Fiscal federalism in Brazil: an empirical investigation*

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RESUMO

O artigo trata de dois aspectos do federalismo fiscal no Brasil. Primeiro, considera-se a mensuração da centralização da receita tributária durante o período 1979-2000 tomando como referência "unidades compostas" (que combinam receitas estaduais e municipais em cada Estado) e a União. Para esse propósito calculam-se índices de entropia de Theil, que foram decompostos em termos de componentes inter e intra-regiões. A análise aplicada para dados antes e depois das transferências indicou que a centralização apresentou uma certa redução ao longo do tempo que é largamente associada com a redução da concentração entre regiões, no caso dos dados pós-transferências. Segundo, investigam-se econometricamente os determinantes da centralização tributária no nível estadual ao longo do período 1985-99. Um conjunto de variáveis relacionadas a ganhos de descentralização, tais como área, população, PIB real *per capita* e outras variáveis de controle foram consideradas. Os resultados obtidos com técnicas para dados em painel não foram fortes como em um estudo previamente realizado para os E.U.A. e, assim, argumentos relacionados essencialmente a aspectos de escala parecem fornecer uma explicação incompleta para a centralização tributária para países em desenvolvimento como o Brasil.

Palavras-chave: federalismo fiscal, centralização tributária, Brasil.

ABSTRACT

The paper addresses two aspects of fiscal federalism in Brazil. First, one considers the measurement of tax revenue centralization during the period 1979-2000 taking as reference "composite units" of analysis (that combine state and municipal revenues in each state) and the federal government. For that purpose one calculates Theil´s entropy indexes that were decomposed in terms of inter-regions and intra-regions components. The analysis, as applied before and after transfers, indicated that centralization presents a certain reduction over time that is largely associated with the reduction of concentration among regions for the case of post-transfer data. Second, the determinants of tax centralization at state level were econometrically investigated for the 1985-99 period. A set of variables related to gains of decentralization such as population, area, degree of urbanization, real per capita GDP and other control variables were considered. The results obtained from panel data techniques were not strong as a previous study developed for the U.S.A., and therefore arguments that essentially relate to scale aspects appear to provide an incomplete explanation for tax centralization in developing countries like Brazil.

Key words: fiscal federalism, tax centralization, Brazil.

JEL classification: H77.

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1 Introduction

In many countries the public sector is organized in terms of multiple levels of government. The fiscal problems emerging from the co-existence of different levels of government define what is known as fiscal federalism (see e.g. Araújo, 1976 and Oates, 1972, 1999). In the Brazilian case, in particular, the discussion on the conflicts between different levels of government (Union, states and municipalities) is recurring. In a schematic form one can highlight the following elements that characterize a federative fiscal system:

(a) A political structure organized in the form of a federation;

(b) A structure of functions´ distribution across different government levels;

(c) A structure of resource sharing (i.e. revenues across those levels);

(d) A system of relationships among the aforementioned components.

The economic literature has emphasized the second aspect listed above. In fact, textbook treatments of fiscal federalism such as Oates (1972), Boadway (1979) and Musgrave & Musgrave (1980), among others, allow to observe such emphasis. The main factors explaining the co-existence of different levels of government refer to: (i) local benefits of publicly provided goods; (ii) local character of externalities; (iii) mobility of economic agents; (iv) scale economies.

The first aspect is clear. The second refers to the extent of the externality and will determine the adequate government level for its internalization. The third aspect indicates, at some level, the necessity of federal taxes given spatial mobility of agents. Finally, the last factor pertains gains associated with centralized tax structures.

The last element of the tax system, relating to the relationship between the revenue and expenses dimensions, has received less attention in the literature. An exception appears in terms of the displacement effect discussed by Peacock & Wiseman (1961).

A possible interpretation for the theoretical work on fiscal federalism is suggested by Carvalho (1983) in terms of the path: "functions → jurisdictions → resources" The empirical works consider the factual manifestation of the two extremes of the suggested

path. It is still lacking, however, proper theoretical developments on the revenue sharing issue and the revenue-expenses compatibility.[1]

In the Brazilian case, the scarcity of studies on fiscal federalism is evident even at the level of descriptive studies, with the possible exception of Shah (1991) at a more aggregate level, More generic studies exist, as for example Longo & Mueller (1982), Rezende (1995, 1998) and Mora & Varsano (2001) among others, but investigations of a more quantitative nature are mostly absent. The existence of conflicts between distinct levels of government is usually addressed by means of aggregate share figures on the three levels of government. Unfortunately, this aggregate description of fiscal centralization obscures the relative sizes of the states.

In that sense, the present paper aims at quantifying the tax revenue centralization in Brazil before and after transfers and additionally undertake an econometric exploratory analysis on the determinants of state level centralization. In fact, the debate on fiscal decentralization has received increasing attention and efforts of actual implementation in Latin America (see Giambiagi & Além, 1999, chap. 7 and Mello, 2000). Even though, more general aspects like the relationship between fiscal decentralization and economic growth appears to be weak as indicated by Woller & Phillips (1998), there is an even more basic gap in the literature that concerns measurement of centralization itself. The paper is organized as follows. The second section highlights some stylized facts on tax centralization and also measures tax revenue centralization, which is decomposed in terms of inter-regions and intra-regions components. Finally, it discusses the related methodological aspects. The third section considers an exploratory econometric analysis on the determinants of tax centralization, indicates the main explanatory factors and presents the empirical results. Finally, the fourth section brings some final comments and suggestions for future research.

2 Measurement of tax revenue centralization

2.1 Fiscal centralization: some stylized facts

Prior to the actual measurement of fiscal centralization in the Brazilian case, it is useful to pinpoint some eventual stylized facts that might emerge from case studies that were undertaken for both developed and developing countries. More specifically, are there general stylized facts related to the pattern of fiscal centralization/decentralization that do not depend on the degree

1 The existent revenue sharing theory in part addresses the first issue. See Boadway (1979).

of regional heterogeneities, political and legal structures and other particular structural aspects? An initial tentative answer can be provided by cross-country and country studies on fiscal decentralization as provided by Patsouratis, (1990), Bird & Vaillancourt (1998), Panizza (1999), Stein (1999) and Fisman & Gatti (2002). These studies consider different countries (mostly from Latin America and Europe, but also some from Africa and Asia). The following regularities appear to emerge:

a) In both developing and developed countries exist, as a rule, a trend towards fiscal decentralization;

b) Fiscal decentralization is proceeding very slowly in developing countries;

c) The majority of decentralization reforms are motivated primarily by political considerations rather than efficiency improvement reasons;

d) Intergovernmental adjustments in terms of responsibilities assignment and revenue sharing schemes are much more complex than textbook schemes and any changes are dependent on institutional changes in tax and budgeting administration;

e) Fiscal decentralization (in expenditure) is strongly associated with lower corruption;

f) The role of political factors is not clearcut.

This cursory characterization indicates that fiscal federalism is largely dependent on institutional and political factors that are likely to be country-specific. Nevertheless, possible gains from decentralization are generally recognized though the actual implementation of the process is usually slow. In the Brazilian case, for example, the tax reform of 1967 indicated a centralized system but initially organized a revenue sharing scheme. The tax reform of 1988 attempted at decentralizing the system by increasing sharing of federal revenues with states and municipalities. An important challenge in the Brazilian case, however, is a proper assignment of functions of the different levels of governments following the tax decentralization initiatives in terms of stronger revenue sharing schemes (see e.g. Rezende, 1995 and Mora & Varsano, 2001).

2.2 Data construction

The necessary data on revenues and transfers are dispersed in different publications (mainly from the Finance Ministry). Some examples include Finanças do Brasil, Revista de Finanças

Públicas, Execução Orçamentária dos Estados e Municípios da Capital. More recently, the Banco Nacional de Desenvolvimento Econômico e Social (BNDES) has been providing tax data in the context of its data bank ("Banco Federativo") but that source only includes the last few years. In order to account for divisions and mergers of states, we consider in the present analysis only comparable units and also considered composite units in the sense that for a given state one considers not only the revenues accruing from state taxes but also municipal taxes from the localities within that state. The currently available data allows to focus on the period 1979-2000. A detailed description of the data sources appear in the appendix.[2]

It is important also to highlight the unit of analysis considered the centralization measurement exercise. We consider the aggregation of tax revenues generated from state and local taxes within each state that are considered in terms of a "composite" unit of analysis. The present study emphasize the sharing of fiscal resources across states (and territories for part of the sample period) and the federal government.

Finally, care was exercised with respect to the creation of new state units over time. In those cases, we opted for the aggregation of divided units in order to insure comparability over time. This kind of procedure was adopted for Goiás and Tocantins for example.[3]

2.3 Methodology

Efforts to quantify tax centralization may still be labeled as incipient. The most detailed study appears to be Srivastava & Aggarwal (1979) that studied the case of India. The authors considered the Hirschman-Herfindahl index to measure tax revenue centralization and decompose it according to the pre and post transfers configurations. Carvalho (1983) considers an application of such methodology to the Brazilian case. These studies are important motivators for the present analysis especially in what concerns comparisons before and after transfers but substantially departs from those studies by considering a regional perspective. For that purpose it

2 In addition to the constitutional transfers, voluntary transfers started to gain importance by the end of the 90s. Data on that type of transfer only became available in 1997, and those represented approximately 25% of the constitutional transfers. The present study focus on the latter category. It is worth mentioning important political aspects that may determine the evolutions of that kind of transfer. Kraemer (1997) studied related political aspects in the context of fiscal systems in Argentina, Brazil and México.

3 Reliable data for the Federal District (Distrito Federal) was not available for the more recent years, so we opted to exclude that unit from the empirical analysis for the whole sample period.

is necessary to consider a concentration measure that possesses convenient decomposition properties for regional analysis. In this sense, we make use of the entropy index proposed by Theil (1967). Next we briefly describe that index.

Consider the prior probability for a given event A as given by p. If afterwards a message confirms the occurrence of such event, the emerging surprise degree will evolve in opposite direction of p. The informational content of a given message (henceforth h(p)) is inversely related with p. Among the possible decreasing functions, the author chose the logarithmic function as indicated next, due to the additivity property.

$$h(p) = \ln (1/p) \qquad (1)$$

One can generalize the previous reasoning to the case of several events A_1,..., A_n with probabilities p_1, ..., p_n. Those events add to 1, since one of the events will occur. If the event A_1 occurs the informational content will be $h(p_1) = - \ln p_1$ as already explained. This reasoning can be generalized for n events and one can conceive an expected information indicator as follows:

$$ET = \sum_{i=1}^{n} p_i h(p_i) = \sum_{i=1}^{n} p_i \ln (1/p_i) \qquad (2)$$

It is possible to interpret ET as an inverse measure of concentration, whose range is situated between 0 e ln n.[4] The adaptation of such index in the context of tax centralization is straightforward if one considers as units of study the different, states, territories and the federal government. We will consider therefore entropy indexes for tax revenues (before and after the transfers). The index emphasizes the contrast between states (in terms of the aggregation of state and local revenues for each state) and the federal government (isolated in terms of a single entity).

Finally, it is worth mentioning the convenient decomposition property of the entropy index. Theil shows the validity of the following decomposition scheme for ET, that is adapted here for the particular context of revenue centralization in period t);

4 In order to obtain a better grasp of the magnitude one can express the entropy index relative to the amplitude of variation ln(n). See Resende (1994) for a discussion.

$$ET_t = \sum_{g=1}^{6} r_{gt} \ln (1/r_{gt}) + \sum_{g=1}^{6} r_{gt} \, ET_{gt} \qquad (3)$$

where $r_{gt} = \sum_{i \in S_g} r_{it}$;

r_{it} is the ratio between tax revenue of unit i and the overall revenue total;

S_g is the region composed by the states indexed by $i \in S_g$;

$ET_{gt} = \sum_i \in S_g \; (r_{it}/r_{gt}) \ln (r_{gt}/r_{it})$.

The upper bound of the sum indicates that we are considering 5 macro-regions and a sixth element referring to the federal level of government. The right-hand side terms of the previous expression respectively refer to inter-regional and intra-regional entropy. These terms respectively indicate to which extent centralization is due to inequalities across regions or within regions.

2.4 Empirical results

In this section we present the results concerning Theil´s entropy indexes and its decompositions before and after transfers. The results appear in Tables 1 and 2 together with the companion Graphs 1 and 2. It is worth reminding the reader that the growth (decrease) of the entropy index indicates a reduction (growth) in the revenue concentration.

Tables 1 and 2 indicate that transfers actually reduce the centralization as measured by index both in terms of the total and inter-regions entropy. One can also notice some decrease of centralization that is consistent with the 1988 decentralization movement.[5] Moreover, the stronger similarity of the observed patterns between total and inter-regions entropy components in Figures 1 and 2 indicates that the inter-regions concentration appears to somewhat dominate the behavior of total entropy when we consider the post-transfer evolution of tax centralization for more recent years. When one considers tax centralization before transfers no

5 Constitutional transfers from the federal government to state and municipalities were increased in the context of the 1988 tax reform (see Varsano, 1997).

dominant behavior is apparent. In that sense the moderate reduction of tax centralization appears to be associated in part with the reduction of inequality across regions, more than the inequality within the different regions when one considers the post-transfer evolution of tax centralization.[6]

Table 1
Entropy Index and Decompositions - 1979/2000
Before Constitutional Transfers

Year	Inter Regional	Intra Regional	Total Entropy
1979	1.11890	0.48150	1.60050
1980	1.09280	0.43590	1.52880
1981	1.10560	0.44170	1.54740
1982	1.12410	0.45860	1.58270
1983	1.13040	0.44670	1.57710
1984	1.15775	0.45833	1.61609
1985	1.14499	0.44944	1.59443
1986	1.24738	0.50683	1.75421
1987	1.17355	0.47365	1.64720
1988	1.10735	0.50109	1.60844
1989	1.24780	0.52827	1.77607
1990	1.26863	0.55536	1.82398
1991	1.30048	0.58982	1.89029
1992	1.23159	0.54026	1.77185
1993	1.23008	0.52618	1.75705
1994	1.26111	0.55421	1.81533
1995	1.29623	0.60085	1.89448
1996	1.37201	0.71331	2.08531
1997	1.30207	0.61852	1.92059
1998	1.35959	0.64583	2.00542
1999	1.25951	0.61606	1.87557
2000	1.34707	0.63620	1.98327

6 If one considers the mean value of the entropy index (before and after the transfers) the adjusted figures (as a proportion of the amplitude of variation) are given by 0.55 and 0.69 respectively, and allows to have a better notion of the magnitudes of revenue centralization.

Table 2
Entropy Index and Decompositions - 1979/2000
After Constitutional Transfers

Year	Inter Regional	Intra Regional	Total Entropy
1979	1.26590	0.57380	1.83970
1980	1.21480	0.53750	1.75440
1981	1.22950	0.54450	1.77400
1982	1.17860	0.50550	1.68410
1983	1.30780	0.60460	1.91240
1984	1.15798	0.45852	1.61650
1985	1.37640	0.66551	2.04191
1986	1.38420	0.65676	2.04096
1987	1.31600	0.60957	1.92556
1988	1.23663	0.61613	1.85276
1989	1.42051	0.72321	2.14372
1990	1.49848	0.84763	2.34610
1991	1.50445	0.87999	2.38444
1992	1.45781	0.81240	2.27022
1993	1.52680	0.88226	2.40906
1994	1.49559	0.85356	2.34915
1995	1.50746	0.93171	2.43916
1996	1.49969	0.98335	2.48305
1997	1.53131	0.94211	2.47343
1998	1.58813	1.06004	2.64818
1999	1.49199	0.99550	2.48750
2000	1.56971	1.02388	2.59359

Figure 1
Entropy Indexes and Decompositions (Before Transfers)-1979/2000

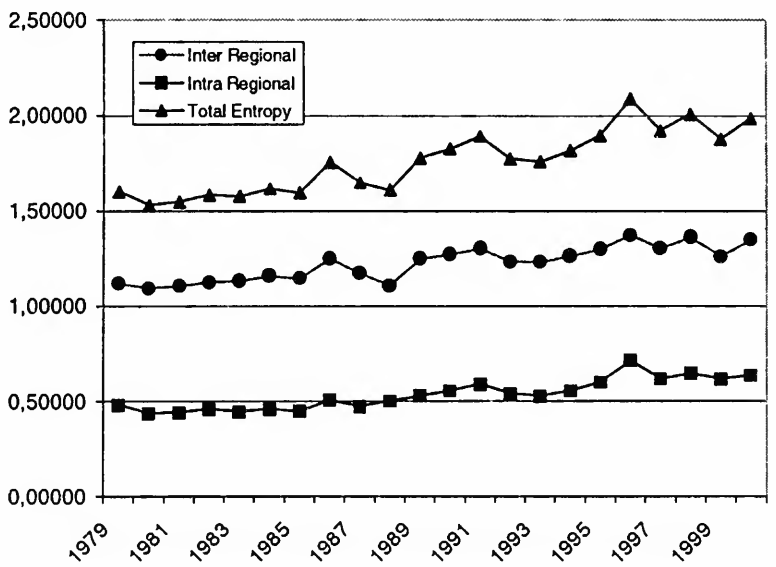
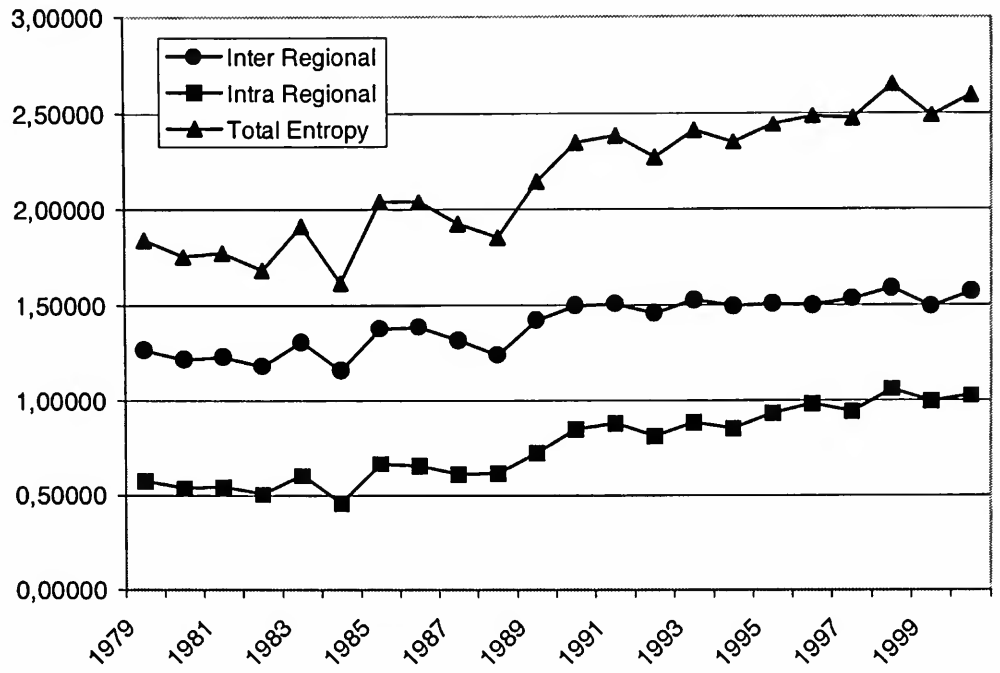


Figure 2
Entropy Indexes and Decompositions (After Transfers)-1979/2000



Despite a certain variability one can definitely observe a moderate reduction in centralization over time. The previous tables present a detailed measurement of centralization in Brazil that contrasts with previously emotional discussions on the topic and indicates that the changes in centralization have not been dramatic.

3 State level centralization: an econometric analysis

3.1 Theoretical motivation

The econometric investigation of fiscal federalism is incipient, the works from Wallis & Oates (1988) and Panizza (1999) are exceptions. Both empirical works consider reduced form econometric estimation. Nevertheless the study of the latter author theoretically motivates comparative static results for the suggested explanatory variables and therefore it will be instructive to briefly describe the elements of the underlying theoretical model. In particular, an important motivation is provided by the so-called decentralization theorem whose central message is that the optimality of local provision of public goods depends on the heterogeneity of consumer tastes for the public goods (see Oates, 1972) that will play a role in the theoretical development considered next.

Panizza (1999) considers a simplified framework with two levels of government and extends the model proposed by Alesina & Spalaore (1997). The model considers a linear country with area S, population N, and divided into J jurisdictions (all assumed to be exogenous). A representative citizen is characterized by a distance-sensitive utility function:[7]

$$U_i = g^{1-\alpha(\theta l_{im}+(1-\theta)l_{ij})} c_i^{\beta} \tag{4}$$

where g denotes the *per capita* amount of government expenditure (referring to both central and local governments), l_{im} represents i´s distance from the center of her country, l_{ij} the distance from the center of the jurisdiction and θ the level of centralization (the share of the public good that is provided by the central government) and c denotes the *per capita* consumption of the private good. Moreover, $\alpha \in [0,1]$ captures the difference in tastes across individuals, where $\alpha = 0$ refers to the case of a very homogeneous country, whereas $\alpha = 1$ refers to the case of a country characterized by a population with diversified tastes. The exponent $\alpha(\theta\, l_{im} + (1-\theta)l_{ij})$ may be interpreted as the distance between individual i´s preferred type of government and the actual type of government in equilibrium. The problem of the consumer is to maximize the utility function given by expression (4) subject to the budget constraint $y = c + g$, where y denotes the income, and the prices of the two goods are normalized to 1. The resulting demand functions for the two goods would be as follows:

$$g_i = \frac{\delta_i y}{\delta_i + \beta} \qquad c_i = \frac{\beta y}{\delta_i + \beta} \qquad where\ \delta_i = 1 - \alpha(\theta l_{im} + (1-\theta)l_{ij}) \tag{5}$$

The another block of the model refers to the decision problem of the government. The central government is assumed to choose the centralization θ so as to maximize the following utility function:

$$V_{gov} = \phi U^{med} + (1-\phi)\theta g \tag{6}$$

where $\phi \in (0,1)$ represents the level of democracy, with the salient polar cases of dictatorship ($\phi = 0$) and perfectly democratic country ($\phi = 1$) and U^{med} denotes the utility of the national median voter. The model is sequential and the time line establishes that first the government

7 This functional form for the utlity function generates the implication that the closer the individual´s preferences are to the actual government the higher is the ratio between public and private goods that the individual will demand. A simple Cobb-Douglas formulation, however, would generate the implausible implication that all individuals demand the same mix of public and private goods.

decides the degree of centralization and conditional on that choice the consumers vote on the amount of public good, and then on the type of the public good. The model is solved in a backward form. For our purpose, it is important only to list the main implications accruing from that kind of theoretical setup. Some salient implications are the negative correlation of centralization with respect to the heterogeneity in the demand for public goods, the level of democracy, income *per capita* and the size of the country. The author undertakes an empirical investigation of these hypotheses in terms of reduced form econometric estimations for both revenue and expenditures centralization equations. The empirical results appeared to be somewhat sensitive to outliers. Nevertheless, some regularities can be identified in the cross-country investigation of fiscal centralization. In particular, land area, GDP *per capita* and democracy exerted the expected negative effect on centralization. It should be pointed out, however, that tastes differentiation as approximated by ethnic fractionalization did not display a strong robust effect.[8] The centralization measure emphasized the relative behavior of central and local governments. From a theoretical perspective, It would be desirable to explicitly consider, in addition to the extensions suggested by the author, a theoretical model that encompasses three levels of governments. From an empirical point of view, it appears that tastes heterogeneity is likely to be difficult to approximate. In fact, ethnic fractionalization does not necessarily have a close association with the referred heterogeneity and would require data that are difficult to obtain. Finally, the aforementioned paper explores the cross-country data variation, but if one is interested in studying the Brazilian case with state level data a more promising approach is to assess the state-local relationship as no data variation would emerge from a uniform federal fiscal system. Next, we undertake an econometric investigation along those lines by closely following the reduced-form estimation advanced by Wallis & Oates (1988).

The first part of the paper had focused on the measurement of tax revenue centralization in Brazil. The relative behavior of revenues (before and after the transfers) among the different state units and the federal government was the central issue. In the present section we deal with a different aspect of fiscal federalism, namely the study of the determinants of tax centralization at state level. Econometric studies of this kind are scarce in the literature. An exception is given by Wallis & Oates (1988) who studied the phenomenon of tax centralization at state level in the U.S. (both in the revenue and expenditures dimensions). The present section, broadly inspired in that study, investigates the Brazilian case. Centralization will be considered in terms of the proportion of state revenues and the sum of state and municipal revenues. The arguments associated with decentralization gains one can point out three groups of variables:

8 The data set comprised very distinct developed and developing countries.

(a) Conditions relating to the state's territorial extension, population size and its geographical distribution;

(b) The level of state income and wealth;

(c) The degree of preference heterogeneity for public provision and its geographic distribution across the population;

The relationship of these class of variables with possible gains arising from decentralization will be discussed in the context of the empirical model presented next.

3.2 Econometric procedures

This section considers an unbalanced panel of states, since two states were federal territories in the initial years of the sample period. Empirical models for panel data are especially useful to capture unobserved heterogeneities (see Baltagi, 1995, for a comprehensive exposition). The simplest model with fixed effects would be given as:

$$CENT_{it} = \alpha_i + \underset{(-)}{\beta_1} AREA_{it} + \underset{(-)}{\beta_2} POP_{it} + \underset{(-)}{\beta_3} URB_{it} + \underset{(+)}{\beta_4} INC_{it} + \underset{(-)}{\beta_5} TREF + u_{it} \qquad (7)$$

where u_{it} denotes the stochastic error and the signs in parentheses denote the expected signs for the coefficients of the respective variables.

A second influential class of models consider random effects. Except for the fact that the first class of models is demanding in terms of degrees of freedom, there is no consensus on the relative superiority of each approach (see Mundlak, 1978). It is possible, however, to test the random effects models against the fixed effects formulation. One can conceive a test along the lines of the specification test developed by Hausman (1978). The application of the test favored the fixed effects formulation as we shall see in a later section.

3.3 Data and empirical results

The variables can be described as follows:

- CENT: for each state one calculates the proportion of revenues accruing from state taxes

relative to the sum of state and municipal taxes in that federation unit;

- AREA (10^3 km^2): such data will, of course, only present variability in the cross-section dimension and were obtained from the "Anuário Estatístico do IBGE";

- POP: state resident population, obtained from the "Anuário Estatístico do IBGE";[9]

- URB: degree of urbanization measured by the percentage of state population residing in urban areas obtained from the "Anuário Estatístico do IBGE";[10]

- INC: proxy variable for the state wealth. We made use of real *per capita* GDP at state level deflated by the general price index (IGP-DI, 1997=100). The referred data was obtained from IBGE;

- TREF: dummy variable referring to the 1988 tax reform, assuming value of 1 since that year and 0 for the previous years.

The expected sign for variable AREA reflects the importance of scale factors in the provision of public goods. Such factor may not be totally explored in a more decentralized configuration in terms of many small localities.

In the case of variable POP, it is possible to motivate the negative sign since there can be important scale economies associated with the state population size, especially when the public provided good possesses an important non-rivalry component. In small localities scale advantages may not be properly exploited.

Taking as reference variable URB it is important to emphasize not only the absolute population size but that also the distribution of that population may be relevant. The provision of certain goods involve indivisible processes that make a minimum concentration of population in a locality as desirable. In this sense, one can justify an inverse relationship between fiscal centralization and urbanization.

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9 Most of the data for the 1985-99 can in fact be obtained from the IBGE site. For years between the censuses most of the annual predicted figures were obtained from IBGE. For the urbanization variable, in particular, a uniform growth rate was assumed between 1996 and 2000 where there was a gap in the urban population prediction reports by IBGE.

10 In a few cases there were data gaps for this variable and one considered average past growth rates to extrapolate future evolution.

The variable INC approximates the level of wealth in each state (in terms of a variable reflecting the activity level of the economy). In general terms, Brown & Oates (1987) point out the restricted capacity of local government to redistribute income given the mobility of agents and therefore one can expect (ceteris paribus) a positive relationship between centralization and the level of wealth.

Finally, one expects that the sign of the dummy variable TREF should be negative.

It is worth mentioning that the expected sign for the AREA variable is the same suggest by Panizza (1999). Similarly, if we interpret URB as in part reflecting heterogeneity of preferences towards publicly provided goods, the predicted sign is also the same mentioned on that paper. A major difference, however, relates to the sign of the INC variable, as the predicted sign in Panizza's work is negative.

Wallis & Oates (1998) considered an analogous model to the one considered here (except for the dummy TREF and the inclusion of dummy variables to capture heterogeneity on the preference for public goods provision).[11] The model considered by those authors for both revenues and expenses corroborated the previous arguments. In the present application tax revenue data is considered for the period 1985-99. It is worth mentioning that the previous arguments apply in the context of revenues. In fact, a redefinition of function between a state and municipalities (as often occurs in the areas of education and public health) ends to reflect on the relative taxation patterns and therefore on the relative revenue behavior of the different government units.

The Brazilian case, substantially differs from the American case. Aggregate data already indicated a much higher centralization if compared to the U.S.[12]

11 The authors considered dummy variables for race that would not be reasonable in the Brazilian case. The general argument would be that states with higher heterogeneity would logically demand more a decentralized fiscal system.

12 In the Brazilian case centralization appears to be substantially higher than in the U.S., since the minimum observed value was 61.60 % (close to the aggregate indicator mentioned in Wallis & Oates, whereas the mean value in Brazil was 92,02 %.

Table 3
Revenue Centralization at State Level – Estimates From Panel Data (1985-1999)

Variable	Model with random effects		Model with fixed effects	
	coefficient	t estatistic	coefficient	t estatistic
AREA	0.225E-07	1.675	0.155E-06	0.193E-14
POP	0.309E-09	0.343	-0.701E-08	-0.933
URB	-0.149	-2.916	-0.239	-3.159
INC	0.320E-05	0.882	0.916E-05	1.012
TREF	-0.012	-1.004	0.726E-02	0.523
Constant	0.995	37.501		
Hausman Test: H_0: random effects vs. H_1: fixed effects				
χ^2 (5) = 9.859 (p-value = 0.0793)				

Table 3 presents the results of the econometric estimation. Hausman's test favors the adoption of the random effects formulation. The results are not strong. The coefficients of variables POP, INC and URB display the expected signs but only URB has the corresponding t statistic as significant. This result is not totally surprising as the decentralization effects of the 1998 tax reform are often disputed especially in terms of revenue centralization before transfers. The exclusion of such dummy variable in both formulations imply in qualitatively similar results.

The evidence indicates that demographic and geographic factors (often being related to scale aspects) do not appear to provide sufficient explanation for tax centralization at state level in the Brazilian case. It is true that certain factors determining the state profile may be defined at the federal level, but the previous arguments on some state and municipal reconfigurations (that are not dependent on federal laws) would be consistent with the previous arguments. In the Brazilian case, in contrast with the American case, we observe that solely the population appears to have the expected effect. Fiscal centralization in developing economies like Brazil appear to be determined by other factors of difficult detection and possibly involving political aspects.

4 Final comments

The present paper aimed at filling part of the gap of the literature on fiscal federalism for developing countries by considering two types of quantitative analyses. First, we considered the measurement of tax revenue centralization emphasizing the revenue "dispute" across differ-

ent regional units. The analysis centered around Theil´s entropy index indicated a moderate reduction in centralization over time. Moreover, it was partially associated with the reduction of revenue concentration across regions when one considers post-transfers data.

O second essay considered the determinants of tax centralization at state level by considering demographic, geographic and economic variables that would portray the benefits related to decentralization. The empirical results were weak if compared to a previous similar study for the U.S. and indicate that explanatory factors that are largely associated with scale aspects do not provide a comprehensive explanation for tax centralization in Brazil. Valuable extensions of the present paper include the expansion of the sample period and the consideration of political control variables. In particular, it would be interesting to consider state-level concentration indexes that indicate the weight of different localities in the state deputy house. Unfortunately the necessary data is not likely to be readily available.

Another line of research considers alternative econometric modeling to explain fiscal centralization such as in Panizza (1999) who undertakes an analysis with two levels of government. It would be worthwhile to extend the underlying theoretical framework to a structure with three levels of government.

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Appendix
Data Sources (Ministry of Finance, unless otherwise stated)

1979 - 1988	Tax Revenues
States	Finanças do Brasil
Municipalities	Finanças do Brasil
	Transfers from the Federal Government
States	Revista de Finanças Públicas
Municipalities	Revista de Finanças Públicas
1989 - 1992	**Tax Revenues**
States	Execução Orçamentária dos Estados e Municípios das Capitais 1986 – 1995
Municipalities	Municípios das Capitais - Execução Orçamentária dos Estados e Municípios das Capitais 1986 – 1995 Municípios – Finanças do Brasil Receita e Despesa dos Municípios do Brasil
	Transfers from the Federal Government
States	Execução Orçamentária dos Estados e Municípios das Capitais 1986 – 1995
Municipalities	Municípios das Capitais Execução Orçamentária dos Estados e Municípios das Capitais 1986 – 1995 Municípios – Finanças do Brasil Receita e Despesa dos Municípios do Brasil
1993	**Tax Revenues**
States	Execução Orçamentária dos Estados e Municípios das Capitais 1986 – 1995
Municipalities	Municípios – Finanças do Brasil Receita e Despesa dos Municípios do Brasil
	Transfers from the Federal Government
States	Execução Orçamentária dos Estados e Municípios das Capitais 1986 – 1995
Municipalities	Municípios - Finanças do Brasil Receita e Despesa dos Municípios do Brasil. Data in current monetary units. Inclui os dados dos municípios das capitais
1994 - 1996	**Tax Revenues**
States	Termômetro da Descentralização – Banco Federativo BNDES
Municipalities	Municípios – Finanças do Brasil Receita e Despesa dos Municípios do Brasil
	Transfers from the Federal Government
States	Termômetro da Descentralização – Site Banco Federativo BNDES
Municipalities	Municípios - Finanças do Brasil Receita e Despesa dos Municípios do Brasil
1997 - 2000	**Tax Revenues**
States	Execução Orçamentária dos Estados – STN – Ministry of Finance
Municipalities	Finanças do Brasil - Receita e Despesa dos Municípios STN – Ministry of Finance
	Transfers from the Federal Government
States	Execução Orçamentária dos Estados – Site: STN – Ministry of Finance
Municípalities	Finanças do Brasil - Receita e Despesa dos Municípios – STN – Ministry of Finance