

**International Studies Program
Working Paper 09-13 (updated)
April 2009**

Decentralization Measures Revisited

**Jorge Martinez-Vazquez
Andrey Timofeev**



**International Studies Program
Working Paper 09-13 (updated)**

Decentralization Measures Revisited

**Jorge Martinez-Vazquez
Andrey Timofeev**

April 2010

International Studies Program
Andrew Young School of Policy Studies
Georgia State University
Atlanta, Georgia 30303
United States of America

Phone: (404) 651-1144
Fax: (404) 651-4449
Email: ispaysps@gsu.edu
Internet: <http://isp-aysps.gsu.edu>

Copyright 2006, the Andrew Young School of Policy Studies, Georgia State University. No part of the material protected by this copyright notice may be reproduced or utilized in any form or by any means without prior written permission from the copyright owner.

International Studies Program Andrew Young School of Policy Studies

The Andrew Young School of Policy Studies was established at Georgia State University with the objective of promoting excellence in the design, implementation, and evaluation of public policy. In addition to two academic departments (economics and public administration), the Andrew Young School houses seven leading research centers and policy programs, including the International Studies Program.

The mission of the International Studies Program is to provide academic and professional training, applied research, and technical assistance in support of sound public policy and sustainable economic growth in developing and transitional economies.

The International Studies Program at the Andrew Young School of Policy Studies is recognized worldwide for its efforts in support of economic and public policy reforms through technical assistance and training around the world. This reputation has been built serving a diverse client base, including the World Bank, the U.S. Agency for International Development (USAID), the United Nations Development Programme (UNDP), finance ministries, government organizations, legislative bodies and private sector institutions.

The success of the International Studies Program reflects the breadth and depth of the in-house technical expertise that the International Studies Program can draw upon. The Andrew Young School's faculty are leading experts in economics and public policy and have authored books, published in major academic and technical journals, and have extensive experience in designing and implementing technical assistance and training programs. Andrew Young School faculty have been active in policy reform in over 40 countries around the world. Our technical assistance strategy is not to merely provide technical prescriptions for policy reform, but to engage in a collaborative effort with the host government and donor agency to identify and analyze the issues at hand, arrive at policy solutions and implement reforms.

The International Studies Program specializes in four broad policy areas:

- Fiscal policy, including tax reforms, public expenditure reviews, tax administration reform
- Fiscal decentralization, including fiscal decentralization reforms, design of intergovernmental transfer systems, urban government finance
- Budgeting and fiscal management, including local government budgeting, performance-based budgeting, capital budgeting, multi-year budgeting
- Economic analysis and revenue forecasting, including micro-simulation, time series forecasting,

For more information about our technical assistance activities and training programs, please visit our website at <http://isp-aysps.gsu.edu> or contact us by email at ispaysps@gsu.edu.

Decentralization Measures Revisited

Jorge Martinez-Vazquez and Andrey Timofeev
Andrew Young School of Policy Studies, Georgia State University

ABSTRACT

For the last half of a century, economists in an ever growing literature have been trying to measure decentralization with the purpose of using that measure as either the dependent or an independent variable in their empirical models. The suggested measures essentially boil down to a few concepts: locally raised own revenues, autonomy on expenditure decisions, locally spent national grants, or the number and size of local units. These basic components have entered decentralization measures in various functional forms: additive, multiplicative, in powers, and various mixes of those. This paper revisits these measures and our main finding is that aggregating those distinct dimensions of decentralization into a single indicator inevitably leads to a loss of information. We conclude that in a multivariate framework the distinct aspects of decentralization should enter regression analyses separately, in the most flexible functional form possible. At the same time, while no single indicator can capture all aspects of decentralization, some indicators are more inclusive and informative than others. Therefore, if for some reason we have to use a single indicator, our study suggests which indicator would be more appropriate for the hypothesis at hand. We illustrate these points examining differences in the empirical behavior of different decentralization indicators in relationship to each other and in their statistical association with some relevant economic outcomes in the fiscal decentralization literature.

JEL classifications: H11, H72, H77

Keywords: fiscal decentralization, decentralization measures, fragmentation

1. INTRODUCTION

For the last half of a century, public policy analysts and economists have been trying to measure decentralization to use as either the dependent or an independent variable in their models. From a theoretical perspective, the suggested measures essentially boil down to a few concepts: locally raised revenues, locally decided expenditures, locally spent national grants, or the number and relative size of local units. However, these basic concepts enter actual decentralization measures in various functional forms: additive, multiplicative, exponential, or various combinations thereof.

The first goal of this paper is to develop a taxonomy of decentralization measures showing their relationship to the primary theoretical aspects of decentralization and how the different measures are related to each other.

The second goal of the paper is to argue convincingly that from an empirical analysis perspective the aggregation of those distinct dimensions of decentralization into a single indicator inevitably leads to a loss of information and that a preferable approach in multivariate frameworks is to enter these distinct aspects of decentralization in the regression analysis separately in the most flexible functional form possible.

In terms of decentralization measures, besides the shares of different government levels in public revenues and expenditures, which are commonly used in the literature, we also take another look at the measure proposed by Breton and Scott (1978): the territorial fragmentation of different government tiers weighted by their relative roles in the public finance. This measure has been all but forgotten in the literature but we argue that, conceptually, it has considerable relevance for assessing the extent of decentralized decision-making.

While no single indicator can capture all aspects of decentralization, some indicators are more inclusive and informative than others. Therefore, if for some reason we have to use a single indicator, our study suggests which indicator would be more appropriate for the hypothesis at hand.

The rest of the paper is organized as follows. In section 2 we identify various dimensions of decentralization. In Section 3 we review approaches to measuring different dimensions of decentralization. In Section 4 we propose a single indicator capturing multiple dimensions of decentralization. In Section 5 we present empirical evidence on the relative explanatory powers of various indicators of fiscal decentralization and their combinations. Section 6 concludes.

2. DEFINING AND QUANTIFYING FISCAL DECENTRALIZATION

Decentralization is commonly defined as the process of transferring decision-making powers to subnational tiers of government. Three forms of this process have been distinguished in the policy literature: deconcentration, delegation and devolution (Bird, 1993). Through *deconcentration* the central government gives some autonomy to its terri-

torial branches that are appointed by, and are accountable to, the higher hierarchy. Under *delegation*, locally elected government bodies assume new responsibilities subject to strict regulations (mostly concerning service outputs) by the upper-level government. The process of *devolution* establishes complete autonomy of locally elected government bodies in their exclusive spheres of responsibility. The definition of decentralization suggests that it is generally a multifaceted process. In particular, at least three different dimensions jointly constitute this concept: the scope of authority, the degree of autonomy, and the direction of accountability.

In practice, we can observe varying extents of decentralization for each of the distinct dimensions of transfer of government power. Therefore there is a multidimensional universe of decentralized systems representing different combinations of power-sharing chosen for each of the dimensions. Using this paradigm, a particular decentralization process would represent a transition from one point in this universe to another, such that local powers for at least one of the dimensions increases (but leaving open the possibility that there are decreases for other dimensions that in combination we weight less). Thus, for example, a central government might offload responsibility for the provision of certain public goods so that it can refocus and centralize some aspects of regulation concerning the same public goods (MacLeod and Goodwin, 1999).

We illustrate this point in Figure 1, by focusing on three dimensions of decentralization of expenditure competencies commonly considered by public finance economists: regulation, financing and delivery of public services (Philip, 1954). The three graphs show how different forms of decentralization increase powers of local government along those three dimensions. Thus deconcentration increases local government powers only on one dimension— delivery of services— while reserving to the central government the powers to regulate and raise finances (bottom graph). Deconcentrated services can be further decentralized by relaxing central government regulation, in particular by allowing local communities to make (some or all of) those decisions via elected local officials; what is known as “political decentralization.” Under “delegation,” local governments are given responsibilities to deliver and (partially) finance public services while regulation of these services remains centralized, as depicted in the middle graph. Finally, through “devolution” local governments receive powers along all the three dimensions (regulation, financing, and delivery) with respect to services that fall in their exclusive spheres of responsibility. Devolution can also be achieved in two steps by first undertaking delegation and then following with “administrative decentralization,” or giving local governments more discretion with respect to the different modes of delivery of the formerly delegated functions.

While this three-dimensional picture is helpful for visualizing the multi-dimensionality of decentralization, it still misses important information about the entire universe of decentralized systems, which in fact has higher dimensionality. There have been several attempts in the decentralization literature to try to capture and quantify this multi-dimensionality. For example, very recently Blume and Voigt (2008) attempted to reduce the dimensionality of their dataset through factor analysis of 25 indicators of decentralization and federalism, including political, fiscal, and administrative aspects (with

Figure 1. The multi-dimensional universe of decentralized systems

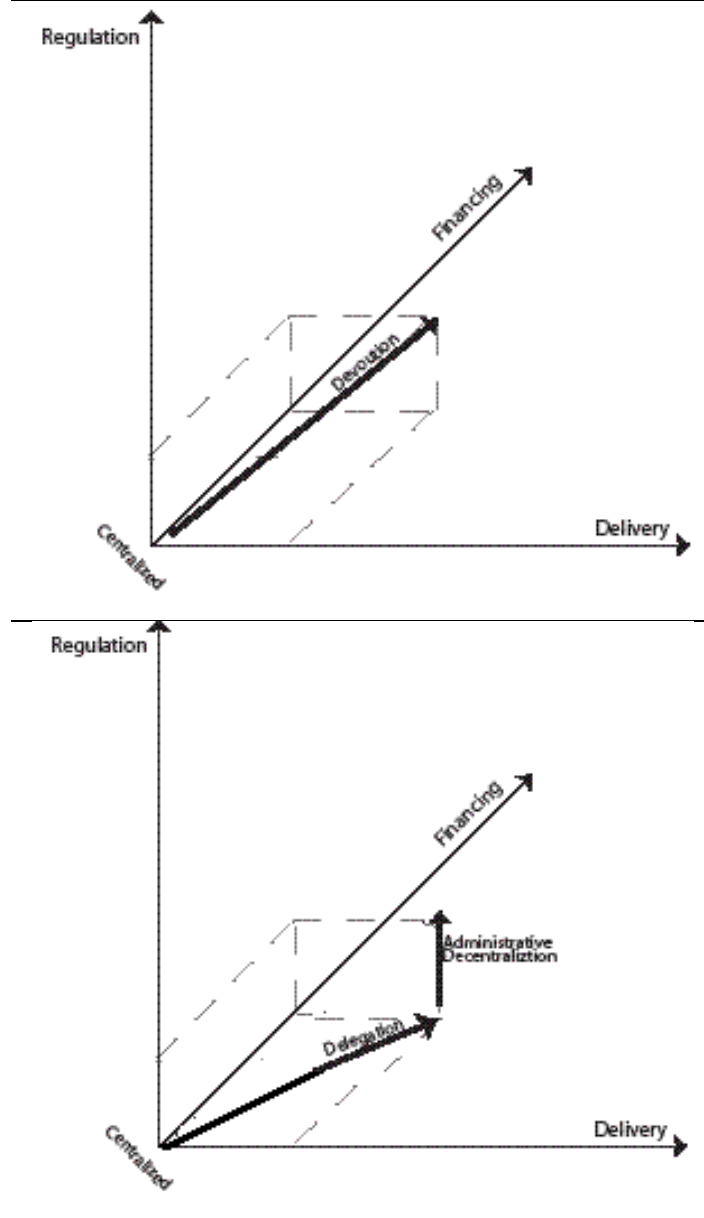
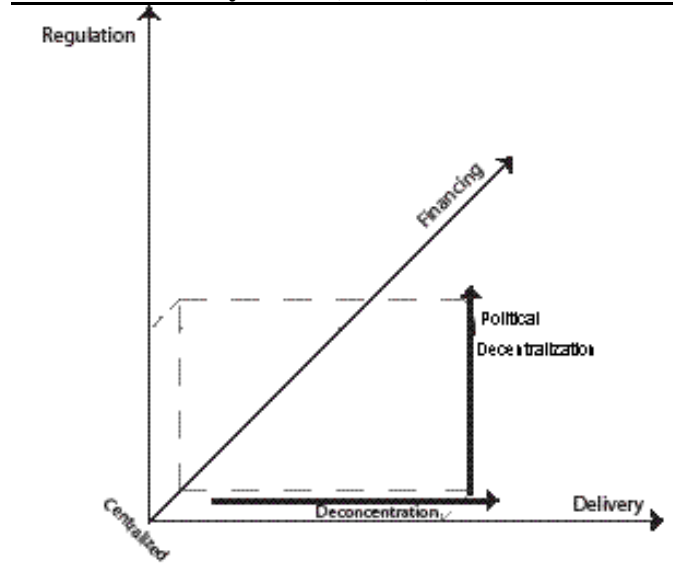


Figure 1. The multi-dimensional universe of decentralized systems (contd.)



the number of countries varying from 33 to 136 depending on the variable). Their factor analysis suggests that the information captured by these indicators cannot be condensed to a dataset of less than seven dimensions. Three of these seven principal components capture fiscal aspects: local role in spending, reliance on own-source revenues, and unconditional sharing of national revenue. The four non-fiscal principal components capture elected local executives, elected local councils, veto power of the house of regional representatives, and political fractionalization. However, the achieved reduction of dimensionality does not imply that conceptually all aspects of decentralization can be defined in terms of those seven principal components. Rather, the results mean that, in the currently observed practice, various manifestations of decentralization would appear to be driven by the seven identified driving forces, which Blume and Voigt (2008) call ‘latent variables’

The main conclusion from the discussion above is that, even in the fiscal realm alone, a single decentralization indicator cannot capture the entirety of powers assigned to the subnational level; simply put, the different aspects of public finances (regulation, financing, administration, and delivery) cannot be captured with the same indicator.

3. MEASURING THE DIFFERENT ASPECTS OF DECENTRALIZATION

The right approach to measuring the extent of fiscal decentralization has been long debated in theoretical works and, more recently, in empirical studies focusing on the link between fiscal decentralization and various fiscal and economic outcomes.¹ The eco-

¹ For a thorough discussion see Riker (1964, p. 51-84), Oates (1972, p. 196-99), and Bahl and Linn (1992, p. 390-91). Econometric applications can be found in Oates (1972), Oates (1985), Nelson (1986), Gross-

nomics literature has focused heavily on the number and size of local jurisdictions and their role in raising and spending public finances. The common caveat is that regulation, while being the most common form of government intervention, cannot be measured by any indicator constructed from fiscal data. Setting aside the regulation aspect, we can use fiscal data to separately approximate other aspects of fiscal decentralization (Levin 1991). Thus, responsibility for financing public services can be measured as total expenditures of a given government net of received grants.² The power of administration can be measured as total expenditures of a given government net of grants provided to other governments. Finally, the direct responsibility for service delivery can be measured as total expenditures of a government net of grants and contracts awarded to private contractors.

Even in the studies narrowly focused on fiscal aspects of decentralization, there has been diversity of the specific approaches to measuring decentralization. A recent meta-analysis of 26 studies in this field finds that about one third of them measure decentralization as the share of local governments in total government expenditures, while another quarter measure the share of local spending financed from own resources (Feld et al., 2008). Other, less frequently used, measures include the share of total government revenues raised by local governments and the gap between revenues and expenditures of local governments. In what follows we attempt to develop a taxonomy of measures, first, for those dealing with fiscal aspects only, and second for measures focusing on the vertical and territorial structure of subnational governments.

3.1. MEASURING FISCAL ASPECTS

To facilitate the comparison and discussion of the relative advantages and disadvantages of various fiscal indicators, we will use a tabular representation. Indeed the structure of the total public sector can be analyzed, on the one hand, by the level of government generating public revenues and, on the other hand, by the level of government spending these resources.³ These two dissections essentially break the total public sector into four parts or quadrants.⁴ For example, Table 1 shows that in the United Kingdom, 72

man (1989), Shah and Huther (1999), Jin *et al.* (2005), Davoodi and Zou (1998), Zhang and Zou (1998), Woller and Phillips (1998), Eberts and Gronberg (1990), Panizza (1999), Stein (1999), Akai and Sakata (2002).

² This should be equivalent to measuring the own-source revenue provided that borrowed funds do not play a big role, which should be the case in most countries for recurrent expenditures reported in IMF's GFS data. But, for example, many Indian states finance a significant part of their current expenditures through borrowing (Bahl et al 2005). If received grants are earmarked for a particular function, then we can measure the responsibility for financing this particular function as the total outlays on that function less the received grants earmarked for that function.

³ This tabular two-dimensional representation implicitly assumes that public expenditures are equal to public revenues. In practice, in any given fiscal year, the revenues and expenditures can diverge due to borrowing. However, over a longer period of time this debt would have to be repaid from own revenues or bailout grants. Thus in our empirical application it is not completely unreasonable to assume that our variables constructed as three-year averages would approximate expenditures with the sum of own revenues and grants.

⁴ In case of a co-financed project, the locally-financed share of the project costs is accounted as subnationally financed and subnationally administered (Quadrant IV). The centrally-financed share of the project

percent of total government expenditures fall into the most centralized category of being both centrally financed and centrally administered (Quadrant I). At the same time 8 percent of total government expenditures fall into the most decentralized category of being both subnationally financed and subnationally administered (Quadrant IV). An additional 20 percent represents an intermediate case of expenditures, which are subnationally administered but centrally financed (Quadrant III).

Because the shares of the four quadrants in the total add up to one, it suffices to know only three out of the four numbers to have a complete picture. Moreover, in countries where central governments do not receive grants from subnational units, only two numbers are required to describe the vertical break-down of public finances (as Quadrant II is empty).⁵ Obviously, no single indicator among those used in the literature can relay all the information in this two-dimensional picture. Indeed, the Expenditure Ratio captures the combined share of grant-financed (Quadrant III) and self-financed (Quadrant IV) expenditures by local governments but conveys no information on the size of these two quadrants relative to each other. This limitation is easily identifiable in the different measures used in empirical decentralization literature as shown in Table 2.

In practice, using the Expenditure Ratio as a regressor can lead to insignificant estimates of the impact of decentralization due to lumping together in one explanatory variable opposite effects: 1) that of tax competition resulting from revenue decentralization and 2) that of over-fishing of the common revenue pool resulting from grant-financed expenditure decentralization (Rodden, 2003).

Similarly, the Revenue Ratio corresponds to the size of Quadrant IV in our tabular representation but has no information on the relative sizes of quadrants I and III. The Revenue Autonomy measure captures the ratio (or relative size) of quadrants III and IV but no information on the size of Quadrant I (or equivalently on the combined share of quadrants III and IV). Similarly, the Vertical Imbalance indicator measures the size of Quadrant III relative to Quadrant IV but no information on the size of Quadrant I (or equivalently on the combined share of quadrants III and IV).

costs is accounted as centrally financed and centrally administered (Quadrant I) if paid directly from the central budget to project contractors; otherwise it is accounted as subnationally administered but centrally financed (Quadrant III) if these moneys are transferred to the local budget first and then paid to the project contractors.

⁵ This has been pointed in the previous literature. For example, Rodden (2003) shows that fiscal decentralization can be quantified by three numbers summing up to one: share of exclusively central expenditures, the share of exclusively local expenditures, and grant-funded local expenditures.

Table 1. Relative authority of different levels of government over total public finances in the UK, 2005

		Revenue-raising authority	
		Centrally financed	Subnationally financed
Expenditure responsibilities	Centrally administered	72% (Quadrant I)	None (Quadrant II)
	Subnationally administered	20% (Quadrant III)	8% (Quadrant IV)

Source: Calculated by authors based on GFS-IMF data.

Table 2. Informational limitations of different decentralization measures used in the literature

Measure	Graphical representation	Application
Expenditure Ratio (ER)	QIII+QIV	Zhang and Zou (1998), Davoodi and Zou (1998), Akai and Sakata (2002)
Revenue Ratio (RR)	QIV	Akai and Sakata (2002)
Revenue Autonomy (RA)	QIV/(QIII+QIV)	Akai and Sakata (2002); Habibi et al (2003)
Vertical Imbalance (VI)	QIII/(QIII+QIV)	DeMello (2000), Ebel and Yilmaz (2002)

However, it can be easily verified that any pair of these measures (except for the Revenue Autonomy and Vertical Imbalance, which are just inverse of each other) can fully characterize the vertical break-down of public finances. For example, the Revenue Autonomy measure is the ratio of the Expenditure Ratio and the Revenue Ratio measures, while the Vertical Imbalance is the percentage difference between the Expenditure Ratio and the Revenue Ratio. It has to be acknowledged that the sufficiency of any two indicators stems from the two-dimensional representation of the fiscal space in Table 1. In fact Quadrant III lumps together expenditures financed by grants having different extents of conditional-unconditional uses while Quadrant IV lumps together revenue from sources over which local governments have different extents of discretion. Indeed, there are different degrees of local discretion in tax financing ranging from allowing subnational authorities to set both the tax rate and tax base to only allowing subnational authorities to retain some of the tax revenue collected in their territory by the central authorities (OECD, 1999). More to the point, Blume and Voigt (2008) find that the extent of grant conditionality conveys additional information not captured by expenditure and revenue ratios. Thus, in practice the dimensionality of the fiscal space appears to be no less than three: 1) extent of local spending, 2) extent of local revenue raising, 3) extent of unconditional transfers (revenue sharing).

Collapsing the multi-dimensional fiscal space into a scalar indicator requires judgment (weighting) regarding the relative importance of different aspects of decentralization. Thus using the total of own-source revenues measure implies equal weighting of revenues derived from different local sources. However, choosing specific—implicit or explicit weights—is not just about quantification. If there is a positive “progress” along all dimensions of decentralization, we can confidently call it an increase in decentralization. But what if we have a significant increase in grant-financed local expenditures with a slight reduction of locally-generated revenues? Depending on how we weight these changes relative to each other, we might have our measure to show either an increase in the decentralization or a decrease, that is qualitatively different assessments.

Even when we include measures of various decentralization aspects as separate regressors, we affectively assign relative weights (given by the regression coefficients). However, in this case the weights are less arbitrary as they are determined by the relative impacts of the decentralization aspects on the dependent variable. The problem with regression-derived weights is that, if different aspects of decentralization have a common driver (e.g., countries with more fragmented local governments have less local responsibilities), then the regression might fail to clearly attribute the impact to separate decentralization indicators resulting in statistically insignificant weights (estimated coefficients). A composite indicator would not have such a problem as it assigns predetermined (arbitrary) weights as a result of the chosen functional form for the formula used to compute the decentralization measure. To avoid the multi-collinearity problem without resorting to arbitrary weights, one can reduce the dimensionality of a set of decentralization measures by way of factor analysis, as in Blume and Voigt (2008), and then use the resulting principal components as explanatory variables in the regression analysis. However, the interpretation of the principal components may not always be transparent or even intuitive.

3.2. MEASURING TERRITORIAL FRAGMENTATION

Besides the shares of different levels of government in total public revenues and expenditures, some empirical studies also have measured decentralization by the number and average size of jurisdictions at each level.⁶ By this type of measure, all other things being equal, a larger number of smaller local governments implies a higher level of (fiscal) decentralization. This can have several interpretations: degrees of freedom for tailoring public goods to heterogeneous preferences; intensity of competition for residents and businesses among jurisdictions; concentration of bargaining power vis-à-vis the central government, and so on. But, the issue of the number of local government units is also connected to economies of scale, inter-jurisdictional disparities, volatility of local revenues, and why not historical and political reasons. This dimension of an intergovernmental finance system has been measured as the absolute number of local jurisdictions, which can be normalized by population or land area. Thus, for example, while the share of state governments in India's total revenue and expenditures is significant, the number of states relative to the national population is not large, suggesting a relatively high degree of centralization.

In a related indicator, Breton and Scott (1978) propose a way to measure fiscal fragmentation in the presence of more than one subnational tier. In their application, they examine at what scale public resources are utilized: some resources are utilized at the national scale, some resources are utilized at the regional scale, while other resources are utilized at the local scale. Their indicator is computed as the average size (population-wise or land-wise) of these three scales weighted according to their share in total public expenditures.

4. A BEST SINGLE INDICATOR?

As we have discussed so far, a strong case can be made for the need to account for all aspects of fiscal decentralization and also non-fiscal aspects when studying the outcomes of fiscal decentralization. However, sometimes a single indicator is needed that would at a glance show us a general trend in fiscal decentralization, and also reveal relationship to other variables, in either a tabular or graphical form. While it would be impossible to capture a multi-dimensional process of decentralization with a single indicator, we nevertheless can attempt to measure more than just one aspect, that is not only revenues and not only expenditures. Such interaction (mutual reinforcement) among different aspects of decentralization is captured in the graphical presentation in Table 1 with the dissection of the total public sector into four quadrants, representing various combinations of assignments for different aspects of government authority. We propose that a ratio of completely decentralized expenditures to completely centralized expenditures—that is Quadrant IV/ Quadrant I—could serve as a composite indicator of the extent of decentralization. For example, in the UK this ratio would be 0.11 indicating a modest amount of subnational authority relative to the authority of the central government.

⁶ See, for example, Oates (1985), Nelson (1986) and Eberts and Gronberg (1990).

For countries where most public services are financed and delivered by the central government, such a ratio would be close to zero. In countries, where a large fraction of public expenditures is financed and delivered by local governments such a ratio would be larger than one. Devolving responsibility for only the administration of some services but not for their financing will raise this ratio by decreasing its denominator (Quadrant I).⁷ However, devolving the responsibility for both administration and financing of this service will both decrease the denominator and increase the numerator of the ratio (Quadrant IV) thus resulting in a larger increase in the ratio than in the first case. Thus, this composite indicator of decentralization weights more heavily comprehensive decentralization than just decentralization of administration.

We call this new measure of fiscal decentralization the “Composite Ratio” because it essentially combines the information captured by the expenditure and revenue ratios. Indeed, except for cases of decentralized systems involving substantial grants to the central budget from foreign and subnational entities,⁸ the composite ratio can be expressed as the following:

$$\text{CompositeRatio} = \frac{\text{RevenueRatio}}{1 - \text{ExpenditureRatio}}. \quad (1)$$

The above identity is clear from Table 1, where the revenue ratio is captured by the sum of Quadrants II and IV while the expenditure ratio is captured by the sum of quadrants III and IV. In the absence of subnational grants to the central budget—that is, the empty Quadrant II in Table 1—Revenue Ratio/(1-Expenditure Ratio) is equal to Quadrant IV/ Quadrant I, which is our definition of the Composite Ratio.

Unlike other attempts to combine the Expenditure and Revenue Ratios—for example, taking the average of the two ratios by Akai and Sakata (2002)⁹—in our measure, revenue decentralization and expenditure decentralization reinforce each other. Indeed, for the same level of revenue decentralization, the Composite Ratio will be larger if the level of expenditure decentralization is higher and vice versa.¹⁰ This mutual reinforcement of expenditure and revenue powers is illustrated in Table 1 above by the area of

⁷ In countries where all local government expenditures are financed by the central government, the suggested indicator of decentralization would be insensitive to changes in the amount of these centrally financed expenditures. This might be a good quality of a decentralization indicator, as a lack of any source of marginal revenue for local governments makes the benefits of decentralization less feasible.

⁸ We can assume that cases of substantial grants from foreign and subnational entities to the central budget are likely to be rare but they occur. In the case of poor developing countries a significant share of international assistance can be in the form of central government budget support grants. In the case of these developing countries the “Composite Ratio” would need to be adjusted accordingly. The occurrence of substantial transfers from subnational entities to the central budget is likely to be even less common. However, in some countries, the equalization grant system includes negative transfers from richer subnational governments to a central pool or the budget.

⁹ While Vo (2008) attempted to interact local revenue autonomy with the local share of the public expenditures, the particular choice of the functional form resulted in a cancelation of the expenditure component resulting in a measure essentially equivalent to the revenue ratio.

¹⁰ This is formally shown in the Appendix.

Quadrant IV, which is a product of its height (expenditure decentralization) and its width (revenue decentralization).

As a side note, it should be recognized that such internal relationships among separate measures of decentralization are important to consider when trying to compare and interpret results from studies using different indicators. For example the meta-analysis by Feld et al. (2008) compares estimates of the impact on growth derived by studies using different measures of decentralization, including the Expenditure Ratio and Revenue Autonomy. However, there is a need to take into account that those latter two measures can be negatively related (see the Appendix). Therefore, even when reflecting the same decentralization process, these two measures can have impacts with the opposite sign. Therefore, the fact that the Composite Ratio proposed here is positively related to both the Expenditure Ratio and the Revenue Ratio should make it more useful in practice.

Alternatively, we can attempt to capture fiscal and territorial aspects of decentralization in a single indicator by building on the idea proposed by Breton and Scott, described above, but with two modifications. In what follows we construct a measure of the jurisdiction scale, which is essentially Breton and Scott's indicator but without the normalization by population or land area.¹¹ We believe that population and land area should play a more flexible role and enter regressions as separate explanatory variables. Our second modification of Breton and Scott's indicator is that we weight different tiers of government according to their role in generating public revenues (the R-Scale indicator) as an alternative to weighing according to their role in spending public resources (the E-Scale indicator).

Formula: R-Scale = {[Central government Revenue]+[Regions' own revenue]/# of regions +[Municipal own revenue]/# of municipalities}/ General govt. revenue.

Example: R-Scale measure in a hypothetical country

1 jurisdiction at the national scale	Central government revenue share = 50%
20 jurisdictions at the regional tier	Regional governments revenue share = 30%
500 jurisdictions at the local tier	LG expenditure share = 20%

$$\text{R-scale} = 0.5 + 0.30/20 + 0.20/500 = 0.5154$$

¹¹ While revising this manuscript, we have learnt that our modifications of Breton and Scott's indicator make it very similar to the two main components of Scotto's (1950) index. While the original Italian text of the latter source is rather unknown in the English-language literature, a detailed description of Scotto's (1950) index can be found in Vo (2008).

5. EMPIRICAL EVIDENCE ON THE RELATIVE PERFORMANCE OF THE DECENTRALIZATION MEASURES

In the previous discussion, we have pointed out conceptual differences among various decentralization indicators in terms of the scope of various dimensions of decentralization that they capture. The importance of these conceptual differences in practice will depend on the extent of divergence in the progress along various dimensions of decentralization. Thus, when we have uniform progress along all dimensions of decentralization, then expenditure decentralization will be the same as revenue decentralization and all the three decentralization ratios will be telling us the same information while the Revenue Autonomy indicator would not give any information because it would be always equal to one. Therefore, we conclude this paper by examining differences in the actual behavior of six decentralization indicators in relationship to each other and in statistical association with some variables of interest:

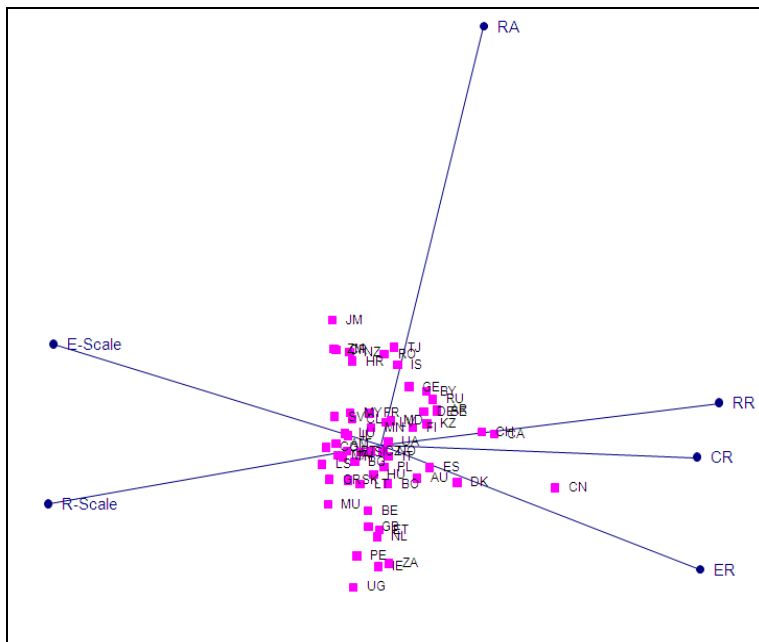
1. Expenditure Ratio (ER) = $(LR+G)/(LR+NR)$
2. Revenue Ratio (RR) = $LR/(LR+NR)$
3. Composite Ratio (CR) = $RR/(1-ER)$
4. Revenue autonomy (RA)
5. E-scale
6. R-scale.

We start by summarizing the relationships among these indicators in a visual form by means of a biplot. The biplot display is a commonly used multivariate method for graphing row and column elements (in this case, countries and their decentralization indicators correspondingly) using a single display (Gabriel, 1971). The rays originating from the center of the graph are linear projections of the six indicators onto the two-dimensional subspace where most variability in the original multidimensional dataset occurs, capturing almost 95 percent of total variation.¹²

The principal component biplot is a powerful tool that allows us to capture the relationship between the different indicators. Variable rays representing uncorrelated indicators are orthogonal. The smaller the inner angle between rays, the higher is the positive correlation between the values of the corresponding indicators. For negatively correlated variables, the inner angle is greater than 90°. Longer rays represent variables with larger standard deviations. Because biplot is a two-dimensional projection of a multi-dimensional space, it deforms relative configurations among objects depending on the angle of projecting. We use the projection aspect that preserves angles among indicators but not necessarily distances among countries.

¹² Somewhat similar to the R-squared in the case of a regression, the goodness of fit of a biplot is defined as the fraction of the sum of squares of singular values accounted for by the two largest singular values.

Figure 2. Principal Component Biplot for 2002-2004 averages of decentralization indicators



Source: Prepared by authors based on data reported in IMF (2008) using Excel© macros from Lipkovich and Smith (2002).

Notes: The sample includes 58 countries, out of which 5 low income, 14 lower middle income, 16 upper middle income, 2 non-OECD high income, and 21 OECD countries.

As was argued in the previous section, the Composite Ratio is positively related with both Expenditure Ratio and the Revenue Ratio, with the latter relationship being the strongest.¹³ The E-Scale and R-Scale indicators are almost perfectly inversely correlated with the corresponding ratios (ER or RR) used in their construction to weigh the government tiers. This suggests that the territorial aspect of decentralization does not develop independently from the fiscal decentralization and in fact countries with higher fiscal decentralization ratios appear to have less territorial fragmentation.¹⁴

¹³ The relationships might not hold exactly for our data as the construction of GFS variables does not coincide exactly with our conceptual definitions. In particular, total revenues might not be equal to total expenditures, as GFSM 2001 excludes capital expenditures. As a result, self-financed local expenditures, constructed as local expenditures less grants received, can be negative if the bulk of the received grants finance capital expenditures (see the appendix in Martinez-Vazquez and Timofeev (2009) for more details). In order not to have negative values for the Composite Ratio indicator, we construct the latter from the IMF's GFS data using the formula in Equation (1), but with the Expenditure Ratio is computed for recurrent expenditure only.

¹⁴ It can be shown that, when territorial fragmentation and decentralization ratios are independent from each other, the negative correlation between the scale indicators and corresponding decentralization ratios are strictly less than unity. Moreover, the higher is the variation in territorial fragmentation relative to the variation in decentralization ratios, the weaker is this negative correlation between the scale indicators and corresponding decentralization ratios. A proof is available from the authors upon request.

Table 3. Coefficients of pair-wise correlation

	ER	RR	CR	RA	E-Scale	R-Scale
ER	1.00	0.89	0.81	0.04	-0.97	-0.83
RR	0.89	1.00	0.88	0.37	-0.90	-0.98
CR	0.81	0.88	1.00	0.33	-0.84	-0.86
RA	0.04	0.37	0.33	1.00	-0.08	-0.40
E-Scale	-0.97	-0.90	-0.84	-0.08	1.00	0.89
R-Scale	-0.83	-0.98	-0.86	-0.40	0.89	1.00

The Revenue Autonomy indicator has very weak relationships with the Revenue Ratio (positive) and the Expenditure Ratio (negative). This latter negative (albeit weak) association conforms to our prediction derived in the Appendix under the assumption that the elasticity of the Revenue Ratio measure with respect to the Expenditure Ratio measure is less than one.

As a robustness check, in table 3 below we report coefficients of pair-wise correlation between our six indicators. The relationships uncovered by examining the projections of those variables on the two-dimensional biplot space for the most part accord with the values of correlation coefficient. The slight differences are due to the biplot approximation as the rank of our dataset is more than two.

The individual points on the chart are linear projections of our observations labeled with corresponding country codes. Because the variables are normalized by subtracting the mean and dividing by the standard deviation, data points located in the center of the graph represent countries with average values of the decentralization indicators. Data points located away from the center in the direction of some variable ray represent countries with values of that variable that are distinct from the average.

As one can see from the biplot graph, most scatter appears along the Revenue Autonomy ray (longer rays represent indicators having larger standard deviations), with Jamaica outlying the most in the positive direction (but having below average decentralization ratios) while Uganda outlying the most in the negative direction. A few countries stand out in the direction of the fiscal ratios, with Canada and Switzerland outlying the most along the Revenue Ratio, China outlying the most along the Composite Ratio, while Denmark outlying the most along the Expenditure Ratio ray. As suggested by the biplot, China is found to be an outlier in our regressions and therefore is explicitly discarded from the results presented immediately below.

Next we examine how much information is lost in practice by (i) using a single indicator rather than several or (ii) one single indicator rather than another single indicator.

This empirical exercise aims to compare the explanatory power of alternative decentralization indicators in terms of the share of variation in the outcome variable ex-

plained by the given indicator(s), known as the R-squared. In computing the R-squared we do not include any additional regressors. Although additional regressors could explain more variation in the outcome variable, this additional explanatory power would be due to the regressors other than the decentralization measures we are trying to compare. Being just a squared coefficient of correlation, the R-squared captures the strength of statistical association between decentralization and the variable of interest but it does not imply causality; in fact, the coefficient of correlation might represent the effect of that other variable on decentralization. This suits our purpose because we are interested in evaluating the ability of alternative measures to capture information about decentralization regardless of whether it is used on the left-hand side or the right-hand side of a regression equation. That is one of the advantages of reporting R-squared, because it does not change if you swap the left-hand side or the right-hand side variables in a univariate regression. In a multivariate regression, of course, we cannot put a set of decentralization measures on the left-hand side but the intuitive interpretation of R-squared still holds.

Table 4 provides some evidence on the explanatory power of different fiscal decentralization indicators for four socio-economic outcomes: the human development index (HDI); GDP per capita; life expectancy; and the combined gross enrollment ratio for primary, secondary and tertiary education.¹⁵ For each of the outcome variables, we report the share of total variation (R-squared) explained by the pair of indicators corresponding to the respective column and row. In the diagonal cells, where the row and the column represent the same indicator, we report the share of total variation explained by this single indicator (the squared coefficient of its correlation to the outcome variable). The decentralization indicators are averaged over 2002-2004 while the values for the outcome variables are taken for 2005. While lagging the fiscal indicators can help capture causality, we do not claim any causal link but rather discuss the strength of a statistical association. This is because our discussion of measuring decentralization equally applies whether decentralization is measured as a dependent or independent variable.

The explanatory power of each pair of decentralization indicators varies among the outcome variables and overall is higher for the school enrollment and lower for the per capita GDP. For any pair of decentralization indicators the explained share of variation in the outcome variables is considerably smaller than the joint explanatory power of all six indicators. For three out of the four outcome variables, the pair of the Expenditure Ratio and Revenue Autonomy indicators has the highest explanatory power. This is not unexpected given that, according to the biplot, these two variables are almost perfect complements and thus jointly capture most of the variation in fiscal decentralization.

¹⁵ We chose this set of outcome variables because it rather comprehensively captures various aspects of development and also because they were used previously in studies of decentralization (e.g. Braun and Grote 2002)

Table 4. Explanatory power of a pair of decentralization indicators

Human development index (HDI) value, 2005						
	ER	RR	CR	RA	E-Scale	R-scale
ER	0.141					
RR	0.194	0.189				
CR	0.181	0.198	0.177			
RA	0.229	0.214	0.209	0.077		
E-Scale	0.141	0.193	0.187	0.156	0.090	
R-scale	0.149	0.191	0.179	0.127	0.102	0.100
Variation explained by all six indicators: 0.2552						
GDP per capita (PPP US\$), 2005						
	ER	RR	CR	RA	E-Scale	R-scale
ER	0.139					
RR	0.145	0.140				
CR	0.148	0.149	0.147			
RA	0.152	0.140	0.147	0.009		
E-Scale	0.145	0.148	0.149	0.127	0.122	
R-scale	0.141	0.140	0.149	0.081	0.124	0.080
Variation explained by all six indicators: 0.172						
Life expectancy, 2005						
	ER	RR	CR	RA	E-Scale	R-scale
ER	0.128					
RR	0.219	0.199				
CR	0.179	0.262	0.171			
RA	0.210	0.220	0.200	0.072		
E-Scale	0.135	0.227	0.208	0.121	0.059	
R-scale	0.135	0.207	0.176	0.114	0.090	0.088
Variation explained by all six indicators: 0.293						
Combined gross enrolment ratio for primary, secondary and tertiary education, 2005						
	ER	RR	CR	RA	E-Scale	R-scale
ER	0.222					
RR	0.232	0.224				
CR	0.235	0.234	0.232			
RA	0.261	0.225	0.235	0.030		
E-Scale	0.234	0.239	0.238	0.217	0.198	
R-scale	0.230	0.224	0.233	0.145	0.198	0.145
Variation explained by all six indicators: 0.304						

Notes: The reported figures are R-squared of the log-log regressions of the outcomes on a pair of decentralization indices (2002-2004 average) on a sample of 57 countries.

At the same time, as a standalone indicator, Revenue Autonomy has almost no explanatory power, reported on the diagonal of the table. Similarly, as a standalone indicator, the Expenditure Ratio comes third in terms of the explanatory power after the Composite Ratio and the Revenue Ratio. As a standalone indicator, the Composite Ratio and the Revenue Ratio perform the best, each showing the highest explanatory power for two out of the four outcome variables. For other indicators, the explanatory power of a univariate regression varies a lot among the economic outcomes but invariably falls below that of the Composite Ratio and the Revenue Ratio.

These straightforward comparisons of explanatory power suggest several important implications.¹⁶ First, the Expenditure Ratio, which happens to be most used in practice according to Feld et al (2008), is not the top performer in terms of explanatory power for the set of socio-economic outcomes reviewed here. While the performance of the Expenditure Ratio might be different for other outcome variables (economic growth, corruption, etc), it does make problematic the common argument that no measure is perfect but this one is mostly used. Second, for outcomes mostly affected by one dimension of decentralization (e.g., life expectancy appears associated with the revenue decentralization more than with any other decentralization aspect), the Composite Ratio, which is conceptually more informative, can in practice perform worse than the measure of that single relevant dimension. This is because it also contains information on other dimensions of decentralization not relevant in this particular case and thus adding noise to the decentralization measure. To use an analogy, the Composite Ratio, like a pellet rifle, is more likely to cover a broad range of targets but would not be as effective as a sniper rifle if we want to focus on a narrowly defined target. Finally, because the specific impacts of various aspects of decentralization vary among socio-economic outcomes, the extent of loss of explanatory power from using a single indicator rather than a pair of indicators varies from being quite limited, as for example in the case of GDP, to being quite substantial, as for example in the case of life expectancy.

6. CONCLUSION

This paper has several practical implications for measuring decentralization and assessing its impact. First, fiscal decentralization unfolds along several dimensions and at different paces, and thus that progress should be measured separately for each of them. Combining various aspects of decentralization into a single composite measure performs less well because this type of measure assigns arbitrary relative weights to those different dimensions and those weights cannot be the right ones in all the different relevant contexts.

¹⁶ While the provided comparisons of explanatory power are useful to illustrate our points about practical implications, they should be treated with caution as the findings might be specific to the sample of countries reported in the IMF GFS data for 2002-2004. To perform a robustness check we would have to wait until data become available for a later period. Re-estimation on an earlier period is problematic as going back even only by five years results in a loss of a quarter of countries in the sample due to missing values in the GFS data. These (mostly developing and transition) missing countries are quite different from the rest of the sample.

Second, when trying to explain the variation in the outcome of interest (e.g., economic development), it is more desirable to include the measures of all aspects of decentralization as separate regressors or, in case of multi-collinearity as separate principal components that the entire set of decentralization indicators can be reduced to. Moreover explanatory variables should include both fiscal and non-fiscal variables. Thus, in addition to the dimensions for regulation, financing, and administration of public goods, we also need to control for other institutional arrangements such as: territorial structure of subnational jurisdictions, political arrangements including legal status of local authorities, clarity in the delineation of powers among levels of government, or subnational borrowing powers and financial infrastructure.

If we are forced to use one single measure of decentralization as an explanatory variable, for example because of the available degrees of freedom or to produce a ranking or a graphical representation, the “Composite Ratio” presented in this paper would seem to be a better choice than the commonly used Expenditure Ratio.

While conceptually appealing, the alternative composite indicators combining fiscal and territorial aspects of decentralization turn out to be less informative in practice as they are almost perfectly inversely correlated with the corresponding fiscal ratios used in their construction. This suggests that the territorial fragmentation measure does not develop independently from the fiscal ratios and that in fact countries with higher fiscal decentralization ratios appear to have less territorial fragmentation.

REFERENCES

- AKAI, N. & SAKATA, M. (2002) Fiscal Decentralization Contributes to Economic Growth: Evidence from State-Level Cross-Section Data for the United States. *Journal of Urban Economics*, 52, 93-108.
- BAHL, R. W. & LINN, J. F. (1992) *Urban public finance in developing countries*, Oxford; New York; Toronto and Melbourne, Oxford University Press for the World Bank.
- BAHL, R., HEREDIA-ORTIZ, E., MARTINEZ-VAZQUEZ, J. RIDER, M., (2005). “India: Fiscal Condition of the States, International Experience, and Options for Reform”, *International Studies Working Paper #05-14*, Andrew Young School of Policy Studies, Georgia State University, Atlanta.
- BIRD, R. M. (1993) Threading the Fiscal Labyrinth: Some Issues in Fiscal Decentralization. *National Tax Journal*, 46, 207-27.
- BLUME, L. & VOIGT, S. (2008) Federalism and Decentralization -- A Critical Survey of Frequently Used Indicators. *MAGKS Papers on Economics 200821*. Philipps-Universität Marburg, Faculty of Business Administration and Economics, Department of Economics (Volkswirtschaftliche Abteilung).
- BRETON, A. & SCOTT, A. (1978) *The economic constitution of federal states*, Toronto; Buffalo, University of Toronto Press.

- BRAUN, J. VON AND U. GROTE (2002), Does Decentralization Serve the Poor? In: Ahmad, Etisham and Vito Tanzi (Hrsg.) (2002), *Managing Fiscal Decentralization*, Routledge Economics, Washington D.C., pp.92-119.
- DAVOODI, H. & ZOU, H.-F. (1998) Fiscal Decentralization and Economic Growth: A Cross-Country Study. *Journal of Urban Economics*, 43, 244-57.
- DE MELLO, L. R., JR. (2000) Fiscal Decentralization and Intergovernmental Fiscal Relations: A Cross-Country Analysis. *World Development*, 28, 365.
- EBEL, R. D. & YILMAZ, S. (2002) On the Measurement and Impact of Fiscal Decentralization. *The World Bank, Policy Research Working Paper Series: 2809*.
- EBERTS, R. W. & GRONBERG, T. J. (1990) Structure, Conduct, and Performance in the Local Public Sector. *National Tax Journal*, 43, 165-73.
- FELD, L. P., T. BASKARAN & J. SCHNELLENBACH. 2008. "Fiscal Federalism, Decentralization and Economic Growth: A Meta-Analysis" paper presented at the 64th Congress of the International Institute of Public Finance, 22-25 August 2008 in Maastricht, The Netherlands.
- GABRIEL, K. R. (1971) The Biplot Graphic Display of Matrices with Application to Principal Component Analysis. *Biometrika*, 58, 453.
- GROSSMAN, P. J. (1989) Fiscal Decentralization and Government Size: An Extension. *Public Choice*, 62, 63-69.
- HABIBI, N. & ET AL. (2003) Decentralization and Human Development in Argentina. *Journal of Human Development*, 4, 73.
- IMF (2008) *Government finance statistics yearbook 2007*. Government Finance Statistics Division. International Monetary Fund: Washington, D.C.
- JIN, H., QIAN, Y. & WEINGAST, B. R. (2005) Regional decentralization and fiscal incentives: Federalism, Chinese style. *Journal of Public Economics*, 89, 1719
- LEVIN, J. (1991) Measuring the Role of Subnational Governments. *International Monetary Fund, IMF Working Papers: 91/8*.
- LIPKOVICH, I. A. & SMITH, E. P. 2002. Biplot and Singular Value Decomposition Macros for Excel©. *Journal of Statistical Software*, 7, 1-15.
- MACLEOD, G. & GOODWIN, M. (1999) Space, scale and state strategy: rethinking urban and regional governance. *Progress in Human Geography*, 23, 503.
- MARTINEZ-VAZQUEZ, J. & TIMOFEEV, A. A fiscal perspective of state rescaling. *Cambridge Journal of Regions, Economy and Society*, 2, 85-105.
- NELSON, M. A. (1986) An Empirical Analysis of State and Local Tax Structure in the Context of the Leviathan Model of Government. *Public Choice*, 49, 283-94.
- OATES, W. E. (1972) *Fiscal federalism*, New York, Harcourt Brace Jovanovich.
- OATES, W. E. (1985) Searching for Leviathan: An Empirical Study. *American Economic Review*, 75, 748-57.
- OECD. (1999) *Taxing powers of state and local government*, Paris, Organisation for Economic Co-operation and Development.
- PANIZZA, U. (1999) On the Determinants of Fiscal Centralization: Theory and Evidence. *Journal of Public Economics*, 74, 97-139.
- PHILIP, K. (1954) *Intergovernmental Fiscal Relations*, Copenhagen: Ejnar Munksgaard.
- RODDEN, J. (2003) Reviving Leviathan: Fiscal Federalism and the Growth of Government. *International Organization*, 57, 695.

- RIKER, W. H. (1964) *Federalism: Origin, Operation, Significance*. Boston: Little, Brown.
- SHAH, A. & HUTHER, J. (1999) Applying a Simple Measure of Good Governance to the Debate on Fiscal Decentralization. *The World Bank, Policy Research Working Paper Series: 1894*.
- STEIN, E. (1999) Fiscal decentralization and government size in Latin America. *Journal of Applied Economics*. Universidad del CEMA.
- VO, D. H. (2008) Fiscal decentralisation indices: A comparison of two approaches. *Rivista di diritto finanziario e scienza delle finanze*, 67, 295-323.
- WOLLER, G. M. & PHILLIPS, K. (1998) Fiscal Decentralisation and LDC Economic Growth: An Empirical Investigation. *Journal of Development Studies*, 34, 139-48.
- ZHANG, T. & ZOU, H.-F. (1998) Fiscal Decentralization, Public Spending, and Economic Growth in China. *Journal of Public Economics*, 67, 221-40.

Appendix

Mathematical formalization

Let us introduce the following notation:

LR=local own revenue

NR=central government revenue

G= grants to subnational governments

Expenditure Ratio (ER) = (LR+G)/ (LR+NR)

Revenue Ratio (RR) =LR/ (LR+NR)

Revenue autonomy (RA) =LR/ (LR+G) =RR/ER

Fiscal Imbalance = ER-RR=G/ (LR+G)

Lemma 1: The Revenue Autonomy measure is increasing with the Expenditure Ratio measure only when the elasticity of the Revenue Ratio measure with respect to Expenditure Ratio measure is not less than one.

Proof:

$$RA=RR/ER$$

$$dRA= (ERdRR-RRdER)/ER^2$$

$$dRA/dER>0 \text{ if and only if } (dRR/RR)/(dER/ER)>1$$

Lemma 2: The Composite Ratio increases with both the Expenditure Ratio and the Revenue Ratio

Proof:

$$CR=LR/ (NR-G) =LR/ [NR-(ER-RR) (LR+NR)] =$$

$$RR/ [NR/ (LR+NR)-(ER-RR)] =RR/ [1-RR-(ER-RR)] =RR/ [1-ER]$$

$$dCR= [(1-ER) dRR+RRdER]/ (1-ER) ^2$$

The latter expression is always positive because $ER \leq 1$ and $RR \geq 0$.