994).

From the perspectives of Courant *et al* (1979) and Oates (1979), the observed tendency for lump-sum grants to stimulate higher public expenditures than equivalent increases in other revenue sources is mainly due to the behavior of budget maximizing bureaucrats and politicians to project the illusion that lump-sum allocations reduce both the actual average tax rates paid by citizens and the marginal tax-price of public goods provided to citizens. Courant *et al* (1979) and Oates (1979) argue that little knowledge regarding the amount of grants extended to the community will result in the voter using the ratio of his tax payments to total expenditures as a proxy estimate for the marginal cost of public goods. Thus, where lump-sum transfers are present, the use of this proxy will cause the voter to make erroneous estimates of his effective income and price of public goods. In a situation where the median voter's tax payments remain unchanged and lump sum grants raise local expenditures, the average price of public goods will then decline causing consumers to perceive a fall in tax price and demand larger expenditure levels (Heyndels and Smolders, 1994).

Using the expenditure behavior model developed by Logan (1986), Hammes and Wills (1987) postulate that an expansion in public expenditure due to lump-sum grant transfers is the outcome of the spending behavior of both recipient and grantor governments. With lump sum transfers raising the perceived price of grantor government expenditures and lowering the perceived price of recipient government expenditures, then such price changes will encourage individuals "over-buying" of recipient government expenditures and "under-buying" grantor government expenditures. Federal transfers such as non-matching grants or categorical lump-sum grants afford political agents the opportunity to return to taxpayers, either directly (via rebates) or indirectly (via a reduction in tax contributions), some of the income derived from grant revenues. However, given that there are greater political gains to be derived from increased public expenditure than offering minor reductions in tax rates paid by citizens, politicians will tend to utilize lump-sum grant allocations in expanding the public budget.

2.2 Empirical Evidence

In quantitatively examining the concept of fiscal illusion using the flypaper effect, two distinct groups of research can be identified. Rather than a direct assessment of the fly paper effect, the first set of studies have followed an indirect route by incorporating expenditure distortions generated by intergovernmental grants into empirical studies of other theories of fiscal illusion, such as the revenue-complexity or elasticity hypotheses (see for example Oates, 1975; Wagner, 1976; Heyndels and Smolders, 1994). Generally, the results of these studies conclude that intergovernmental grants are a key determinant of expenditures on public goods and services. The second set of studies have followed a more direct approach with attention devoted to the empirical analysis of fiscal illusion using the flypaper effect hypothesis. Within this category of direct analysis, there are two distinct approaches: (i) one in which the analysis of the flypaper effect is based on the premise that grants lower the average price of recipient public goods, and it is this price rather than the actual marginal-tax price, that forms the basis of voter's allocative decisions), and (ii) an alternative approach that considers the flypaper effect as the result of a "windfall illusion".[3] Irrespective of this distinction, a common view held by both direct approaches is that by reducing the perceived marginal cost of

[2] *Wyckoff (1988) further cites the example of the case where a median voter opts to spend his share of lump-sum grants on private consumption. In such a case, the grant share will be directed towards lowering the median voter's local taxes, with the voter's after-tax income increasing by the product of (i) the lump-sum grant, (ii) the voter's tax share, and (iii) the community or jurisdiction's share of expenditures under any matching grant scheme.*

[3] *Windfall illusion describes the case in which the voter is conscious of grant transfers but perceives an increase in such grant as (i) an increase in income (and not a fall in marginal cost of public goods), and (ii) an increase in income financed by other jurisdictions.*

the public goods, grants have the effect of biasing public expenditures upwards (Worthington and Dollery, 1996). The two strands of the direct approach are discussed below.

Amongst studies that have followed the direct approach, the pioneering work of Winer (1983) which examined provincial data for Canada is particularly instructive. In Winer's view, while voters are aware that federal taxes are levied nationally and that some of these taxes are transferred as aid to recipient provincial government(s), they tend to believe that the funding for such aid is derived from taxes levied on residents of other jurisdictions. The result is a decline in the relative (tax) price of the public good provided by the recipient government and a possible increase in the levels of public expenditure. Winer's empirical analysis of this fiscal illusion utilized pooled time series and cross sectional data covering ten Canadian provinces. Regressing net provincial expenditures against interprovincial grants, provincial income, federal grants and dummy variables capturing the different categories of recipient (or poor) and donor (rich) provinces, Winer finds that the Canadian grant system does raise expenditure with the elasticity expenditure of grants for recipient governments twice as large as donor jurisdictions.

The seminal works of Logan (1986) for the United States, and Hammes & Wills (1987) for Canada extended Winer's study to include the analysis of the flypaper effect on the expenditures of both the aid granting and aid receiving government/jurisdiction. Their analysis was based on the argument that while voters lacked complete information, they still acted like rational agents in making economic decisions. Thus, when faced with the perception that federal taxes were rising but services were not (and vice versa), the dissimilar effects of misperceived tax prices would lead to the increase in expenditures of the recipient government, and a downward bias in non-grant expenditures of the aid granting (i.e. donor) government (Dollery and Worthington, 1996). In both Logan (1986) and Hammes and Wills (1987), the empirical analysis of the flypaper effect was undertaken by regressing real per capita federal (non-aid) direct expenditures against per capita measures of federal aid, total sub-federal government expenditures and unemployment. Both studies reported an inverse correlation between federal (non-aid) direct spending and aid disbursed to sub-federal government authorities. For Hammes and Wills (1987), the results indicating that intergovernmental grants transfer incomes and alter the relative price of grantor to recipient government expenditures provides support for the existence of fiscal illusion using Canadian data.

Extending the argument of Courant *et al.*(1979), Grossman (1990) noted that the higher the indirectness of grant transfer and the greater the degree of separation between taxing and spending powers, the higher the distortion of taxpayers' perception of the true costs of locally provided goods and services. In Grossman's opinion, the transfer of funds from the federal government to local authorities is more indirect with the relationship involving a greater separation in tax and spending powers, with the resultant effects that federal grants stimulate local expenditures far higher than state grants. To test this hypothesis, Grossman (1990) utilized data on the recurrent expenditures of 136 counties and cities in the state of Virginia, and regressed these expenditures against various socio-economic variables and categories of grants (i.e. conditional and unconditional) disbursed by both the federal and state governments. The results supported those of Courant *et al* (1979) and Oates (1979), as it found that federal government unconditional grants generate twice as much increase in local expenditures than an equivalent state government unconditional grant.

3 An Overview of South Africa's Local Government Grant Process

The democratic elections of 1994 ushered in a phase of significant reforms and encompassed the political and socio-economic system under which South Africa would operate. The 1996 Constitution and Local Government Municipal Structures Act (1998) consolidated the complex system of local authorities into two hundred and eighty four local governments subdivided into three categories: 6 metropolitan (or Category A) municipalities that exclusively cover large urban areas; 231 local

(or category B) municipalities covering non-metropolitan localities that vary in size and degree of urbanization, and 47 district (or category C) municipalities encompassing several less capacitated category B and rural municipalities. These two legal frameworks have mandated municipal governments to give priority to the provision of basic socio-economic services and infrastructures to their communities. At present, about two-thirds municipal functions relate to the provision of crucial socio-economic services including water, sanitation, roads, storm water drainage and electricity. To meet their legislated mandate, local governments in South Africa are assigned a number of revenue sources by the Constitution, with the main sources being rates on property and utility/user charges levied on for the services provided by (or on behalf of) municipal authorities (see Figure 3).

While for many well eendowed municipalities, assigned revenue sources provide for relatively adequate funding and provision of mandated social services, many municipalities (especially those in small, rural settings) lack adequate fiscal capacity in meeting their constitutional mandates. For such municipalities, intergovernmental fiscal transfers provide crucial resources for funding service delivery programs and administration costs. In April 1998, the National Treasury (then known as the Department of Finance) issued a comprehensive document called the "Green Book" which outlined a new system of intergovernmental transfers to the local sphere of government in South Africa. The Green Book's major focus was on the framework underpinning the horizontal allocation of the share of nationally raised revenues (or the equitable share)due to municipalities. The proposed framework for the horizontal split of revenues mirrored that developed in a policy discussion document published by the Financial and Fiscal Commission (FFC, 1997).

The initial sharing mechanism developed by National Treasury proposed that allocations of equitable share transfers be made up of four separate transfer programs, with amounts allocated to each municipality being a function of four separate formulas. The proposed transfer programs included: (i) a municipal basic services (S) grant that was set equal to the cost of providing services to poor households in each municipality; (ii) a tax base equalization (T) grant designed to reduce fiscal disparities among sub-structures within each municipal areas; (iii) a municipal institution (I) grant to aid the costs of governance and administration of democratic local governments; and, (iv) a matching (M) grant designed to encourage provision of local public goods having significant and positive inter-jurisdictional spillover effects (Reschovsky, 2003). Since 1998, consolidation of the complex system of local government and reforms to the powers and functions of municipalities has also necessitated changes in the mechanism underpinning the allocation of transfers to municipalities. These changes have resulted in the current system of unconditional grant allocations having three distinct features (see Amusa *et al.* 2006). First, transfers received by the local sphere are derived mainly from nationally raised revenues and fall into two main categories: equitable share allocations and conditional grants. Equitable allocations are general purpose (or unconditional) grants that are intended to (i) reduce fiscal imbalances stemming from the asymmetric matching of revenue and expenditure functions; and (ii) enable sub-national governments provide basic services and perform any functions assigned to them. Conditional grants are utilized in addressing inter-jurisdictional spillovers, meet national redistribution objectives, and aid the implementation of specific national priorities and policies related to socio-economic services provided by sub-national governments.

Second, although equitable share allocations are provided from nationally raised revenues, the actual allocation and distribution of funds, that is, the horizontal division, is done through the local government equitable share (LES) formula developed by the Financial and Fiscal Commission (FFC) in conjunction with National Treasury and the Department of Provincial and Local Government (DPLG). In making allocations to municipalities, the LES formula takes into account four key factors: (a) the need to ensure that allocations support the capacity of municipalities in providing basic services and perform functions allocated to them; (b) fiscal capacity and fiscal efficiency of municipalities; (c) the developmental needs of municipalities; and (d) to the extent that information is available, the degree of poverty and backlogs in municipalities. Based on these principles, the structure of the present LES formula can be summarized as:

$$Grant = BS + D + I - R \pm C \tag{1}$$

where BS, D, I and R are the basic services, development, institutional support and revenue-raising capacity components respectively, while C denotes a stabilization factor.[4] Details of the formula are provided in Appendix A. It is observed from Equation (1) above that the key consideration of the LES formula is to make allocations based on an objective assessment of the needs and disabilities of local government authorities. The needs of municipalities relate to their expenditure functions of providing constitutionally mandated basic services as well as governance and administration, while their disabilities relate to the amount of revenues that can be generated by applying a standard set of rates to available revenue instruments.[5] With the formula substantially limiting the ability of individual municipalities to manipulate individual grant allocation, it is often argued that the use of a formula driven approach has produced a transfer system that is almost exclusively based on the objective assessment of local government's functional capacity.

Third, unconditional grant allocations form a significant share of intergovernmental transfers to the local sphere. Between the 2000/1 – 2007/08 fiscal years, about R124 billion representing 4.9 percent of the estimated R 2.5 trillion of nationally raised revenues shared by the three spheres of government has been transferred to the local government sphere. Of the R124 billion of total intergovernmental transfers, the shares of equitable share (unconditional) allocations and conditional grants have averaged 55 and 45 percent, respectively (see Figure 4). While unconditional allocations are disbursed using the LES formula, the bulk of conditional transfers have been channeled via the municipal infrastructure grant (MIG). Approved by the South African Cabinet in March 2003, the MIG is a consolidated grant mechanism intended to: (a) supplement municipal capital projects aimed at eradicating backlogs in basic municipal infrastructure especially where such infrastructure is crucial in supporting national government's objective of expanding delivery of socio-economic services to poor households, and (b) provide municipalities with a foundation to stimulate local economic development and job creation (National Treasury, 2007).

4 Methodology and Data Description

4.1 The Empirical Model

The basic empirical framework employed has its foundations in the median voter model developed in the article by Wyckoff (1988, 1991) and adapted in Heyndels and Smolders (1994). It begins by assuming that the expenditure function of government relies basically on the median voter demand model, and in this framework, demand for public goods is dependent on the median voter's income and the tax price of local public goods she demands. This is expressed as:

$$Q_s = P_m^{\beta} \times Y_m^{\delta} \tag{2}$$

where Q_s represents the demand for public services while $P_m$and $Y_m$denote the tax price of local goods and the median voter's income, respectively. The terms $\beta$and δrepresent the price and income elasticities of demand, respectively. In comparison to the median voter-model where the voter is assumed to be well informed about the true costs of public goods, a primary assumption of fiscal illusion models is that in the presence of intergovernmental transfers, the median voter is unaware of neither the actual tax burden of public goods nor the true nature of the local community's income.

[4] *Since the inception of the current sharing formula, the D component has been set to zero. The formula's implementing authority, the National Treasury, plans to keep this component inactive until a suitable factor or measure that adequately captures the development needs of local government is develop.*

[5] *It is important to note that the disparities in the functional capacity, size and income base of municipalities will result in the LES formula generating some form of equalization of municipalities capacity to provide services, but not equalization in the quantity and quality of services delivered.*

In this case, the price of the public good is a perceived price with the median voter's tax price of locally provided public goods denoted as P_m^p rather than P_m. Assuming that each publicly provided good (or service) has a unit costc_s, then local expenditure on public goods can be expressed as:

$$E = c_s \times Q_s \tag{3}$$

Both theoretical and practical evidence suggests that public goods and services are provided via public facilities. The argument is also advanced that the relationship between facilities and a publicly provided good depends on the extent to which that particular good is public in nature. In this sense, the relationship between public facilities and units of the public goods can be expressed as:

$$Q_f = n^{\alpha} \times Q_s \tag{4}$$

where Q_f stands for units of public facilities, n the population size (of a particular jurisdiction), and αrepresents the crowding out parameter. In the case of a pure public good the crowding out parameter equals zero while in the case of pure private goods, the measure is equal to unity (Heyndels and Smolders, 1994). As with the case of demand for public goods, if we assume that the unit cost of each public facility is equal to c_f, then total expenditure on public goods can be written as:

$$E = c_f x Q_f \tag{5}$$

On the basis of the specification of Q_f in Equation (4) above, Equation (5) can be rewritten as

$$E = c_f x n^a x Q_s \tag{6}$$

The median voter's tax price P_m^p is assumed to be dependent on the share of his taxes in local taxation. This tax share, expressed as a fraction of total tax revenues (T) raised in the jurisdiction (or local community) can be written as:

$$T_m = \frac{\gamma_m}{n} \times T \tag{7}$$

where T_m represents the median voter's tax share, and γ_m reflects the relative fiscal pressure for the median voter. Where the median voter's tax liability is equivalent to the average tax paid in the community/government jurisdiction then $\gamma_m$will be equal to 1. On the basis of this tax share, the median voter's unit tax price for locally provided public goods (and services) can be represented as:

$$P_m = T_m \times c_s \tag{8}$$

From Equations (2) and (5) it can be shown that $c_{\ s} = \frac{E}{Q_s}$ and $E = c_f \times n^{\alpha} \times Q_s$, respectively. Substituting these terms and expression in Equation (7) into Equation (8) we obtain:

$$\begin{aligned} P_m &= \frac{\gamma_m}{n} \times T \times \frac{c_f \times n^{\alpha} \times Q_s}{Q_s} \\ &= \gamma_m \times T \times c_f \times n^{(\alpha-1)} \end{aligned} \tag{9}$$

Equation (2) can thus be re-specified as:

$$Q_s = \left(\gamma_m \times T \times c_f \times n^{(\alpha-1)}\right)^{\beta} \times Y_m^{\delta} \tag{10}$$

Taking into account the specifications in Equations (2) – (10), total local expenditures on public goods as stated in Equation (3) can thus be re-specified as:

$$E = c_s \times \left(\gamma_m \times T \times c_f \times n^{(\alpha-1)}\right)^{\beta} \times Y_m^{\delta} \tag{11}$$

As not all the explanatory variables are directly relevant or easy to measure, a refinement of the model structure in equation (10) is necessitated. We follow the exposition given in Worthington and Dollery (1999), and specify an expenditure function for publicly provided goods as:

$$Q = f(Y, P, I_s) \tag{12}$$

where Q is the level of expenditure on publicly provided goods, Y is the total amount of fungible resources available for funding such expenditures, P denotes the relative tax-price of Q, and $I_s$captures institutional and demographic factors that impact on local government expenditure outcomes. Equation (12) thus forms the function to be estimated.

4.2 Data Description

This study utilizes expenditure and financial data covering the 2005/06 fiscal period and drawn from 237 category A and B municipalities in South Africa to test the flypaper effect hypothesis of fiscal illusion. The use of cross sectional data follows other major studies on the flypaper effect (see for example DiLorenzo, 1982; Winer, 1983; Marshall, 1991 as well as Heyndels and Smolders, 1994.), and more importantly, is imposed upon by the paucity of comprehensive and consistent time series data on the finances of municipalities in South Africa. The basic model estimated in this study (see Equation 12) consists of four main variables defined in Table 1 below.

The dependent variable, Q, is the level of per capita expenditures by the i-th municipality. As noted by Dollery and Worthington (1999), applying the level of expenditure is not the most appropriate measure of public good provision as it assumes that output is measured by the value of public inputs. However as a significant number of past empirical studies (see for example Nagamine, 1995; Lalvani, 2002 as well as Sagbas and Saruc, 2004) have demonstrated, the paucity of more suitable measures makes the level of local expenditure the most appropriate measure of public good provision. For municipalities constituting the local sphere in South Africa's intergovernmental system, total fungible resources Y can be divided into two distinct components: (a) own-source revenues mainly derived from surcharges on fees for basic services (electricity, water and refuse removal) provided by municipalities, and (b) intergovernmental grant transfers that consists of unconditional and conditional grant allocations. The variable $Y$is thus defined by the two components L and G. L is defined as per capita revenue derived from own-revenue sources available in the i-th municipality. A number of factors support the inclusion of per capita income as an explanatory variable. Using Wagner's Law, Henrekson and Lybeck (1988) note that "growth in income facilitates the relative expansion in (on public goods)". Furthermore, Marshall (1991) argues that based on the assumption that public goods may be defined as a normal good, then income serves as a useful estimation of "the willingness to pay for public goods".

The grant variable (G) that is utilized in this study is restricted to transfer allocations disbursed via the LES formula. Unlike conditional grants which emphasize spending on national priority programs and often have stringent accounting and planning conditions attached to their use, transfer allocations via the LES formula are unconditional. This gives municipalities some relative autonomy (and flexibility) in designing grant expenditure frameworks and altering spending to suit local priorities. In addition, a significant quantum of intergovernmental transfers (about 60 percent) made to the local government sphere in South Africa are in the form of unconditional grants funded via the LES formula. Thus, in the context of South Africa's local government sphere, we define the variable G to reflect the amount of per capita intergovernmental unconditional transfers received by i-th municipality through the LES formula. (see Appendix A for details on grant-sharing mechanism). The variable P is used to proxy the implicit tax price of own-revenue sources. It reflects the ability of municipalities to derive revenues from assigned tax bases and is measured as the assessed revenue need (or the revenue raising capacity) of the i-th municipality as calculated in the LES formula.[6]

[6] *In the South African case, efforts remain ongoing in establishing adequate measure(s) of revenue raising capacity.*

Finally, I_s is measured in terms of the assessed expenditure need of the i-th municipality and expressed in per capita terms. This variable denotes the ability of a municipality to meet the demands for publicly provided goods required by residents in that jurisdiction. To capture expenditure needs, we note that in accordance with the provisions of the 1996 Constitution, the core function of municipalities in South Africa relates to the provision of crucial socio-economic services including water, sanitation, roads, storm water drainage and electricity. Also, for municipalities to carry out their Constitutional mandate, there is a recognized need to build, enhance and sustain their institutional capacity. The measure of expenditure need utilized in this study is therefore based on figures provided in the LES allocation framework. These figures take into account the expenditure needs (with respect to the available resource envelope) required by municipalities to provide basic social services and fund the basic costs of administration and governance which are crucial to enhancing the institutional capacity of local governments.

5 Empirical Results

5.1 Model Estimation and Interpretation of Results

The explanatory variables in Equation (12) are by no means exhaustive. By quantifying public service provision in terms of expenditure, this vector would ideally be made up of a single direct measure that is able to capture two key factors: (i) citizens/taxpayers preferences for local public services, and (ii) exogenously imposed disability factors impacting on service provision (Dollery and Worthington, 1999). For instance, the preferences of citizens may relate to type of sanitation (ventilated pit latrines or waterborne sewer systems depending on if jurisdiction is rural or urban) or to the length and type of roads (gravel or tarred), while disability factors relate the topography, climate and technological constraints faced by the local authority. In this regard, a number of studies (see for example Wagner, 1976; Munley and Greene, 1978) have included rateable/taxable area and length of roads provided in the taxable areas as explanatory variables as direct measures quantifying expenditure on each local government function.

Expansive data on such direct measures are not readily available in South Africa.[7] Thus, using equation (11) and following the conventional approach applied in Courant *et al.* (1979) and Sagbas and Saruc (2004), the flypaper effect is examined within the context of a linear budget constraint. The application of a linear budget constraint is consistent with the South African situation where the LES disburses equitable share funds without the need for matching requirements on the part of municipalities. To estimate Equation (12), two versions – a linear form model and its logarithmic version are specified. These are expressed as:

$$Q_i = \alpha_0 + \alpha_1 L_i + \alpha_2 G_i + \alpha_3 P_i + \alpha_4 I_{si} + \varepsilon_i \tag{13}$$

where the subscript $i$denotes the $i-$th municipality. The logarithmic counterpart of Equation (13) can be written as:

$$Q_i = e^{\alpha_0} L_i^{\alpha_1} G_i^{\alpha_2} P_i^{\alpha_3} {I_s}_i^{\alpha_4} \tag{14}$$

Equation (13) can also be specified as:

$$\ell n Q_i = \alpha_0 + \alpha_1 \ell n L_i + \alpha_2 \ell n G_i + \alpha_3 \ell n P_i + \alpha_4 \ell n I_{si} + \varepsilon_i \tag{15}$$

At present, the LES formula uses a basic approach to proxy revenue raising capacity by utilizing the relationship between demonstrated revenue-raising capacity among municipalities that provide detailed financial information, and objective municipal information obtained from Statistics South Africa.

[7] *For example, while the Department of Transport is currently involved in classifying roads, there remains significant ambiguity on whether some roads are to be placed under the administration of district, provincial or local authorities.*

In estimating Equations (13) and (15), it is important that the examination of the flypaper effect should be conducted using the most appropriate estimation technique, where such a technique yields consistent and efficient estimators. As noted by Gujarati (1995), this implies taking cognizance of the simultaneity problem; where there is no simultaneity problem, then the ordinary least squares (OLS) estimation method will produce consistent and efficient estimators. However, where simultaneity is detected, then other methods such as the two-stage least squares (2SLS) and instrumental variables (IV) approaches will give estimators that consistent and efficient. On this basis, the first step in our analysis is to verify the exogeneity of the grant variable. This is done via the application of Hausman's specification test which uses the variables L, P, I_s and municipal population size as exogenous and instrumental variables. The use of the three variables as exogenous variables and instruments is premised the understanding that the LES formula allocates funding on the basis of three factors: (i) expenditure needs, (ii) fiscal capacity, and (iii) demographic characteristics of municipalities. In the first step of the test, the grant variable (G) is regressed on all exogenous variables and instruments, and the residuals retrieved. In the second step, we re-estimate a version of equation (14) that includes the residuals from the first regression as additional regressors (for details about the test see Gujarati, 1995 and Maddala, 1989). The results of the two step Hausman test are presented in Table 3 as:

According to the Hausman specification test, if OLS estimates are consistent, then the coefficient on the first stage residuals should not be significantly different from zero. From Table 3 above, the test indicates that the coefficient of the first stage residuals (*RES G)* is not statistically significant, thus allowing for the non-rejection of the null hypothesis (of consistent OLS estimates) and the conclusion that G is exogenously determined with respect to expenditure at the local government sphere. This finding is also consistent with the exposition on the local government grant process as outlined in section 3 of this paper. While the results presented in Table 3 are based on the results of regressing the variables in logarithmic form, similar results and conclusions are obtained when the variables are expressed in linear form. The finding that G is exogenous allows for the estimation of equations (13) and (15) using OLS. The results obtained are reported in Table 4 below.

Table 4 presents estimates obtained from both the linear and logarithmic regressions. To determine the appropriate functional form, Ramsey's regression specification error test (RESET) is used. The result shows that the model in logarithmic form is not misspecified and based on the estimated standard error of the regression (*SEE*), that the model specification in logarithmic form fits the data better than the linear specification. The analysis that follows is thus based on estimates obtained from the regression of the logarithmic specification in Equation (15). For convenient interpretation and comparison, the elasticities of the explanatory variables in Table 5 are evaluated at sample means and converted into marginal effects on local government expenditure. All the estimated coefficients on the independent variables are statistically significant at the 10 percent (or better) level although, the signs for P and I_s do not conform to *a priori* expectations. Turning our attention to two variables of interest – G and L, we note that evaluated at the means, the marginal effect of own-revenues on local government spending is estimated to be 0.89. This indicates that that a marginal 1 percent increase in collections from own revenue sources increases local government spending by 0.89 percent. On the other hand, the elasticity of expenditure at the local government sphere with respect to unconditional grants transfers is about 0.05, indicating that an extra 1 percent increase in LES allocations to municipalities increases local government expenditures by a mere 0.05 percent. The verification of the flypaper effect hypothesis requires the existence of a relatively larger response in local government expenditures (Q) to changes in unconditional grants (G) as against income generated from own revenue sources (L). However, the finding that $\delta Q/\delta G < \delta Q/\delta L$ (or $0.05 < 0.89$) yields no evidence in support of the flypaper effect in South Africa's local government institutional setting, a finding similar to those reported in developed country studies (see for example Becker, 1994 and Worthington and Dollery, 1999).

Most developed country studies examining flypaper effect of sub-national grants (see for example Heyndels and Smolders, 1994) have reported a negative coefficient for the tax price variable, P.

Following from the relationship between prices and demand, increases in sub-national government taxes that raise the costs of public goods would have the effect of dampening consumption of such goods. The consequence of any decrease in demand will be a reduction in spending undertaken by sub-national authorities. While the finding in this study of a positive coefficient for P contradicts *a priori* expectations, it perhaps captures the "accountability" obligation of local government authorities in South Africa. According to Grewal (1995) and Webb (2005), this obligation represents the political cost to government for imposing taxes. The accountability obligation also requires authorities to demonstrate that tax is necessary and the revenue collected through any increases to the tax obligations of citizens will in turn be utilized effectively in the provision of services. This argument becomes more plausible when one considers recent policies and legislation enacted to enhance the sustainability and management of funds at the local government sphere,[8] and the finding that the most influential factor (in terms of marginal effects) on local government expenditure appears to be incomes derived from own revenue sources.

At a first glance, the result indicating the non-existence of flypaper effect in South Africa, the small but statistically significant marginal impact of grant allocations on local government expenditure and perhaps more importantly, the negative correlation between I_s and per capita expenditures of local government might be considered implausible. However, a brief contextualization of the local government landscape could help provide some insights into this anomaly. The uneven state of municipalities' administrative and skilled capacity has been identified as perhaps the greatest risk to municipal performance and equitable service provision in South Africa's communities. In recent years, national government's plan of action on spurring economic growth and social development have continually emphasized the need to (i) strengthen skills and spending capacity in local government to achieve delivery targets, and (ii) ensuring that local governments function effectively and efficiently. The lack of skilled personnel, especially at middle and senior management level in many local governments has significantly constrained the capacity of municipalities in adequately drawing up integrated development plans crucial for the eradication of socio-economic infrastructure backlogs and the implementation of service delivery programs. For poorly capacitated municipalities, the potential consequences of the failure to fully adhere with stringent accounting and financial management frameworks (as outlined in the Municipal Finance Management Act [MFMA] of 2003) has led to some resistance on the part of municipal officials to undertake spending programs. The lack of institutional and administrative capacity has also limited the ability of many municipalities to collect and spend budgets, especially funds earmarked for capital expenditures.[9]

In order to support the expenditure needs of municipalities with regard to delivery of essential social services, total conditional and unconditional grant allocations to the local government sphere have increased from R2.1 billion in 1998 to approximately R40 billion by the 2007/08 financial year (National Treasury, 2007). Despite this, the results and outputs have been mixed; while enormous strides have been made in tackling poverty and providing basic services to South Africa's disadvantaged citizens, service delivery backlogs still exist in key areas, presenting a number of challenges to municipalities in fulfilling their service delivery mandate (National Treasury, 2005). While there has been a substantial increase in grant transfers, an audit of municipalities in 2004 revealed the extent of underspending by municipal authorities. Some 203 out of the 284 municipalities are unable to provide sanitation to an estimated 40 percent (about 5 million) of their residents, while an estimated 37 municipalities can not provide any form of free basic electricity. In addition, 36 percent of

[8] *Most notably the enactment of the Municipal Fiscal Powers and Functions Act (2007) is expected to bring about changes to the local government fiscal framework through the introduction of taxes and regulation of certain municipal surcharges.*

[9] *According to the 2006 local government review, realized expenditure for metropolitan municipalities grew by R2,5-billion between 2001 and 2005 (or by 43% a year over this period).Capital expenditure for local municipalities increased annually by 30% over the same period. However, these increases were off a very low base. For instance, the Nelson Mandela Bay Metro, which has one of the biggest municipal budgets at R3,6-billion, had only spent 4,9% of its capital budget at the end of September2005. Similarly, metropolitan authorities in Johannesburg and Cape Town had only spent 9,2% and 7.7% of their capital budgets, respectively.*

South Africa's population lacks access to piped water either in their dwelling or yard, and around 3.7 million citizens (or around 8 percent of the population) completely lack access to water (*Mail and Guardian,* 2006). Informed by the potential impact that poor administrative capacity and skill deficit problems could have on service delivery functions of local governments, the Department of Provincial and Local Government (DPLG) developed a support initiative program for local governments called "Project Consolidate". In brief, the initiative is basically a program of coordinated interventions aimed at assisting targeted municipalities in overcoming challenges of capacity building and addressing practical issues of service delivery, revenue collection, financial management & reporting and local governance.[10]

6 Concluding Remarks

In the context of the South African local government grant process, this paper attempted to empirically examine the concept of fiscal illusion using the flypaper effect hypothesis. Based on 2005/06 financial year data drawn from 237 municipalities, the results suggest that in comparison to unconditional grant transfers to municipalities, incomes derived from own revenue sources have higher (and positive) marginal effects on local government expenditures. Thus, evidence of intergovernmental grant transfers having a flypaper effect on municipal expenditures in South Africa can be refuted.

Two major policy implications emerge from the analysis of the empirical results. First, there is a need to improve the overall administrative, institutional and financial capacity of municipalities. Such improvements can have a positive impact on the efficiency of expenditure spending by municipalities in South Africa. In particular, policies aimed at enhancing the ability and innovation of municipalities in effectively spending their grant allocations can help bring about improvements in the implementation of service delivery initiatives as well as address the significant backlogs in socio-economic infrastructure. Second and perhaps more importantly, a high degree of attention need to be focused on the potential effects that current reform proposals will have on fiscal autonomy and revenue raising capacity of municipalities. At a macro-level, total local government revenues accounting for over 16 percent of all revenues generated by the three spheres of government and is equivalent to about 5 percent of South Africa's gross domestic product (GDP). Policy initiatives and changes to key legislation on the financing framework of municipalities has seen (i) the introduction of the Municipal Property Rates Act of July 2005 which ushered in a new and uniform property rating system for the local government sphere; (ii) the abolition of RSC levies with effect from July 2006 and as an interim measure, its replacement by a national grant pending the introduction of alternative tax instrument(s)[11]; and (iii) an ongoing process of restructuring the electricity distribution industry into six financially viable and independent regional electricity distributors (REDs). Through legislation, municipalities will be encouraged to participate in the six REDs with income derived through two possible streams – dividends from REDs profits or a municipal levy on electricity (where such levy conforms to the uniform national regulation and tariff settling framework).

The reforms outlined above have serious implications for predictability and adequacy of revenue flows, as well as for the fiscal autonomy of municipal authorities. With the abolishment of RSC levies, metropolitan and district authorities have expressed concerns that alternative tax instruments might fail to yield enough revenue to compensate for the loss of funds derived from RSC levies. In addition, questions have arisen as to whether in the interim period, the size of transitional grant t reflects revenues that could potentially have being raised from RSC levies. With a total of 173 municipalities licensed as electricity distributors and serving an estimated 52 percent of the 7 million

[10] *For greater understanding about Project Consolidate see documents listed on DPLG's website at www.dplg.gov.za.*

[11] *For details and review of alternative tax proposals see (a) National Treasury discussion document: Options for the Replacement of RSC and JSB Levies (available at www.treasury.gov.za); and (b) the Financial and Fiscal Commission's submission document: Comments on National Treasury's Proposals for the Replacement of RSC and JSB Levies (available at www.ffc.co.za).*

electricity consumers in South Africa, proposed reforms to the electricity industry could result in municipalities experiencing significant losses in their revenues, where such losses emanate from (i) the inability of licensed municipalities to derive revenues from surcharges levied on electricity sales; and (ii) reliance on dividend income that by nature is unpredictable as it depends on firm profitability and shareholder decisions on dividend declarations. he Also, the suggested uniform national regulation and tariff-setting structure envisaged for the REDs can be viewed as reducing the fiscal autonomy of municipalities. In the long-term, ambiguity and unpredictability of the impact of reform initiatives on revenue flows could adversely impact on the ability of municipal authorities to formulate proper planning and budgeting requirements, requirements that are crucial to enhancing the delivery of essential basic services. It is therefore imperative that decisions on reforms to existing revenue sources and introduction of new ones should (i) ensure that fiscal autonomy of municipalities is not compromised; (ii) be aligned with assignment of powers and functions to municipalities, and (iii) ensure that revenue flows are adequate enough to fund the expenditure functions of municipalities.

It is important that some caution be observed in interpreting the results and subsequent explanations. The finding of a negative relationship between unconditional grant allocations and expenditures at the local government sphere might be as a result of potential aggregation bias. While negative impact of increased grant allocation on service delivery expenditures may hold for poorly capacitated municipalities (especially in rural areas), the opposite could be the case for municipalities covering large urban centers and towns where higher levels of administrative and institutional capacity has contributed to sound fiscal practices and vastly improved service delivery outcomes.[12] However, in the absence of detailed, consistent and comparable data collected over some adequate time period, comprehensive analysis that would (a) take into account specific characteristics common to the different categories of municipalities, and (b) provide an alternative framework (such as fixed and random effects model or a general equilibrium framework) for modeling the decision variables of municipal authorities was outside the scope of this paper.

The shortcomings of this paper should therefore be noted and turned into areas for future research. The model used is a relatively simple framework for describing an aggregated determination of expenditure at the local sphere. Hence, it can be viewed as a simple expositional tool for a first attempt at analyzing the effects of grant transfers within the general context of fiscal illusion using a specific hypothesis. Future research aimed at examining further potential fiscal illusionary effects of grant transfers in South Africa would be enhanced by (i) availability of data detailing institutional constraints impacting on the spending and taxing decisions of municipalities; (ii) applying other underlying hypotheses underpinning the concept of fiscal illusion to South African data; and (iii) analyzing grant effects using relatively more sophisticated statistical methods that take into account a range of demographic and economic characteristics peculiar to different categories of municipalities in South Africa.

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[12] *An example might help illustrate this point. Using available statistics for the fiscal years 2001/02 – 2007/08, analysis indicates that total expenditure undertaken by metropolitan councils (or category A municipalities) were on average 16 times higher than all received subsidies and grant allocations For local municipalities (including district councils and category B authorities), total expenditure was on average only 7 times higher than all subsidies and grants received.*

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1 APPENDIX A: THE CURRENT LOCAL GOVERNMENT EQUITABLE SHARE

Each municipality i receives a per capita LES allocation of G_i, defined as:

$$G_i = ScG_i + CO_i \tag{1}$$

where ScG_idenotes scaled grant per capita, and CO_i is the correction factor. The scaled grant per capita is calculated as:

$$ScG_i = \alpha(BS_i + IS_i) - RRC_i \tag{2}$$

where BS and IS refer to the basic services and institutional support components, and RRC to revenue-raising capacity, and

$$BS_i = \Sigma \quad _j(poor_{serviced,ij} * S1_j + poor_{unserviced,ij} * S2_j) \tag{3}$$

where

- the subscripts j run over the four basic services, electricity, water, refuse collection, and sanitation,
- $poor_{serviced,ij}$is the number of poor households receiving service j in local government i,
- $poor_{unserviced,ij}$is the number of poor households not receiving service j in local government I,
- $S1_j$ is the annual service cost for those poor households receiving public service j and
- $S2_j$is the annual service cost for poor households not receiving public service j. [1] The monthly service costs used in the 2005/06 formula are listed in Table E.17 of Annexure E of National Treasury's *2005 Budget Review.*
- $IS_j = \beta + \gamma * pop_i + \delta * coun_i$, $pop_i$is the population of local government i and $coun_i$is the number of councilor seats in local government i.

For the 2005/06 LES allocation, the following parameter values are used:
β = R350,000; γ = R1; and δ = R36,000.

RRCi = θ * imputed revenue-raising capacity in i. For the 2005/06 fiscal year, θ was set at 5 percent.

$$\alpha \quad = scalefactor = (TotES + \Sigma_i RRC_i)/\Sigma_i(BS_i + IS_i) \tag{4}$$

where TotES is the total local government equitable share as determined by parliament. For the 2005/06 financial year it was set at R 9,343,365,000. For 2005/06 α = 1.681313553.

CO_i= a correction factor to prevent large changes in allocations. For each local government, a minimum guarantee amount (MIN_i) has been defined as the indicative amount for this year indicated in the previous Medium Term Expenditure Framework (MTEF). Local governments for which the scaled grant (ScG_i) is less than MIN_i, receive a **positive correction** or "topup" equal to MIN_i – ScG_i. Local governments whose scaled grant is greater than $MIN_i$are considered to have a "surplus" and receive a **negative correction** equal to that local government's *share* of the total amount of all "top-ups". Municipality *i*'s share is thus equal to its surplus (ScG_i – MIN_i) divided to the sum of all surpluses.

[1] *The monthly service costs used in the 2005/06 formula are listed in table E.17 of National Treasury's 2005 Budget Review*

Figure 1: The Concept of Fiscal Illusion

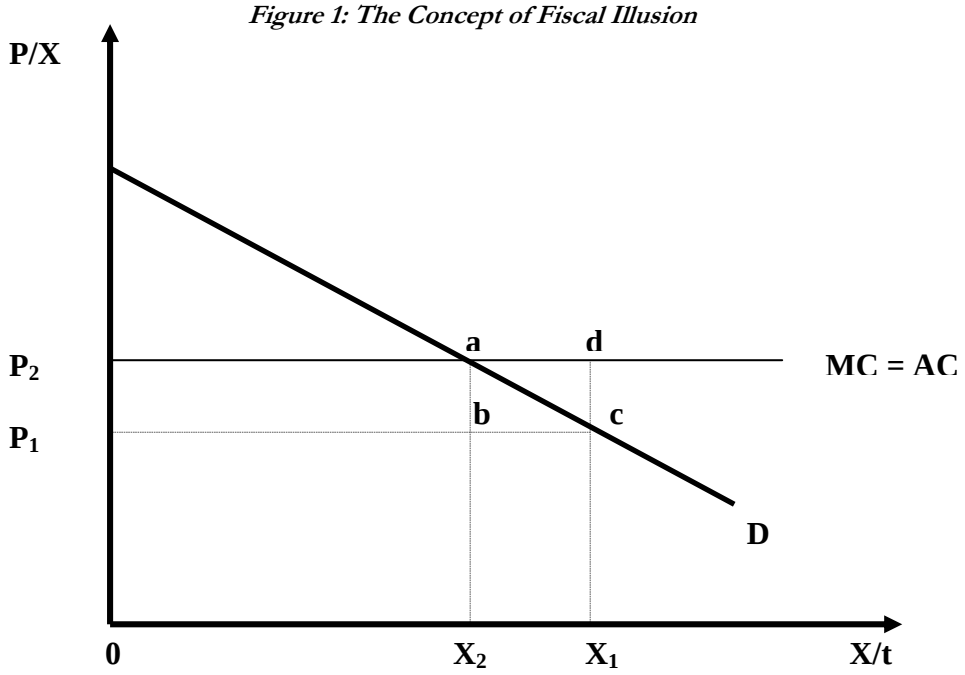


Figure 2: The Concept of the Flypaper Effect Based on the Median Voter Model

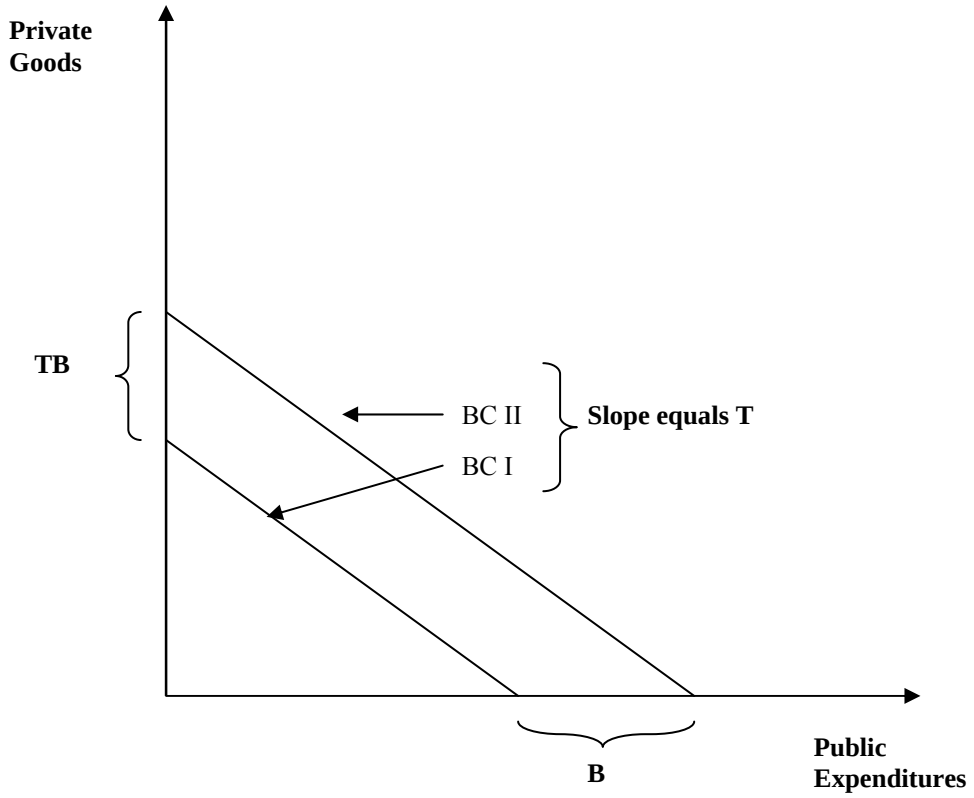
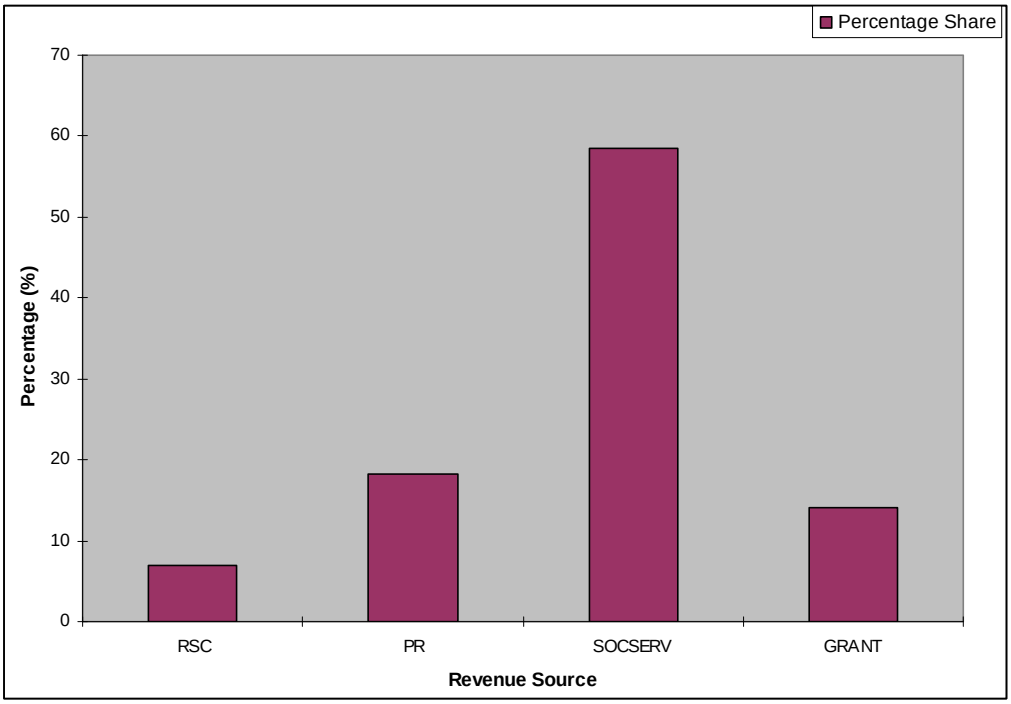
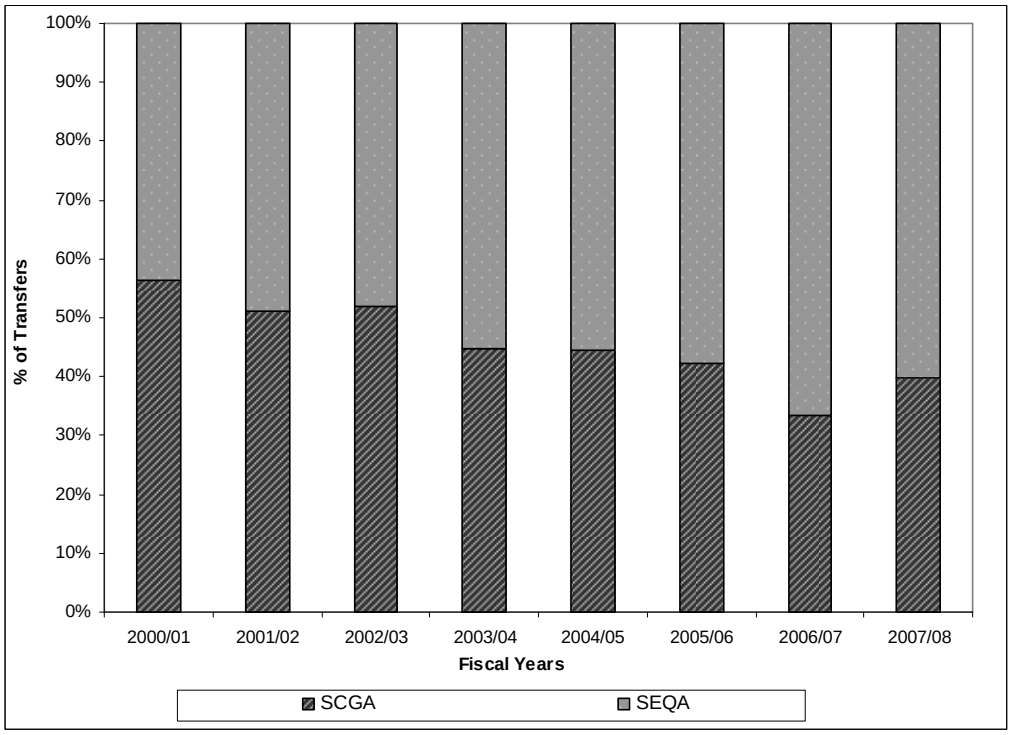


Figure 3: Composition of Local Government Revenue – 2005/06 Fiscal Year



Source: National Treasury Budget Review (2005). Legend: RSC – Regional Services Council Levy; PR- property rates; SOCSERV-social services (water, electricity, sanitation and waste removal); GRANT – grant and subsidies.

Figure 4: Composition of Transfers of Nationally Raised Revenues to Local Government Sphere - 2000/01 – 2007/08



Source: National Treasury Budget Review (2005). Legend: SCGA: share of conditional grant allocations in total intergovernmental grant transfers to the local government sphere; SEQA: share of equitable grant allocations in total intergovernmental grant transfers to the local government sphere.

Table 1: *Variables Used in the Study*

VARIABLE	DEFINITION
Q	Total expenditure of municipal authorities (per capita)
Y	Total revenues generated by municipalities (per capita; where revenues include intergovernmental transfers [G] and own-source income [L])
P	Fiscal or revenue raising capacity of municipal authorities (in per capita terms)
I_S	Expenditure needs (per capita)

Table 2: *Summary Statistics of Variables Used in Study*

	MEAN	STD. DEVIATION	MINIMUM	MAXIMUM
Q	993.05	797.99	61.18	3661.08
L	1052.69	830.74	87.04	4181.94
G	230.12	81.10	77.47	467.50
P	6.94	9.53	0.14	73.61
I_S	170.18	57.69	71.83	338.71

Table 3: *Hausman Test for Exogeneity of Grant Variable*

Regressors	Estimate	T-Ratio
Intercept	.50987	2.012 (.045)
L	.88062	25.452 (.000)
G	1.1542	1.908 (.058)
P	.16512	5.581 (.000)
I_s	-1.225	-1.881 (.061)
RES G	-.8170	-1.223 (.223)
R^2	.96425	
R-Bar Squared	.96347	
DW-statistic	2.0512	

Note: *RES G* denotes residuals derived from first regression of the grant variable against chosen exogenous and instrumental variables.

Table 4: *Ordinary Least Squares Regression Estimates*

Dependent Variable Q

Regression Estimates of the Linear Model

Regressors	Coefficient Estimates	Calculated $\partial Q/\partial X$
Intercept	-14.34 (26.94)	
L	0.917 (.0164)****	0.92
G	1648.3 (1466.5)	169.78
P	1651.8 (1466.5)	13.83
I_s	-2296.0 (2042.7)	-183.58

Tests and Diagnostics

Adj. R^2	.9746
SEE	127.26
DW-statistic	2.0177
Serial Correlation (χ^1)	.0378 (.846)
Functional Form (χ^1)	37.507 (.000)
Normality (χ^2)	4292.7 (.000)
Heteroscedasticity(χ^1)	37.574 (.000)

Regression Estimates of the Logarithmic Model

Regressors	Coefficient Estimates	Calculated $\partial Q/\partial X$
Intercept	-0.492 (.2534)**	
L	0.8785 (.0346)****	0.8853
G	0.4844 (.2571)*	0.0499
P	0.1439 (.02395)***	0.0012
I_s	-0.5052 (.2789)*	-0.0404

Tests and Diagnostics

Adj. R^2	0.9634
SEE	0.1858
DW-statistic	2.0260
Serial Correlation (χ^1)	0.0413 (.839)
Functional Form (χ^1)	0.6082 (.435)
Normality (χ^2)	1455.1 (.000)
Heteroscedasticity(χ^1)	9.6898 (.002)

Note: For coefficient estimates, asterisks ***, **, and * denote statistical significance at the 99, 95 and 90% levels, respectively. For the coefficient estimates of the linear and logarithmic models, figures in parentheses are corresponding standard errors. The following diagnostic tests are reported. *SEE* refers to the standard error of the regression while Adj. R^2 expresses the ratio of explained sum of squares to total sum of squares (adjusted for degrees of freedom). Both are indicators of "goodness of fit" requiring that *SEE* be as small as possible and Adj. R^2 be as close to unity as possible. The DW *statistic* denotes the Durbin-Watson tests for serial correlation; as a rule of thumb, if the statistic is found to be around 2, it can be assumed that there is no first-order serial correlation. *Serial correlation* refers to the Lagrange multiplier statistic that specifically tests whether the disturbances are autocorrelated up to order 1. *Functional form* shows the result of Ramsey's RESET tests using the square of fitted values. *Normality* shows the results of the testing of skewness and kurtosis of the residuals while *Heteroscedasticity* captures the regression of squared residuals on squared fitted values to establish whether the disturbances have constant variance. A "chi-square" (χ^2) statistic is shown for each of the diagnostics, and the comparison with critical values determining whether the regression passes the tests. The order is given in the notation p of χp. At the 95% significance level, the critical values are 3.84 for p=2 and 5.99 for p =2. Figures in parentheses next to the individual chi-square statistic shows within what percentage of the distribution the individual statistic is found (De Vita *et al*, 2006).