**Transfers and marginal cost of public funding:**

**Empirical evidence for local governments in Brazil**

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**Abstract**

This paper documents empirical evidence on price-effect caused by lump-sum transfers using unconditional and conditional transfers for local governments in Brazil between 2006 to 2010. Dahlby (2011) demonstrates theoretically that lump-sum transfers can reduce the cost of public goods provision (price-effect), in addition to the traditional income effect. Our constirbutions are threefold. First we calculate the MCF of the local tax imposed on the supply of services (ISS) for Brazilian municipalities, Next we control for potential simultaneity between unconditional transfers and local tax revenue in a two-stage least square approach using instrumental variables (IV-2SLS); and third we estimate the effects off tax rate changes on tax base. Our price-effect estimation for ISS tax suggests that a R$ 1 increase in unconditional transfers reduces the local price effect (MCF) around R$ 0.12.

**Keywords:** Price effect, income effect, transfers, taxes, and fiscal federalism.

JEL Codes: H20, H70, R50.

AREA: Applied Microeconomics

1. **Introduction**

Dahlby (2011), following Hamilton (1986), provides a model in which local governments are financed by distortive taxes. That allows lump-sum intergovernmental transfers to have both an income effect, which is widely reported in the literature, and a price effect. The mechanism that such price-effect works is via a decrease in the marginal cost of public fund (MCF), after receiving those transfers, because tax rate can be lowered to maintain the same level of public goods provision.

The main objective of the paper is to estimate the price-effect in lump-sum transfers using data from 5,260 Brazilian municipalities between 2006 and 2010 (five years sample). In this article we (i) calculate the MCF of the local tax imposed on the supply of services (ISS) for Brazilian municipalities; (ii) control for potential simultaneity between unconditional transfers and local tax revenue in a two-stage least square approach using instrumental variables (IV-2SLS); and (iii) estimate the effects off tax rate changes on tax base and (iv) estimate the effect of transfers on calulcated MCF.

The literature concerning fiscal federalism has provided considerable attention to the intergovernmental transfer systems, which are important tools for correcting horizontal fiscal imbalances caused by the spatial concentration of taxation sources and the dispersion of the need to provide public goods. However a companion effect observed in empirical papers due to those intergovernmental transfers is associated with larger propensity to public spending compared to a correspondent income increase, a phenomenon entitled flypaper effect (Gramlich, 1977, Fisher, 1982, Wycoff, 1991 and Inman, 2008).

Lump-sum transfers seem to stimulate more the local public spending than increases in local income, reinforcing the expression “*money sticks where it hits*”, i.e., the money received by the public sector remains in that sector. Hines e Thaler (1995) expressed that as an anomaly and there seems to have many theoretical explanations for that[[1]](#footnote-1). More related to our work, Hamilton (1986) claims that flypaper effect might be due to the distortion caused taxes and the difference between income and transfers effect captured by empirical evidence might be due to the deadweight loss of taxation.

This issue is further explored in Dahlby (2011) that argues that these transfers can reduce the cost of taxation for local governments through changes in the MCF. In particular, he shows that lump-sum transfers allow the recipient government to reduce its tax rate, which in turn, reduces the MCF in order to keep the same level of public service. Whether local MCFs are larger than national counterpart, transfers could result in welfare enhancing policy.

The author still provides a numerical example using Brazilian data (Dahlby, 2011, pp 309) in order to offer a potential explanation for the flypaper effect. In addition, the Brazilian system of intergovernmental transfers is broad; totaling 12% of gross domestic product (GDP) and it corresponds about 70% of local revenue streams in 2008. That motivates our choice to use Brazilian data in order to provide empirical evidence of the price-effect of transfers[[2]](#footnote-2).

The MCF measures the marginal loss to society caused by a tax increase. The imposition of a (non lump-sum) tax distorts the allocation of resources in an economy, such as the labor supply, consumption, and investment decisions. The MCF aims to capture that distortion resulting from tax-response. According to Browning (1987) tax-response can produce very disperse estimates (1% increase of a particular tax can trigger a marginal loss in well-being between 9.9% and 300%).[[3]](#footnote-3) Our results suggests that a R$ 1 increase in unconditional transfers reduces the local price effect (MCF) around R$ 0.12.

The paper is organized in four sections. Section 2 presents a small modification in Dahlby (2011) in order to focus on comparing the price effect of transfers to the price effect of income, describes how the data are constructed and empirically implemented. Section 3 describes the results, and Section 4 presents the conclusions.

1. **Theoretical background**

**2.1 Marginal Cost od Public Finance (MCF) Model**

In this section, we explore Dahlby´s (2011) model of MCF in order to develop an empirical approach to obtain the price effect of unconditional transfers. First, suppose that all local governments have a homogeneous, fixed population that may be represented by a single agent. The local government is in charge of selecting a tax rate *t* that affects the tax base, *B*, and the amount of public services provided, *g*, at a constant production cost per capita *c*. The local government receives a lump-sum transfer *T*. Therefore, the government’s budget constraint is *tB + T =* cg.

The utility of the representative resident is *U = u (x, B) + w (g)*, where *x* is the private consumption of goods (price equal to 1), *u(⋅)* is a quasi-concave function, *w`> 0*, and *w``< 0*. In our case, the tax base (*B*) depends only on the local tax, *t* *.* Thus, we can write  . Dahlby derives MCF as (his equation (1) on page 307):

 , (1)

where  is the elasticity of the tax base with respect to the tax rate (i.e., R is total IPTU tax revenue). It is expected that the elasticity inherent in the tax base, , is negative because a higher tax could lead to greater tax avoidance, which reduces the tax base. Equation (1) indicates that the MCF is a measurement that reflects the cost of a tax rate increase in terms of tax revenue. For example, if the tax base is not affected by the increase in taxes (i.e., = 0), then an increase in the tax rate reflects the same measurement in tax revenue. However, it is expected that the tax base shrinks with a tax increase (as we expect that < 0), which leads to MCF greater than1.[[4]](#footnote-4)

The local government maximizes the well-being of the residents, supplying public goods up to the point at which the marginal benefit equals the effective price (*P*), e.g., *P  MCF.c,* where *c* is the constant cost of production of the public good per capita. If this government receives a lump-sum transfer, *T* from the central government, the quantity of public goods provided could increase and the tax rate might decrease. The MCF decreases because tax rate is lowerhave decreased, which in turn, allows for a reduction in the effective price of providing the public good. Deriving the effective price in relation to *T,* keeping *g* constant () the price effect relative to an increase in transfers may be expressed as

 (2)

where E = (d/ d)(/), which is the change in the elasticity of the tax base in relation to the tax rate. If the local government is financed with lump-sum taxes, we have MCF = 1. If E = -1, and there would be no price effect for lump-sum transfers. Supposing that MCF > 1 and -1< E, a lump-sum transfer has a greater price effect than that of the lump-sum transfer ratio over the local tax revenue, as well as that of the local MCF.

To find the expression that reflects the relationship between the two forms of variation in the price-effect (transfers and income), we first have to completely differentiate the budget constraint, while keeping *g* constant, then one has to derive *P* with respect to *Y* and to *t*. After some algebra, one can find the price effect of income:

 (3)

Equation (3) represents the change in the price of the public good resulting from the variation in income[[5]](#footnote-5). Comparing the price-effects of income (equation (3)) to its correspondent of the transfers (equation (2))

 (4)

Equation (4) shows that if, one has . The intergovernmental transfers have a greater ability compared income to decrease the effective price of the public good.

2.2 Local tax revenues and unconditional transfers in Brazil

Unconditional transfers are the main source of fiscal revenue resource for local governments in Brazil. Table 1 shows that meanwhile intergovernmental transfers from the Municipalities Participation Fund (FPM, in Portuguese) accounts for on average 60% of total revenue resources, local tax corresponds to only 20% of fiscal resources on average for municipal jurisdictions. Regarding local tax, the tax imposed on the supply of services (ISS) is the main source of revenues. The ISS median revenue corresponds to about 80% of total tax revenue. There are other two (main) sources of intergovernmental transfers: Federal Support for Education Fund (FUNDEB, in Portuguese), and Federal Support for Health System (SUS, in Portuguese). These transfers together account for around 10% of municipalities revenue resources on average. However, as opposed to FPM transfers, they are denominated matching grant transfers as they produce different allocative effects because they impose a counterpart spending for local governments.



An important characteristic of FPM transfers is that it follows exogenous criteria based on populations cutoffs. Excluding the 27 State capitals, municipalities which follows different distributive rules (based on both population and income inverse rules), municipalities with less than 142 thousands inhabitants receive FPM different amounts based only on populational ranges. Those ranges are on Table 2. What makes this interesting for our methodological approach is that it allow us to explore this legal framework in a instrumental variable approach[[6]](#footnote-6) as discussed in further detail in the next section.



*3 Methodology*

3.1 *Empirical strategy*

There are several methodologies to calculate the MCF, as shown by Dahlby (2008a). The method we follow consists of estimating the sensitivity of the tax base in relation to the tax rate as in equation (1). Therefore we need local tax rate and the sensitivity of the tax base.[[7]](#footnote-7) The only parameter one has to estimate is the sensivity of the tax base to tax rates and we approach that as follows

(5)

where corresponds to the (log) of the tax base corresponding to the municipality *i* at time *t*,  corresponds to the tax rate, and  is a vector of control variables and *d* are time dummies. Therefore, the coefficient of the tax rate in this regression is the elasticity of the tax base in relation to the tax rate ().

The next step is to identify whether the increase in transfers and income acts to reduce the municipal MCF according to the equation below:

(6)

where corresponds to MCF of municipality *i* at time *t*, is the transfers received by the municipalities, *Y* is income, and X includes the same vector of control variables used in equation (5). Regarding our empirical approach, since we have constructed MCF from equation (5) we should calculate standard errors using bootstrapping technique.

According to public finance literature, we should expect that municipalities decisions over local tax rate (tax revenue) and intergovernamentals transfers revenues are simultaneously determined which might bias the estiation of equation (6). For this reason, Ordinary Least Squares (OLS) regression would produce inconsistent and biased coefficient estimates. In order to obtain valid estimates of MCF we explore the fact that the FPM transfers follow populationonal ranges and build binary variables based on FPM populational cutoffs. Finally, a fixed effect model should account for heterogeneity across municipalities.

We should note that this formulation of the MCF relies on the following hypotheses: (i) changes in ISS rates produce very small effect over IPTU tax revenues, (ii) each municipality’s ISS tax burden is supported only by the its own; (iii) there is no interaction between the tax bases; (iv) the elasticity of the tax base may be the same in all of the local governments.

*3.2 Data*

We collect data for 5,260 (from a total of 5,565) municipalities in Brazil from year 2006 to 2010 (five years period). The data concerning municipal revenues and expenditures are annual and are extracted from fiscal balances and reports from Brazilian Treasury (Secretaria do Tesouro Nacional – STN). Group data over the period of analysis is available over population, tax revenue (over ISS and IPTU) and Gross Domestic Product (GDP) by sector of activity excluding taxes. We also collect data on number of service firms (which compound ISS tax base), and their number of employes and firms´s payroll total costs. This last group of information is available in the Brazilian Bureau of Geography and Statistics (IBGE) reports on Services Firms Census. All monetary variables are deflated to year 2010 in Brazilian currency (R$ Reais) values.

One of the main difficulties to estimate policies related to marginal cost of public funding is the identification of the appropriate tax base for local tax. In our case, there is not systematic data available for ISS tax rates across municipalities. Thus, we follow Hayashi and Boadway (2001), and instead of using tax rates, we build an effective average tax rate (AETR). According to equation (5) we build two different AETR’s: [AETR1] the ratio between ISS tax revenues and services valued added GDP (last one excludes government participation) and [AETR2] the ratio between ISS tax revenues and annual payroll of firms services under the municipalities in the analysis. The main advantages to use a AETR approach is that we can use a longer time period of analyses (and explore fixed effects); and that tax revenue reflects both the effect of tax rate changes on number of firms and firms revenues. Both measures should capture tax base changes.

As discussed in Section 2 and following equations (2) and (3), we use all variables in natural logarithm, since we are interested in the elasticity effect of tax rate change and tax base .Table 3 brings the descriptive analysis of the variables used.



**4. Results**

**4.1. Tax base elasticity**

We first estimate the tax base elasticity as described in equation (5). We report three different measures of the tax base as dependent variables. We consider the number of employees in the services sector, the number of firms in the service sector and percentage of the firm in the service sector with less than 5 employees as a percentage of total firms in that sector. The first two variables are in natural logarithnm.

The dependent variables number of employees and number of firms are expected to have a negative correlation with the ISS tax base ( < 0). Results on Table 4 show that a ISS tax rate increase reduces number of employees on those firms as well as the number of firms. In the regressions using AETR1 (ratio of ISS revenue and value added GDP from services) as tax rate, an 1% change in ISS average tax rate reduces in 1,5% firms workforce. Similarly, an 1% change in ISS average tax rate reduces in 1,3% the number of service firms. Both coeffcients estimates are significant at the 1% significance level. The effect on number of firms is smaller but still large. It reflects the fact that most service firms around municipalities in Brazil are very small with less than five employess. In fact, although not significant, the coefficient for the tax rate elasticity over percentage of firms with few employess is positive: the tax rate rise reduces the size of the firms. Meanwhile, income appears to move in the opposite direction, increasing the tax base, as predicted in our model .

Results are similar when we use AETR2 (ratio of ISS revenue and firms from service sector total payroll costs). The coeffcients are larger and still significant at the 1% level. We drop from the controls personal income since it is correlated to the AETR2 denominator (payroll costs). Since our tax base elasticity results seems to produce consistent (and expected) results we estimate equation (6) in the next sub-section.



**4.2. MCF’s Price-effect**

In this section we estimate the unconditional transfers price effect on the MCF using our model described in Section 2. We expect that FPM transfers present a negative effect on the MCF since this should reduce the price of public provision as in Dahlby (2011). We use baseline model the estimate elasticity based on number of employers for AETR1 and number of firms for AETR2. Table 5 brings the results panel fixed effect model with bootstrapping standard errors (FE - bs) and with two stage least squares instrumental variable with and without (2SLS-IV) bootstrapping standard errors (2SLS-IV bs).



In all models the FPM coefficient is negatively associated to MCF (as expected) and, when we estimate using AETR1, significant (at least at the 10% significance level). The significance level drops when we use bootstrapping in the FE model (FE –bs) and in the 2SLS model. As the MCF reflects the marginal loss in the economy due to the marginal increase in tax rate, the negative coefficients show that each Brazilian real increase in unconditional transfers is associated with a reduction in the cost of taxing about 0.1%.

Regarding AETR1, we should note that meanwhile the 2SLS-IV approach estimates that 1% increase in the FPM transfers causes a 1.2% reduction in the MCF, in the FE model the coefficient is under estimated. This occurs probably because by instrumenting FPM we seem to eliminate the main source of bias that could be the political capacity to obtain federal funds on the part of the municipality.This unobserved variable which seems to be related negatively with the amount of resource that would be entitled to receive. Moreover, this political ability to achieve political resources is probably positively related to MCF that would lead to underestimation of price-effect.

**4.3. Results – Robustness**

One main concern in the IV model is that we do not face neither the problem of weak instruments (due the use of multiple instruments) nor the instruments are related to other unobserved characteristics of the municipalities. In this section we bring first stages results for our populational binary variables. Table 6 brings the coefficents for the first stage regression and it shows that all binary variables are significant. They present negative signal which reflects the fact that the smaller the population the higher the FPM per capita received. Similarly for elasticity, ie., smaller the population the higher the estimated elasticity of price-effect.

To test whether those cutoffs could be associated to other chacacterisitics we do the same regression with GDP as the dependent variable. At this time, from the 18 binary variables only two are significant at the 10% significance level. Thus, we believe that our IV approach is solid (does not suffer from selection bias or weak instruments).

Next we split our sample to municipalities with less than 52 thousand inhabitants and less than 250 thousand. We note that the coefficient is similar and significant in both samples. We run this regression in FE approach and obtain similar results for FPM coeffcients. We sustain that our results (based on populational cutoffs) describe better small and medium municipalities.





Finally, we include additional independent variables which could affect our FPM coefficient as SUS and FUNDEB transfers and IPTU revenues. We note that our IV results are maintained.



**5. Conclusion**

This paper investigates the effect of unconditional transfers, conditional transfers, and income on the MCF using Brazilian local governments data. In particular, we attempt to show how these three different methods of increasing income change the effective price of public goods.

First based on the model proposed in Dahlby (2011), we design a theoretical extension that shows the difference between the price effect resulting from transfers and from income.

Using data from Brazilian national Treasury for the years 2006 to 2010 we construct average effective ISS local taxes and unconditional (FPM - the recipient government has complete freedom to decide on the allocation of the resources) transfers to estimate such difference

We first estimate the effect of tax rates on a tax basis in order to construct MCF estimations. That estimated elasticity is used to identify the MCF, representing the price of the public good for each municipality. Next, we estimate the effect of transfers and income on the constructed MCF, correcting the standard error of these estimations. We estimate that for R$ 1 increase in unconditional transfers reduces the local price effect (MCF) around R$ 0.12. The magnitude of this effects is not different across any of the models. We also estimate a positive effect of income on tax base.

We are not particularly interested in the flypaper effect although consequences of results above are straightforward. If lump-sum transfers encompasses price-effect (substitution effect) and if we estimate the income effect properly the eventual flypaper effect could be caused by the differences between the two.

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1. : See for instance Courant et al. (1979), Oates (1979); Winer (1983), Logan (1986), Romer and Rosenthal (1979), Wickoff (1988), Dougan and Kenyon (1988), Chemick (1979), Becker (1996), Bailey and Connoly (1998), Worthington and Dollery (1999). For a detailed survey, see Inman (2008) Dollery and Worthington (1996), Bailey and Connolly (1998), and Gamkhar and Shah (2007). For Brazil, Siqueira et al. (2010) found (0.002 to 2.2) using 27 groups of goods. Lanzer and Porto Júnior (2011) estimated the MCF for the whole Brazilian tax system in between 1.167 and 1.173. See also Blanco (2006) and Blanco and Carvalho (2000). [↑](#footnote-ref-1)
2. Also, Mattos, Rocha and Arvate (2011) use Brazilian data to provide evidence that transfers reduce tax collection efficiency which follows from Dahlby’s model. [↑](#footnote-ref-2)
3. Recently, Auriol and Walters (2011) estimated a mean MCF of 1.21 for 38 African countries using a general equilibrium model, finding that taxes on production factors have higher MCFs than do taxes on imports and domestic goods. [↑](#footnote-ref-3)
4. Furthermore, the municipalities are assumed to be in the increasing segment of the Laffer Curve, i.e., It can be shown that MCF is increasing with respect to tax rate under some conditions. [↑](#footnote-ref-4)
5. For example, if we consider c=1, E=0 (i.e., there is no variation in the elasticity of the tax base), B=100, and t=1.01 (IPTU rate of 1%), one has a price effect resulting from the transfers that is equal to -0.0001 and a price effect of income equal to 0.00001, less (in magnitude) because the price effect of income is multiplied by the variation in the tax base in relation to income. [↑](#footnote-ref-5)
6. We should note that this fact has being previously explored by and Brollo and Nancinni, 2011 in a regression discontinuity design (RDD). [↑](#footnote-ref-6)
7. There is a large literature on the determination of the response of the tax base in relation to a tax variation. Gruber and Saez (2002) perform this estimation for the USA, and Mintz and Smart (2004) do so for Canada. Dahlby (2008a) provides a good review of the topic and also shows results in the context of fiscal federalism. [↑](#footnote-ref-7)