JEL classification: H11; H70; C33
Keywords: fiscal decentralization, government size, pooled mean group

An Empirical Analysis of the Relationship between Fiscal Decentralization and the Size of Government

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Abstract
The goal of this paper is to investigate the relationship between fiscal decentralization and the size of government. Using a pooled mean group estimator, which has rarely been applied in this context, we analyze a set of 23 OECD countries over the period 1970–2008. In contrast to previous studies we use an improved measure of fiscal decentralization, which effectively quantifies the degree of sub-national autonomy. Our results suggest that, in the long run, fiscal decentralization decreases the size of government.

1. Introduction

In the past few decades many former socialist as well as developed centralist countries have started political and fiscal decentralization reforms. To a large extent, such reforms have been strengthened by the argument that the decentralized organization of government brings about welfare-enhancing results and makes government activities more accountable. While the stabilization and the redistribution functions of government are more efficient on the central level, it is argued that resource allocation efficiency can be improved if sub-national governments are given discretion to govern their own revenues and expenditures. Sub-national governments are closer and more responsive to the needs and preferences of local residents, and this allows a closer match between the preferences of the population and the bundle of public goods and services chosen by government—assuming that preferences are heterogeneous across different sub-national units. Consequently, sub-national tiers of government emerged as important players in the field of public finances. However, recent data on sub-national governments' revenue autonomy suggest that many countries have an "incomplete" form of decentralization that involves only the transfer of expenditure responsibilities to sub-national governments, without the corresponding transfer of revenue responsibilities. However, as pointed out by Stein (1999), a crucial dimension of decentralization is how the provision of these services is financed. Because of this widespread divergence between the sub-national responsibilities for expenditures and revenues, decentralized countries often end up having a large degree of vertical fiscal imbalance. Vertical fiscal imbalances are mostly bridged through governmental transfers from the central government, many of which are discretionary in nature. This practice may reduce the fiscal discipline of sub-national governments and result in a common pool problem. As long as the central government is willing to tolerate and, more importantly, bail out fiscally irresponsible sub-national governments, there will be no incentive for sub-governmental fiscal discipline, which is at the heart of fiscal decentralization.

While most authors agree that fiscal decentralization brings about efficiency gains in the provision of public goods and services, there is no theoretical (or empirical) consensus on its impact on the total size of government. In this paper we shed some light on this issue by providing the results of the pooled mean group (PMG) estimation technique, which allows for the diversity of countries within the panel by allowing short-run cross-section heterogeneity of the slope coefficients and error variances, while maintaining homogeneity of long-run relationships.

The originality of our approach to answering the question of the relationship between the size of government and fiscal decentralization is that we, unlike most of the empirical studies in this field, use an adequate econometric technique that tackles some methodological issues that were "swept under the rug" in the earlier studies. Specifically, to arrive at precise estimates of the effects of fiscal decentralization on government size, we use a recently developed panel-equivalent error correction methodology which allows a researcher to distinguish between the long-run effects on the share of government expenditures in GDP and short-run dynamics in order to accommodate the joint occurrence of dynamics and parameter heterogeneity as well as to address the problem of endogeneity. Using a PMG estimator, we analyze a set of 23 OECD countries over the period 1970–2008. Such a "wide and long" dimension of the panel allows us to apply this technique and to consistently estimate the long-run relationship between the size of government in the economy and fiscal decentralization. The failure to account for parameter heterogeneity in a dynamic panel model with a relatively long time-series dimension can produce inconsistent and potentially very misleading estimates of the average values of the parameters (Pesaran and Smith, 1995).

Furthermore, we employ what we believe is the improved measure of fiscal decentralization, namely Stegarescu's (2005) indicator of sub-national tax autonomy, which effectively quantifies the degree of sub-national autonomy.

The paper is organized as follows: Section 2 discusses theoretical aspects of the relationship between fiscal decentralization and the size of government, while Section 3 summarizes the empirical literature. Problems related to measurement of the degree of fiscal decentralization are discussed and the existing indicators presented in Section 4. Methodological issues—data set, empirical specification, estimation techniques—are discussed in Section 5. The results are presented and discussed in Section 6. Our conclusion is presented in the final section.

2. The Effects of Fiscal Decentralization on the Size of Government: Theoretical Considerations

Fiscal decentralization is commonly thought to restrict the growth of government spending (Rodden, 2003). This stylized fact about the relationship between fiscal decentralization and the size of government is articulated in the influential work of Brennan and Buchanan (1980), who describe government as a monolithic Leviathan that seeks to maximize revenues and increase its dimensions through excessive rates of taxation, debt or money creation. Greater government size in the economy is a result of centralization and weak intergovernmental competition. Assuming that firms and citizens are mobile across jurisdictions, any attempt by one sub-national unit to raise the "tax price" will result in a migration of its economic

resources. Because of this competitive pressure, each sub-national unit will aim to reduce the "tax price" and in consequence, given the balanced-budget proposition, the supply of sub-national public goods and services. In the Brennan and Buchanan (1980) model, the presumption of government benevolence is dropped (Nelson, 1986) and the observed level of government expenditure in the economy is predominately determined by the supply of government expenditures.

The original Leviathan hypothesis is built on the assumed inseparability of tax and expenditure decentralization. However, there are very few countries in the world that are truly decentralized, i.e. countries in which citizens are represented at each level of government and their representatives can decide on both expenditures and taxes at each respective level (Muller, 2003). It is often the case that even in those countries that are considered to be federalist, sub-national expenditures are funded frequently by intergovernmental grants, revenue-sharing programs or other centrally controlled funds. This type of decentralization, i.e. expenditure decentralization without corresponding tax decentralization, is not expected to provoke the tax competition that drives the Leviathan model.

Moreover, it might have the entirely opposite effect on the size of government (Rodden, 2003). The revenue-sharing schemes reduce the competitive pressure and result in concentration of taxing power in the hands of the revenue-maximizing national governments (Ehdaie, 1994). It blurs the responsibility for spending decisions by dispersing it among a potentially large number of different levels of government and makes consumers/voters less confident about their true tax burden. It can add to the problem of the common pool, i.e. make it more likely for sub-central governments to impose the political and economic costs of their spending decisions on residents outside their jurisdictions. To an extent, sub-national governments, aiming to maximize their own share of the "common revenue pie", may face an incentive to overfish and, as pointed out by Fiva (2006), to push for higher taxes at the central level, which in turn yields expenditures with sub-nationally concentrated benefits.

This means that sub-national governments would behave as interest groups and would engage in "competition" for intergovernmental grants, rather than in competi-tion for mobile tax bases, as assumed by the Leviathan hypothesis. Hence, decentralization funded by intergovernmental grants from the common revenue pool, for a given extent of tax revenue decentralization, could be associated with higher overall government spending.

Apart from the supply-side explanation for the effect of fiscal decentralization on the size of government, in the absence of a formal structural model of the size of government in the economy, a demand-side explanation can be easily motivated: within the conventional median-voter model we can assume that government is a benevolent social-welfare maximizer, so that the supply of government expenditures is perfectly elastic, while the demand for government expenditures determines the observed level of government expenditures in the economy. From this demand-side perspective we can envisage two opposite effects of fiscal decentralization on the total size of government. Because fiscal decentralization encourages competition among sub-national governments and results in more transparent decentralized budgets, it decreases the fiscal illusion of some consumers/voters making them more aware of their true tax burden. In a truly decentralized structure of governance,

consumers/voters in adjacent jurisdictions can relatively easily compare their relative positions and penalize their sub-national government for excessive and wasteful spending. To minimize the probability of not being re-elected, sub-national governments may want to indulge their consumers/voters and reduce the size of expenditures. Consequently, we would expect a negative relationship between the government share in the economy and the extent of fiscal decentralization. However, alternative mechanisms may give the opposite results. As already pointed out, the efficiency and quality of government services can be increased by fiscal decentralization. In a decentralized structure, government services are tailored more consistently to the needs of consumers/voters. This, in turn, enhances citizens' trust in government, leading to an increase in the demand for public goods and services, and consequently to a greater size of government. Moreover, decentralization implies more access points and politicians willing to answer to special-interest groups demanding more government expenditures. The more decentralized political power is, the greater the potential for interest-group influence there is and the greater the number of interest groups there will be. Given these different possible channels of influence, it is not quite certain what differences in the size of government might be caused by more fiscal decentralization.

3. Review of the Empirical Literature

The ongoing intensive empirical "search" for the Leviathan was initiated by Oates's (1985) seminal paper where he failed to find the Leviathan in the sample of the 48 US contiguous states as well as in the sample of 43 developed and developing countries. In the same vein, Nelson (1986) also finds no evidence in support of the Leviathan hypothesis for the state governments in the US. He does provide, however, some evidence that a greater number of relatively homogeneous sub-state governmental units exert a constraining effect on the level of state revenues. As a note, we point to the measure of government size used by both Oates (1985) and Nelson (1986) and potential problems related to it. Namely, the relative size of government in both studies is measured in terms of tax receipts. Although there is no single best measure that would reflect all the activities undertaken by the government, the majority of the studies in this field use the share of government expenditures in the total economy as a measure of the size of government. It could be argued that measures of government size defined in terms of total expenditures reflect a more complete and meaningful measure of total resources absorption by government than those using a revenue-based measure. Namely, total government expenditures can be financed from several sources, directly and/or indirectly, through money creation, inflation and/or debt.

A negative statistically significant relationship between decentralization and the size of government is found in Marlow (1988). The main difference between Marlow (1988) and the two previous studies is the level of analysis. Whereas Oates (1985) and Nelson (1986) investigate the behavior of the state government level, Marlow (1988) focuses on the total general government size. Using data on aggregate US government expenditures from 1946 to 1985, he shows that increased levels of fiscal decentralization lead to a smaller government size. Using the same sample, Grossman (1989) confirms Marlow's results. In the relationship between decentralization and government, Grossman (1989) emphasizes the role of intergovern-

mental grants, which are supposed to encourage expansion of government size by concentrating taxing power in the national government and by weakening the fiscal discipline imposed on sub-national governments for the financing of their own expenditures. He empirically confirms that vertical fiscal imbalance—measured by the share of federal grants to state and local governments in total state and local receipts—increases the size of government, measured by total government expenditures relative to GNP. Shadbegian (1999) builds on Marlow (1988) and Grossman (1989), but in addition to the general government level, he extends the analysis to include the federal government and the state government levels. He shows that fiscal decentralization causes decreased expenditure by total and federal governments. At the same time, as fiscal decentralization increases, state and local public expenditures increase, but this increase is more than offset by the decrease in federal government expenditures, hence total general government decreases as a reaction to fiscal decentralization. Shadbegian (1999) also shows that intergovernmental transfers lead to an increase in overall government expenditures and an increase in expenditures at each individual level of government, confirming that collusion among the different levels of government weakens the disciplining power of fiscal federalism. Contrary to the studies that argue in favor of a more aggregate level of analysis, Forbes and Zampelli (1989) estimate a single equation model using data for 345 counties in 157 Standard Metropolitan Statistical Areas (SMSAs) to test the hypothesis that county government (own) revenues (per capita/per personal income) should be lower in those metropolitan areas with a larger number of competing county governments. The results, which are pretty much in line with Oates (1985) and Nelson (1986), suggest that at the county level of government Leviathan is a "mythical" beast.

Ehdaie (1994) tests the relationship between fiscal decentralization and the size of government using international cross-country data, divided into two samples—sample 1 consists of 30 countries in 1987, while sample 2 consists of 26 countries in 1977. He employs the Government Finance Statistics (GFS) ratio of sub-national governments' own-source revenues to total government expenditures as a proxy for fiscal decentralization. However, for the reasons explained in the subsequent sections, this measure does not satisfactorily reflect the inseparability of revenue-raising and spending responsibilities at the sub-national level of government. To control for the level of collusion among governmental units, he includes the ratio of the central government's revenues transferred to sub-national governments over total government expenditures. Failing to control for the collusion, he argues, would lead to biased estimates for decentralization, and consequently to confounded conclusions and policy recommendations, particularly in countries where intergovernmental transfers compose a large portion of sub-national budgets. This study's findings lend support to the Leviathan hypothesis, since the coefficient on the decentralization variable proves to be statistically significant and negative. In line with *a priori* expectations, fiscal collusion has the opposite, albeit statistically insignificant effect. The effect of collusion is thoroughly examined in Stein (1999) on Latin American cross-country data, averaged for the 1990–1995 period. The problem of vertical fiscal imbalance, which is typically bridged through the use of transfers from the central government, may weaken the budget constraints of sub-national governments, unless, as pointed out by Stein (1999), these intergovernmental transfers are very strictly defined, with resources allocated according to objective criteria and with little room

for discretionality and bargaining between the different levels of government. If such conditions are not satisfied, sub-national governments may have an incentive to overborrow and overspend, and then shift the burden onto the central government and other governmental units. Not only do Stein's results (1999) indicate that decentralized governments tend to be larger, but also, quite expectedly, that the size of government depends on the form of decentralization—arrangements more likely to lead to soft budget constraints seem to be associated with larger size. Jin and Zou (2002) examine how different levels of government—general, national and sub-national—behave in response to expenditure decentralization, revenue decentralization and vertical fiscal imbalance, using a panel of 32 developed and developing countries over the period 1980–1994. Broadly, the main results suggest that expenditure decentralization leads to smaller national governments, larger sub-national governments and larger total general governments. Revenue decentralization, on the other hand, increases the size of sub-national governments by less than it reduces the size of national governments, thus leading to smaller aggregate governments. Finally, vertical imbalance tends to increase the size of total, as well as of national and sub-national, governments. Cantarero and Perez (2012) demonstrate that in Spain, for instance, the intensive process of expenditure decentralization has not been accompanied by decentralization of revenues, which resulted in a system in which regional levels of government depend excessively on grants from the central government. Using a panel of seventeen Spanish regions over the period 1985–2004, they find that a negative relationship between revenue decentralization and regional government size, while expenditure decentralization had a positive effect.

More recent empirical studies employ more refined measures of fiscal decentralization, discussed in more detail in the subsequent section. Fiva (2006), for instance, employs the Stegarescu (2005) "purified" measure of revenue decentralization; that is, the share of sub-national government autonomous own revenues—only those where the sub-national government has discretion over the tax rate, tax base or both—in total general government revenues. From a cross-country perspective, the findings in Fiva (2006) suggest that tax decentralization is associated with a smaller government sector, lending support to the Leviathan hypothesis. Expenditure decentralization, on the other hand, is associated with a larger government sector. Cassette and Paty (2010) also employ the data compiled by Stegarescu (2005). Using a panel data set of 15 European countries over the period 1972–2004, they estimate both the long- and short-run effects of fiscal decentralization on the aggregate, central and sub-national government size. Their results suggest that in the long run, tax autonomy reduces central government expenditures, but increases sub-national government expenditures to a greater extent, leading to higher aggregate expenditures. To investigate the relationship between tax autonomy and sub-national government size in more detail, Liberati and Sacchi (2013) take into account the quality of tax decentralization. More precisely, to capture the impact of different tax decentralization mechanisms, they separate the impact of income tax, taxes on goods and services and property tax on the sizes of local public sectors. The key reason for this disaggregation is that while income and consumption taxes usually are assigned to local governments on the basis of various methods of revenue and tax-base sharing, property taxes are more frequently based on tax-separation schemes.

Their results suggest that property taxes only seem to have a robust negative and significant impact on the size of the local public sector. This suggests that tax decentralization is a necessary but not a sufficient condition to restrain the size of the public sector, as tax-separation schemes would therefore seem to be required to achieve that goal. In addition, they also find that grants have the standard (positive) impact on the size of local government. Consequently, they conclude that the local public sector is expected to be smaller when decentralization is funded by its own taxes and comparatively larger when funded by intergovernmental grants.

Prohl and Schneider (2009) study the effect of decentralization on the growth of government size for a panel of 29 countries over the 1978–2003 period. They employ two different proxy variables of fiscal decentralization—the "classic" GFS measure of expenditure and revenue decentralization and their own index of fiscal federalism. The results indicate that the growth of government, measured either by the share of government expenditures or revenues in GDP, is inversely influenced by each of the decentralization variables—the GFS's expenditure and revenue sub-national government shares and the Prohl and Schneider (2009) index of fiscal federalism.

Using a sample of 18 OECD countries over the 1980–2000 period, and controlling for the ideology of the central government, Baskaran (2011) finds that decentralization leads to an increase in the size of government irrespective of whether the government is controlled by a left- or right-wing party.

Using a panel co-integration approach, Ashworth et al.'s results (2013) consistently indicate that expenditure decentralization raises the size of the public sector, but this can be constrained by increasing the tax-raising powers of sub-national governments. The amount of revenues raised by sub-national governments leads to a long-term reduction in the size of government, while grants between the different levels of government instead lead to growth in the public sector's size. The message is that if one desires to control spending at the local level, raise revenue there as well.

For clarity, *Table A1 in the Appendix* provides a summary overview of the empirical studies discussed in this section.

4. Measures of Fiscal Decentralization

In the empirical literature the standard source of data on revenue and expenditure shares for sub-national relative to total government is the International Monetary Fund's Government Finance Statistics (GFS). Despite being consistent and operational, as pointed out by Fiva (2006), this data set fails to address properly the intergovernmental fiscal structure of countries. To an extent, this database keeps track of certain types of grants and various forms of own-source sub-national revenue. However, it fails to distinguish between tax revenues that are legislated and collected locally from those that accrue to sub-national governments automatically through revenue-sharing schemes (Rodden, 2003). Consequently, it tends to overestimate sub-national revenue autonomy. It is also likely to overestimate the true nature of spending autonomy, since the figures on sub-national expenditures also include those expenditures that are funded by intergovernmental grants, mandated by the central government or spent on behalf of the central government. As pointed out by Stegarescu (2005),

a system where sub-national levels of government have real autonomy to determine the allocation of their expenditures or to raise their own revenue is more decentralized than a different system in which sub-national government expenditures and revenues are determined by national legislation, even though the formal assignment of functions or revenues might be the same. Consequently, the findings of the studies employing this dataset might be misleading, since intergovernmental grants or some other revenue-sharing arrangements between sub-central and central governments are not explicitly accounted for. Aiming to overcome this deficiency, researchers from member countries of the OECD are making an effort to classify taxes in terms of the degree of autonomy they provide to sub-national governments. Rodden (2003) uses both the GFS and the OECD improved data set to demonstrate that the effect of decentralization on government size depends on the nature of fiscal federalism. Results from a somewhat limited data set consisting of 1985–1995 averages for 19 OECD countries suggest that decentralization, when funded primarily by autonomous local taxation, is associated with smaller government. On the other hand, when funded by revenue sharing, grants or centrally regulated sub-national taxation, fiscal decentralization is associated with larger government. Rodden (2003) extends the number of countries to a sample of 44 countries for the period 1978–1997, but at the expense of employing less satisfactory GFS data. The results obtained also indicate that decentralization funded by direct intergovernmental transfers is associated with larger government. It seems that when central governments increase transfers to sub-national governments, they do not reduce their own direct expenditures, while sub-national governments spend all they receive through increased transfers.

Stegarescu (2005), drawing on the OECD's analytical framework, compiled a database which includes 23 OECD countries in the period 1965–2001 where he distinguishes between different types of sub-national government revenues according to the degree of discretion sub-national governments are granted in determining them autonomously. In the subsequent part of the paper, we employ the Stegarescu (2005) measure of fiscal decentralization.

5. Data Description and Methodological Issues

5.1 Econometric Specification and Estimation Technique

While many studies on the topic use either cross-section averages or single-country time-series data, in the cross-national studies the authors in general take advantage of both the cross-section and time-series dimension of the data at hand. They mostly use panel data analysis techniques and estimators that are, unlike the classic ordinary least squares (OLS) estimator, robust to some of the specification problems frequently encountered in this kind of analysis. Given the dynamic nature of both fiscal decentralization and government size, a better analysis of dynamic adjustment that panel data allow is certainly one of the most important advantages of this type of data. However, since modeling dynamics typically involves including a lagged dependent variable as an explanatory variable, unless the time-series dimension of the data set is very large, pooled OLS, fixed-effect (FE) and random-effects (RE) estimators are biased. Additionally, the problem of a reverse causation in the relationship between fiscal decentralization and government size as another source of endogeneity seems to be avoided by the authors, either by being neglected

completely or only mentioned in passing. Among the reviewed studies, Rodden (2003), Feld et al. (2010) and Martinez-Vazquez and Yao (2009) address this problem more explicitly. In order to tackle the problem of possible endogeneity of the decentralization variable, Feld et al. (2010) and Martinez-Vazquez and Yao (2009) use the two-stage least square (2SLS) procedure. As suitable instrumental variables—uncorrelated with the error term and correlated with the potentially endogenous decentralization variable—Feld et al. (2010) use lags of the original decentralization variable, while Martinez-Vazquez and Yao (2009) use ethnic, language and religion fractionalization indices. Rodden (2003) uses several different estimators, including the Arellano-Bond generalized method of moments (GMM), where internal instruments for the potentially endogenous variables are created and used.

The methods used in prior empirical research require pooling individual groups and allowing only the intercepts to vary across the groups. However, as pointed out by Pesaran and Smith (1995) and many others (see, for example, Im et al., 2003; Pesaran et al., 1997, 1999 and Phillips and Moon, 2000), one of the key findings from the literature that analyses panels with a large number of cross-sectional observations (N) and a large number of time-series observations (T) is that the assumption of slope parameters homogeneity is often inappropriate. Recent years have seen a surge of interest in these large N-large T panels, primarily due to the availability of data with greater frequency. T is assumed to be large enough that each nation (or state) can be estimated separately.

In our sample the time-series component (T) is large, and the recent literature on panel estimation in which both N and T are relatively large suggests several approaches. On the one end, there are static fixed-effect estimators (SFE) or dynamic fixed-effect estimators (DFE), which normally assume homogeneity of all slope coefficients, allowing only the intercepts to vary across countries. If, however, the slope coefficients are heterogeneous, as is often the case in reality, then the fixed-effect approach could produce inconsistent and potentially misleading results (see, for example, Pesaran and Smith, 1995 and Baltagi, 2005). Since the size of government and fiscal decentralization differ across countries, these assumptions are not realistic. On the other end there is the mean group (MG) estimator proposed by Pesaran and Smith (1995), whereby the model is estimated separately for each individual state, and a simple arithmetic average of the coefficients is calculated. With this estimator the intercepts, slope coefficients and error variances are all allowed to differ across states.

More recently, Pesaran et al. (1999) have proposed an intermediate estimator, a pooled mean group (PMG) estimator, that allows for slope heterogeneity in the short run (like the MG estimator), but imposes common long-run coefficients (like the fixed-effects estimator). This estimator is specially suited for panels with large T and N, such as ours. Therefore, we use the PMG estimator in our empirical investigation in the following section.

Assume the long-run relationship between the size of government, fiscal decentralization and a set of control variables:[1]

$$\ln G_{it} = \alpha_{0i} + \theta_{1i} \ln SubRev_{it} + \theta_{ki} \left(\ln Z_k \right)_{it} + u_{it} \tag{1}$$

[1] Control variables will be explained in the text below.

Table 1 Summary Statistics

Variable[a]	Obs	Mean	Std. Dev.	Min	Max
G	904	41.99	9.52	16.15	67.47
SubRev	649	19.82	16.77	0.05	61.50
GDP	952	21350.25	8108.43	2981.34	65308.75
RP	926	0.93	0.12	0.38	1.37
GOVEMP	731	18.03	6.54	4.80	34.58
OPN	897	71.94	44.32	11.25	326.60

Note: [a] The variables listed in this table will be explained in more detail in the sub-section 5.2.1.

where the number of nations $i = 1, 2, \ldots N$; the number of periods $t = 1, 2, \ldots T$; G is the size of government, *SubRev* is the measure of fiscal decentralization, and Z_k is a vector of K ($k = 1,2,\ldots,K$) control variables. The autoregressive distributed lag (ARDL) (1,1,1) dynamic panel specification of (1) is:

$$\begin{aligned} \ln G_{it} &= \gamma_i + \lambda_i G_{it-1} + \delta_{10i} \ln Sub\,\mathrm{Re}v_{it} + \delta_{11i} \ln Sub\,\mathrm{Re}v_{it-1} + \\ &+ (\delta_k)_{0i} (\ln Z_k)_{it} + (\delta_k)_{i1} (\ln Z_k)_{it-1} + \varepsilon_{it} \end{aligned} \tag{2}$$

The error correction reparameterization of (2) is

$$\begin{aligned} \Delta \ln G_{it} &= \varphi_i \left[\ln G_{it-1} - \theta_{0i} - \theta_{1i} \ln Sub\,\mathrm{Re}v_{it} - \theta_{ki} (Z_k)_{it} \right] + \\ &+ \delta_{11i} \Delta \ln Sub\,\mathrm{Re}v_{it} + (\delta_k)_{1i} \Delta (\ln Z_k)_{it} + \varepsilon_{it} \end{aligned} \tag{3}$$

Finally, since the PMG estimator allows the intercepts and short-run coefficients to differ freely across countries while imposing homogeneity on the long run coefficients (i.e. $\theta_{1i} = \theta_1$ and $\theta_{ki} = \theta_k$), the corresponding PMG specification is:

$$\begin{aligned} \Delta \ln G_{it} &= \varphi_i \left[\ln G_{it-1} - \theta_{0i} - \theta_1 \ln SubRev_{it} - \theta_k (Z_k)_{it} \right] + \\ &+ \delta_{11i} \Delta \ln SubRev_{it} + (\delta_k)_{1i} \Delta (\ln Z_k)_{it} + \varepsilon_{it} \end{aligned} \tag{4}$$

One would expect φ_i to be negative if the variables exhibit a return to long-run equilibrium.

5.2 Data

We estimate the model outlined in (4) using annual data for 23[2] OECD countries for the time period 1970–2008. Since observations for some of the countries and/or time periods are missing due to data non-availability, our panel is unbalanced. *Table 1* reports summary statistics, while *Table A2 in the Appendix* gives more details on the data employed in our paper.

In what follows we explain the variables to be included in our model in more detail.

[2] The 23 countries we include in the sample are those for which Stegarescu (2005) provides fiscal decentralisation data. These include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.

5.2.1 Dependent Variable—Government Size

We employ an imperfect but widely used measure of the size of the government sector in the economy—the share of government expenditure in total expenditures or outputs, approximated by GDP. An ideal measure of government size includes all aspects of government intervention in the economy. Cullis and Jones (1998) point out that the influence of the government sector in an economy goes far beyond the effects of government expenditures. Data on government expenditure does not capture the overall significance of government in many countries. Most obviously, the expenditure data do not take into account quasi-fiscal activities and government regulation, which is yet another important role that governments play in the economy. The size of government in an economy unquestionably depends on the scope of institutions and individuals that the government owns, controls and/or regulates. Garen and Trask (2005) particularly highlight the importance of non-budgetary aspects of the government. They demonstrate that countries with less government expenditure tend to be more interventionist and encompass a great deal more government in other forms, such as government ownership of enterprises in the economy, the extent of price controls, the risk of expropriation by the government and the risk of contract repudiation by the government. Instead of taking over production directly, Holcomb (2006) suggests that an alternative would be for the government to regulate the behavior of market participants. The concept of the size of government involves so many multidimensional issues that no single comprehensive measure can embrace it in practice. So far, most of the researchers attempting to quantify the share of national output absorbed by the government ended up employing the government expenditure shares in GDP. This study is not an exception in this regard. The dependent variable in our model is measured as the ratio of total government expenditure to GDP, in nominal terms, to proxy the size of government in the economy.

5.2.2 Variable of Interest—Fiscal Decentralization

Measurement issues related to fiscal decentralization are discussed in Section 4. Here, we briefly present the measure that, we believe, is the best available approximation of the genuine degree of fiscal decentralization which is our main variable of interest. It is taken from Stegarescu (2005).[3] The variable on revenue decentralization $\left(DEC_{REV} = \frac{\text{sub-national autonomous revenues}}{\text{general government revenues}} \right)$ is measured as the revenue share of sub-national government relative to general government, but only includes revenues where the sub-national government has discretion over the tax rate, tax base or both, i.e. the share of sub-national government autonomous own revenue in the total revenue of general government.

5.2.3 Control Variables

In line with previous research and most prominent theories in this field, in our model we include a set of control variables that are a *priori* expected to have an effect on the total size of government in the economy. Our model is essentially

[3] We kindly thank Dan Stegarescu and Jon Fiva for making this indicator available to us.

a demand-led model, based on the median voter theorem and the assumption of a benevolent government that ultimately complies with the citizens' demand. Control variables included are all assumed to affect the demand for public expenditure.

The first is GDP per capita (*GDP*). The rationale for controlling for the level of a country's income is based on Wagner's Law. Being one of the oldest hypotheses in the literature on government size, this law proposes that government expenditures as a share of national income tend to grow in the course of economic development. The underlying idea is that goods and services generally provided by the government sector are superior goods. Given that the demand for government goods and services is income-elastic, as nations grow wealthier and more complex, they demand a larger public sector. *A priori*, in the long run, GDP per capita is expected to exert a positive effect on government size.

We include yet another important variable, namely the relative price of public to private goods (*RP*) to allow for the so-called Baumol's cost disease effect. This variable is measured as the ratio of the deflator for government final consumption expenditure to the deflator for private final consumption expenditure. According to Baumol (1967), a continuous increase in the relative costs and prices of productivity-lagging public services will result in the relative growth of the government sector in the economy, should the demand for government services be price-inelastic. Given that the dependent variable in our empirical model is the government share, we expect a positive coefficient on the relative price variable as an indication that all of Baumol's fundamental assumptions—i.e., slower productivity growth in the government sector compared to the private sector, wage equalization across all sectors in the economy and price-inelastic demand for government deliveries—hold empirically.

We further control for the effect of a country's degree of trade openness (*OPN*) on its size of government. The unsettled question of whether more open economies have bigger governments makes it difficult to speculate on the sign of this influence. There are two conflicting views on the effect of a country's openness on the share of government in the economy in the literature, namely the compensation hypothesis and the efficiency hypothesis. The former presumes a positive effect stemming from higher demand for the risk-reducing role of government in more open economies, while the latter assumes more open economies to have smaller governments due to more competitive deregulation and greater competition for mobile factors that more open economies are subject to.

We also allow for the effect of bureaucracy on the size of government by including the general government employment variable (*GOVEMP*) as a control variable. In our model, which posits that the size of government in the economy is determined by the demand-led factors, government-sector employees are treated as a special-interest group. Special-interest groups benefit from particular government actions at the expense of the overall taxpaying population. They organize and lobby to protect and promote their interests before government, either directly or indirectly by influencing the views of the general public, or in both ways. In this manner, interest groups can ultimately influence government activity and its share in the economy. It can be argued that government-sector employees act both as voters and as a pressure group to achieve and defend a larger public sector that provides their living.

5.3 Unit Root and Cointegration Tests

The fact that our panel is unbalanced guides our choice of the appropriate panel unit root test. Among the first-generation test procedures, only Fisher-type tests do not require a balanced panel. These tests combine the *p*-values from *N* independent unit root tests, as developed by Maddala and Wu (1999). Based on the *p*-values of individual unit root tests, Fisher-type tests assume that all series are non-stationary under the null hypothesis against the alternative that at least one series in the panel is stationary. In *Table A3 in the Appendix* we present the results for this test. In addition, we also apply a second generation unit root test since the assumption of cross-sectional independence does not hold in our sample (results of the tests for cross-sectional dependence are not reported). Hence, we want to allow for the error cross-sectional dependence, i.e. the potential for errors to be contemporaneously correlated across panel members due to unobserved (global) common factors. Among the second-generation unit root test procedures that allow for dependence among countries, we apply Pesaran's cross-sectionally augmented IPS (CIPS) test, since it can be applied to unbalanced panels. In the Pesaran panel unit root test the standard Augmented Dickey-Fuller (ADF) regressions are augmented with the cross-section averages of lagged levels (as a proxy for the single common factor) and first-differences of the individual series. CIPS test results are reported in *Table A4 in the Appendix*. However, it should be stressed that, as noted by Pesaran and Shin (1999), the ARDL approach yields consistent estimates of the long-run coefficients that are asymptotically normal irrespective of whether the underlying regressors are I(1) or I(0).

Another issue that has to be tackled before turning to unit root testing is to determine the lag length. In both the Fisher-type and Pesaran unit root tests, the lag length was suggested by the Akaike information criterion (AIC) for ADF tests. Given that the Fisher-type Phillips Perron test is a non-parametric one, no lags were introduced. Using the Akaike information criterion, lags are chosen for each individual cross-section unit.

The panel unit root tests we have undertaken generally suggest that all series are I(1). This is confirmed by both the first- and second-generation unit root tests. We next test for the absence/presence of cointegration among the variables in our model by using the Stata routine *xtwest* developed by Persyn and Westerlund (2008). This routine applies four panel cointegration tests proposed by Westerlund (2007), which test for the absence of cointegration by determining whether the individual panel members are error correcting. The results for different combinations of the variables in our model are given in *Table A5 in the Appendix*. The results indicate that each independent variable is cointegrated with the dependent variable (*G*) when we test for bivariate cointegration. Furthermore, three-variable combinations containing the dependent variable (*G*), our main variable of interest (*SubRev*) and an additional variable also seem to be cointegrated. Finally, the results for the whole model suggest that we can reject the null of no cointegration. Moreover, the negative and significant error correction term in PMG estimation (given in *Table 2*) further confirms this finding, indicating the presence of a long-run relationship.

6. Results

The main aim of this paper is to investigate the long-run relationship between the size of government and fiscal decentralization. The Pesaran and Smith (1995) and

Table 2 Estimation Results

Dependent variable: *G* growth	PMG
Convergence coefficient	-0.272*** (-2.8)
Long-run coefficients	
ln*SubRev*	-0.035*** (-3.84)
ln*GDP*	0.226*** (4.38)
ln*RP*	-0.093 (-1.13)
ln*OPN*	-0.194*** (-3.46)
ln*GOVEMP*	0.494*** (8.66)
CONS	0.274*** (2.91)
Short-run coefficients	
Δln*SubRev*	0.081* (1.69)
Δln*SubRev* (-1)	-0.001 (-0.03)
Δln*GDP*	-0.949*** (-7.23)
Δln*GDP* (-1)	0.08 (0.75)
Δln*RP*	-0.083 (-0.34)
Δln*OPN*	-0.029 (-0.54)
Δln*GOVEMP*	0.510*** (5.87)
Δln*GOVEMP* (-1)	0.104 (1.13)
Number of countries	17[a]
Number of observations	454
Log likelihood	-1114.06

Notes: [a] The number of countries is less than 23 due to missing data for certain variables.

z-statistics in parentheses; *, ** and *** denote significance at 10, 5 and 1 percent, respectively. The presented short-run coefficients are averages of the country-specific short-run coefficients, which are not given in the table for space-saving reasons.

Pesaran et al. (1999) approach is, essentially, a panel equivalent to the time-series error correction (EC) re-parameterization of an ARDL model, which appears to be a useful platform for studying a number of methodological issues. It has the advantage of accounting for both the short-run fluctuations and the long-run equilibrium relationship between the variables, even if they appear to be non-stationary. Although we report both the long-run and short-run coefficients, we only discuss the long-run coefficients of interest and abstract from further elaborating the short-run coefficients. *Table 2* presents the results.

Pesaran and Shin (1999) and Pesaran et al. (1999) argue that the appropriate modification of the orders of the ARDL model is sufficient to simultaneously correct for the residual serial correlation and the problem of endogenous regressors, thus ensuring consistency and efficiency of the parameters of interest, whether the variables of interest are integrated or stationary. Following this point of reference, we introduce an additional lag for each variable we suspect of being endogenous. More precisely, we introduce additional lags for revenue decentralization (*SubRev*), GDP per capita (*GDP*) and government-sector employees (*GOVEMP*).

The results indicate firstly that, as expected, the convergence coefficient is negative and statistically significant. It implies that approximately 24% of the discrepancy between government expenditure and its long-run equilibrium level is corrected each year. The coefficient on ln*SubRev* is significant and negative, suggesting that the higher degree of fiscal decentralization reduces the demand for total government expenditures. This finding lends support to the view that fiscal decentralization brings about competition among sub-national governments, reduces the fiscal illusion and increases the overall transparency of the government sector, making it less likely for the government to engage in excessive and wasteful spending. In line with Wagner's Law, the coefficient on ln*GDP* is positive and significant, thus indicating that an increase in a country's income increases the demand for government expenditures by a greater amount. Consequently, the size of government in the economy increases. As hypothesized by Wagner's Law, this result suggests that people demand larger public sectors as market and legal relationships become more complex and as nations grow wealthier. The effect of relative prices of public to private goods is negative and thus not in line Baumol's cost disease explanation. It is, however, statistically insignificant. This negative finding could be an indication that some of Baumol's assumptions—slower productivity growth in the government sector compared to the private sector, wage equalization across all sectors in the economy and price-inelastic demand for government deliveries—are not relevant for the countries and time period under investigation. A more detailed analysis of each of these assumptions requires, among other things, data on public sector productivity which is, due to the conceptual difficulties, hard to construct and obtain. Given this practical obstacle and statistical insignificance of this variable, we do not engage in further elaboration of the effect of relative prices on the size of the government sector in the economy. A negative and statistically significant coefficient on the trade openness variable suggests that the effect predicated by the efficiency hypothesis might be more relevant to explain the effect of a country's trade openness on its size of government. More competitive deregulation and greater competition for mobile factors increases the constraints on the government's ability to tax, spend and regulate relative to its neighbors and induces race-to-the-bottom behavior in terms of social protection and provision of government goods and service. In line with our expectations, the statistically significant and positive coefficient on government-sector employees suggests that government-sector employees, like any other special-interest group, exert a positive effect on the size of government in the economy. Aiming at maximizing the impact of their actions, government-sector employees will protect and promote their interests before government.

Table 3 Robustness Checks

Dependent variable: *G* growth	(1)	(2)	(3)	(4)	(5)
Estimation technique	**PMG**	**PMG**	**PMG**	**DFE**	**MG**
Convergence coefficient	-0.272***	-0.265***	-0.278***	-0.199***	-6.853
	(-2.91)	(-2.62)	(-2.72)	(-8.26)	(-1.14)
	Long-run coefficients				
ln*SubRev*	-0.046***	-0.035***	-0.034***	-0.033	-0.575
	(-4.59)	(-3.08)	(-3.92)	(-1.57)	(-1.22)
ln*GDP*	0.124	0.277***	0.269***	-0.243***	-2.201
	(1.53)	(5.00)	(4.97)	(-2.88)	(-1.17)
ln*RP*	-0.173*	-0.170*	-0.118	0.449**	6.455
	(-1.79)	(-1.83)	(-1.51)	(2.45)	(1.13)
ln*OPN*	-0.228***	-0.147***	-0.228***	-0.023	-0.697
	(-3.88)	(-2.62)	(-3.95)	(-0.27)	(-0.97)
ln*GOVEMP*	0.526***	0.580***	0.459***	0.481***	-3.269
	(9.52)	(9.03)	(7.63)	(5.22)	(-0.84)
ln*OPNlmf*	0.040				
	(1.49)				
ln*UNION*		0.033			
		(0.92)			
CRISIS			-0.099***		
			(-1.99)		
CONS	0.559***	-0.022	0.228***	1.029***	18.441
	(2.96)	(-0.89)	(2.86)	(6.49)	(1.09)

continued on the next page

6.1 Robustness Checks

In order to check the robustness of our findings, we test alternative specifications of the model. *Table 3* presents the results for different explanatory variables and alternative estimation techniques. More precisely, in column (1), in addition to our preferred specification (presented in *Table 2*), we add the financial openness variable (ln*OPlmf*). As proposed by the proponents of the efficiency hypothesis, it might be the case that greater financial openness, i.e. more competitive deregulation and greater competition for mobile factors, forces governments to scale down the extent of their involvement in the economy. This variable is measured as the share of external assets and liabilities in GDP (Lane and Milesi-Ferretti, 2007). In *Table 3* the financial openness variable is found to be statistically insignificant, while all the conclusions from our baseline specification remain the same (with the exception that ln*RP* becomes statistically significant). In column (2) we add a variable that proxies the effect of an additional special-interest group, namely trade union density (ln*UNION*). This variable also turns out to be insignificant, while, upon its inclusion, variable (*RP*) becomes statistically significant. All the remaining results remain unchanged in terms of the signs and significances. Thirdly, in order to allow for the impact of breakouts of financial crises (during the investigated period) on the size

Table 3 Robustness Checks *(continued)*

Dependent variable: *G* growth	(1)	(2)	(3)	(4)	(5)
Estimation technique	**PMG**	**PMG**	**PMG**	**DFE**	**MG**
Convergence coefficient	-0.272***	-0.265***	-0.278***	-0.199***	-6.853
	(-2.91)	(-2.62)	(-2.72)	(-8.26)	(-1.14)
	Short-run coefficients				
Δln*SubRev*	0.066	0.083	0.083*	-0.011	-2.241
	(1.20)	(1.47)	(1.74)	(-1.05)	(-1.00)
Δln*SubRev* (-1)	-0.010	-0.007	0.008	0.017	-2.070
	(-0.23)	(-0.17)	(0.20)	(1.60)	(-1.00)
Δln*GDP*	-0.900***	-0.989***	-0.942***	-1.026***	-1.956*
	(-6.32)	(-6.6)	(-6.92)	(-9.94)	(-1.65)
Δln*GDP* (-1)	0.127	0.071	0.080	0.027	-2.925
	(1.10)	(0.54)	(0.68)	(0.24)	(-1.13)
Δln*RP*	0.007	-0.102	-0.059	0.019	-4.560
	(0.03)	(-0.48)	(-0.24)	(0.19)	(-1.04)
Δln*OPN*	-0.019	-0.030	-0.028	-0.056*	-2.253
	(-0.28)	(-0.88)	(-0.52)	(-1.82)	(-1.01)
Δln*GOVEMP*	0.601***	0.466***	0.530***	0.331***	-21.947
	(5.84)	(6.11)	(5.71)	(3.31)	(-0.99)
Δln*GOVEMP* (-1)	0.138	0.069	0.127	-0.086	-11.964
	(1.60)	(0.61)	(1.28)	(-0.88)	(-0.99)
Δln*OPImf*	0.039				
	(1.36)				
Δln*UNION*		-0.012			
		(-0.07)			
Δ*CRISIS*			0.000		
			(-0.32)		
Number of countries	16	17	17	17	17
Number of observations	439	447	454	454	454
Log likelihood	-1091.399	-1128.862	-1115.144		

Notes: *z*-statistics in parentheses; *, ** and *** denote significance at 10, 5 and 1 percent, respectively. The presented short-run coefficients are averages of the country-specific short-run coefficients, which are not given in the table for space-saving reasons.

of government, we additionally construct a shift dummy variable (*CRISIS*) and include it as an additional control variable (column (3)). The effect of financial crises is statistically significant and negative, suggesting that crises reduce the size of government. The rest of the results remain robust.

Finally, we also test two alternative estimation techniques. As put forward previously, the literature on panel estimation in which both N and T are relatively large also suggests some other approaches, and these are: the dynamic fixed-effect estimators (DFE) and the mean group (MG) estimator (Pesaran and Smith, 1995). DFE assumes homogeneity of all slope coefficients, allowing only the intercepts to

vary across countries, and it is equivalent to equation (4) under the assumption that $\delta_{11i} = \delta_{11}$ and $(\delta_k)_{1i} = (\delta_k)_1$. MG, on the other hand, allows the intercepts, slope coefficients and error variances to differ across countries, and it is represented by equation (3). The results from these two approaches are given in *Table 3,* columns (4) and (5), respectively. The results vary significantly in terms of signs as well as significances when compared to our preferred specification in *Table 2*, i.e. PMG. Since Pesaran et al. (1999) argue that the MG estimator is always consistent, we apply the Hausman test in order to determine the consistency of the PMG estimator. The calculated Hausman statistic does not reject the null hypothesis of common coefficients between the MG and PMG estimators; therefore, the PMG estimator is preferred. Similarly, we compare DFE and the MG estimator and the results suggest that the DFE model is also preferred to the MG model. All in all, the results consistently suggest that common long-run coefficients are a reasonable assumption, which is supported by the data, and that PMG, i.e. the efficient estimator under the null hypothesis in the Hausman test, is preferred.

Overall, the robustness checks confirm that the main results remain intact with different samples and additional controls.

7. Conclusion

Economists are struggling to give a clear-cut theoretical explanation of the effect of decentralization on the size of government, and the empirical results are mixed. This paper is an empirical contribution to the understanding of the relationship between fiscal decentralization and the size of government in a set of developed economies. Until recently, studies that examined the relationship between fiscal decentralization and the size of government typically employed accounting measures of either revenue or spending shares for sub-national relative to general government as a proxy for fiscal decentralization, irrespective of whether sub-national governments actually have discretion over those assigned functions or revenues. Since fiscal decentralization seems to have occurred almost exclusively through increased grants and shared revenues rather than the devolution of expenditure and tax authority in the majority of countries (Rodden, 2003), those two measures do not capture accurately the phenomenon of fiscal decentralization. Our study employs an improved indicator of sub-national tax autonomy. In addition, we account for the potential endogeneity of the decentralization variable, which has been a rather neglected issue in previous research. We use the pooled mean group estimator, which allows for slope heterogeneity in the short run, but imposes common long-run coefficients. Our results imply a negative relationship between the size of government and fiscal decentralization, thus suggesting that fiscal decentralization brings about competition among sub-national governments, reduces the fiscal illusion and increases the overall transparency of the government sector, making it less likely for government to engage in excessive and wasteful spending. This is in line with the findings of Jin and Zou (2002), Rodden (2003), Fiva (2006) and Prohl and Schneider (2009) but contrasts with the findings of Cassette and Patty (2010).

APPENDIX

Table A1 Empirical Studies on the Impact of Fiscal Decentralization on the Size of Government

Study	Data sample—countries, time period	Estimation technique, estimator	Measure of decentralization	Measure of government size	Main finding(s)
Oates (1985)	43 countries, 1982 48 contiguous USA states, 1977	Cross-section, OLS	Central government revenues/ /expenditures as a share of total government revenues/ /expenditures State government revenues/expenditures as a share of state and local government revenues/ /expenditures The absolute number of local government units in a state	Total government revenues as a share of GDP State and local tax revenues as a share of personal income	No support for the LH
Nelson (1986)	49 USA states, 1976/77 fiscal year	Cross-section, OLS	State government tax revenues as a share of total state and local tax revenues The 1975 population of the state divided by the number of counties within the state	State and local government tax revenues per capita/per state personal income	No support for the LH—revenue decentralization
Marlow (1988)	USA, 1946–1985	Time-series, OLS	State and local government expenditures as a share of total government expenditures	Total government expenditures as a share of GNP	Support for the LH
Forbes and Zampelli (1989)	157 USA SMSAs (345 counties), 1977	Cross-section, OLS, ML	Total number of county governments in a SMSA	County government revenue per capita/ /per personal income County government own revenue per capita/ /per personal income	No support for the LH
Grossman (1989)	USA, 1946–1986	Time-series, OLS	State and local government expenditures as a share of total government expenditures	Total government expenditures as a share of GNP	Support for the LH
Ehdaie (1994)	Sample I: 30 countries, 1987 Sample II: 26 countries, 1977–1987	Cross-section, OLS	Sub-national government own-source revenues as a share of total government expenditures	Total government expenditures as a share of GDP	Support for the LH

Study	Data sample—countries, time period	Estimation technique, estimator	Measure of decentralization	Measure of government size	Main finding(s)
Shadbegian (1999)	48 USA states, 1979-1992	Panel data, GLS, FE	State and local government own-purpose expenditures as a share of total government expenditures	Local/state/state and local/federal/total government own-purpose expenditures as a share of gross state product	Support for the LH—total and federal government
Stein (1999)	Latin America (and the OECD countries) average 1990–1995	Cross-section, OLS	Sub-national government expenditures as a share of total government expenditures	Total government expenditures as a share of GDP	No support for the LH
Jin and Zou (2002)	17 developed and 15 developing countries, 1980–1994	Panel data, FE, FGLS	Sub-national government expenditures as a share of total government expenditures Sub-national government own-source revenue as a share of total government revenue	Sub-national/ /central/total government expenditures as a share of GDP	Support for the LH—revenue decentralization
Feld, Kirch-gässner and Schaltegger (2003)	26 Swiss cantons, 1980–1998	Pooled cross-section time-series OLS, 2SLS	Local government revenue as a share of state and local government revenue Total number of communes in a canton per capita	Cantonal and local government revenue (income, property, profit and capital tax as well as user charges) per capita	Support for the LH—revenue decentralization
Rodden (2003)	Dataset I: 44 countries, 1978–1997; subsample: 25 countries, 1980–1993 Dataset II: 19 OECD countries, average 1985–1995	Panel data, error-correction model, FE, Arellano-Bond's GMM, "between effects" OLS	Sub-national government own-source revenue as a share of total government revenue (GFS) Sub-national government own-source revenue as a share of total government revenue (OECD)	Total government expenditures as a share of GDP	Support for the LH—revenue decentralization
Fiva (2006)	18 OECD countries, 1970–2000, 5-year averages	Panel data, pooled cross-section time-series OLS, fixed-effects	Sub-national government revenue as a share of general government revenue (Stegarescu, 2005) Sub-national expenditures as a share of general government expenditures	Total government expenditures as a share of GDP	Support for the LH—revenue decentralization

Study	Data sample—countries, time period	Estimation technique, estimator	Measure of decentralization	Measure of government size	Main finding(s)
Martinez-Vazquez and Yao (2009)	74 countries, 1985–2005 (various years)	Panel data, 2SLS	Sub-national expenditures/ /revenues as a share of general government expenditures/ /revenues	Public sector employees as a share of population/ /labor force General government employees as a share of population	No support for the LH
Prohl and Schneider (2009)	29 countries, 1978–2003	Panel data, pooled cross-sectional time-series, GLS	Sub-national government expenditures/ /revenues as a share of general government expenditures/ /revenues Prohl and Schneider (2009) fiscal federalism index	Total government expenditures/ /revenue as a share of GDP	Support for the LH
Cassette and Paty (2010)	EU-15 countries, 1972–2004	panel data, spatial and dynamic model, system-GMM	Sub-national government own tax revenue/ /consolidated general government total tax revenue	Total public sector expenditures/GDP Central government expenditures/GDP Sub-national public sector expenditures/GDP	No support for the LH
Baskaran (2011)	18 OECD countries, 1980–2000	panel data, FE, IV approach	Expenditure decentralization: Sub-national government expenditures/total government expenditures Revenue decentralization: Sub-national government revenues/total government revenues	Total government expenditures/GDP	No support for the LH
Cantarero and Perez (2012)	17 Spanish regions, 1985–2004	panel data, FE, system-GMM	Expenditure decentralization: Sub-national government expenditures/total government expenditures Revenue decentralization: Sub-national government revenues/total government revenues Regional government taxes/GDP	Total regional government expenditures/GDP	Support for the LH—revenue decentralization

Study	Data sample—countries, time period	Estimation technique, estimator	Measure of decentralization	Measure of government size	Main finding(s)
Asworth, Galli and Padovano (2013)	28 developed and developing counties, 1976–2000 18 OECD and Israel	Panel cointegration analysis	Expenditure decentralization: Dummy variable taking the value of one when the country falls within the highest quartile (highly centralized spending) Revenue decentralization: Own revenues raised and retained by state-regional and local level/total revenues Stegarescu (2005)	Total government expenditures/GDP	Support for the LH—revenue decentralization
Liberati and Secchi (2013)	19 OECD countries, 1980–2004	Panel data, FGLS, FE, PCSE, difference and system-GMM	Revenue decentralization: Local income tax/local revenues Local property tax/local revenues Local taxes on goods and services/local revenues	Total local government spending/GDP	Support for the LH–property tax

Notes: LH = Leviathan Hypothesis, GDP = gross domestic product, SMSA = standard metropolitan statistical area, ML = maximum likelihood, GLS = generalized least squares, FE = fixed effects, OLS = ordinary least squares, 2SLS = two-stage least squares, FGLS = feasible generalized least square, PCSE = Prais-Winsten panel corrected standard error, IV = instrumental variables, GMM = generalized method of moments, GFS = Government Finance Statistics, OECD = Organization for Economic Cooperation and Development.

Source: Golem (2010) for references up to 2009, and the authors' own insertion for references thereof.

Table A2 Data Documentation

Variable	Definition and Construction	Source
Government expenditure in GDP (*G*)	Total nominal general government expenditure as a ratio of GDP. It consists of two series: government outlays in GDP for 1970–2000 and government expenditures in GDP for 2001–2008. The two series are merged so that the average conversion factor is calculated over the latest five overlapping observations for each country and applied to "correct" the last eight observations in the government expenditure series, which are then added to the government outlays series. The government outlays include the final consumption expenditures of the general government, interest paid, subsidies paid, social benefits other than in-kind paid, other current transfers paid, net capital transfers paid, gross capital formation and net acquisitions of non-produced non-financial assets, minus consumption of fixed capital. Government expenditure includes: intermediate consumption + compensation of employees + + other taxes on production payable instead of the final consumption expenditures. Other categories remain as in the government outlays. The data cover the general government sector (central government, state government, local government and social security funds).	OECD (2001): Total Government Outlays, *Historical Statistics*, available at http://www.oecdilibrary.org/oecd/content/serial/19962061; supplemented for the period 2000–2008 by OECD (2010) Total General Government Expenditure, General Government Accounts—Volume IV, *OECD National Accounts Statistics* (database), available at http://www.oecdilibrary.org/oecd/content/datacollection/na-gga-data-en.
Revenue decentralization (*SubRev*)	The share of sub-national government autonomous own revenues (with discretion over the tax rate, tax base or both) in total revenue of general government	Kindly provided by the author: Stegarescu (2005), and Jon Fiva (2006).
GDP per capita (*GDP*)	GDP per capita in constant prices, US $2000	OECD (2010), gross domestic product, aggregate national accounts, OECD National Accounts Statistics (database), available at http://dx.doi.org/10.1787/data-00001-en.
Relative prices (*RP*)	Ratio of the deflator for government final consumption expenditure to the deflator for private final consumption expenditure	OECD (2010), Deflators and Prices *OECD Economic Outlook No. 86* (database), available at http://www.oecdilibrary.org/oecd/content/data/data-00370-en?isPartOf=/content/datacollection/eo-data-en.
Trade openness (*OPN*)	Value of exports plus imports as a share of GDP	World Bank (2009), *World Development Indicators* (WDI) Online
General government employment (*GOVEMP*)	General government employment as a share of total employment. The data on General government employment include government units—core ministries, departments and agencies, non-market publicly owned hospitals, public schools, social security organizations, private non-market non-profit institutions financed and controlled by government units. It includes units at all levels of governments	OECD (2010), General Government Employment, Labor Market, *OECD Economic Outlook No. 86* (database), available at http://www.oecdilibrary.org/oecd/content/data/data-00370-en?isPartOf=/content/datacollection/eo-data-en.

Financial Openness: Lane and Milesi-Ferretti (*OPImf*)	Ratio of the volume of external assets and liabilities to GDP. External assets and liabilities are claims between a country's residents and non-residents and comprise portfolio equity assets and liabilities, foreign direct investment assets and liabilities, portfolio debt assets and liabilities, financial derivative assets and liabilities, and total reserves minus gold.	Lane and Milesi-Ferretti (2007), downloadable from http://www.imf.org/external/pubs/ft/wp/2006/data/wp0669.zip
Trade union density (*UNION*)	Ratio of active wage- and salary-earning trade union members to the total number of wage and salary earners (OECD Labor Force Statistics methodology)	OECD (2010), Trade Unions, *OECD Employment and Labor Market Statistics* (database), available at http://www.oecdilibrary.org/oecd/content/datacollection/lfs-tu-data-en.
Crisis dummy (*CRISIS*)	Dummy variable taking the value of one for the crisis inception year onwards, and zero for the period before the crisis.	Laeven and Valencia (2008), Reinhart and Rogoff (2008) and Dell'Ariccia et al. (2008)

Note: The data are annual.

Table A3 Panel Unit Root Tests: Fisher-Type Tests

Dependent variable	Fisher-type Augmented Dickey-Fuller	Fisher-type Augmented Dickey-Fuller + trend	Fisher-type Phillips-Perron	Fisher-type Phillips-Perron + trend
ln*G*	0.000***	0.0936*	0.0001***	0.8511
ln*SubRev*	0.2241	0.000***	0.0477**	0.0285**
ln*GDP*	0.9892	0.0001***	0.5803	0.273
ln*RP*	0.0043***	0.0000***	0.0000***	0.0557*
ln*OPN*	0.8737	0.0162**	0.9437	0.5854
ln*GOVEMP*	0.001***	0.1945	0.000***	0.9480
*D*ln*G*	0.000***		0.000***	
*D*ln*SubRev*	0.000***		0.000***	
*D*ln*GDP*	0.000***		0.000***	
*D*ln*RP*	0.000***		0.000***	
*D*ln*OPN*	0.000***		0.000***	
*D*ln*GOVEMP*	0.000***		0.000***	

Notes: Numbers in the table are *p*-values, while ***, ** and * denote 1, 5 and 10 percent level of significance, respectively. The lag length was suggested by the Akaike information criterion (AIC) for ADF tests. Both ADF and PP test the null hypothesis of the existence of a unit root. The Fisher-type tests were performed in Eviews 7.

Table A4 Panel Unit Root Tests: Pesaran CIPS Tests

Dependent variable	Pesaran intercept only	Pesaran intercept and trend
ln*G*	1.060	0.716
ln*SubRev*	0.922	4.333***
ln*GDP*	2.172*	2.738**
ln*RP*	-0.91	0.433
ln*OPN*	1.535	0.881
ln*GOVEMP*	2.554	5.802***
*D*ln*G*	14.299***	
*D*ln*SubRev*	11.897***	
*D*ln*GDP*	8.414***	
*D*ln*RP*	-6.753***	
*D*ln*OPN*	-3.948***	
*D*ln*GOVEMP*	2.116	

Notes: Null hypotheses: presence of a unit root. Numbers in the table are CIPS stats, while ***, ** and * denote 1, 5 and 10 percent level of significance, respectively. Reported CIPS stats are from cross-sectionally augmented ADF regressions with intercepts, and with intercept and trend. The lag length was suggested by the Akaike information criterion (AIC) for ADF tests and a specific lag was used for each country. Critical values for the CIPS statistic were taken from Pesaran (2007) and for N =26 and T = 39 are around 2.335, 2.178 and 2.093 at the 1, 5, and 10 percent level of significance, respectively, for regressions with intercept only. Critical values for the CIPS statistic for N =26 and T = 39 are around 2.83, 2.685 and 2.605 at the 1, 5 and 10 percent level of significance, respectively, for regressions with intercepts and trend. The Pesaran unit root tests were performed in Stata 10.

Table A5 Cointegration Testing Using Westerlund's (2007) *Gt*, *Ga*, *Pt* and *Pa* statistic

Variables	Statistic	Value	*Z*-value	*P*-value
G, GDP	Gt	-3.214	-7.992	0.000
G, GDP	Ga	-17.616	-9.620	0.000
G, GDP	Pt	-19.919	-12.754	0.000
G, GDP	Pa	-25.512	-23.968	0.000
G,OPN	Gt	-3.332	-8.477	0.000
G,OPN	Ga	-19.883	-11.466	0.000
G,OPN	Pt	-17.362	-10.330	0.000
G,OPN	Pa	-23.635	-21.414	0.000
G, RP	Gt	-3.210	-7.974	0.000
G, RP	Ga	-20.393	-12.171	0.000
G, RP	Pt	-17.274	-10.094	0.000
G, RP	Pa	-22.790	-20.903	0.000
G,SubRev	Gt	-3.451	-8.332	0.000
G,SubRev	Ga	-16.617	-7.783	0.000
G,SubRev	Pt	-15.397	-8.975	0.000
G,SubRev	Pa	-18.901	-14.778	0.000
G,GOVEMP	Gt	-3.741	-9.773	0.000
G,GOVEMP	Ga	-25.151	-14.795	0.000
G,GOVEMP	Pt	-17.330	-10.919	0.000
G,GOVEMP	Pa	-28.211	-24.157	0.000
G, SubRev, GDP	Gt	-3.146	-5.395	0.000
G, SubRev, GDP	Ga	-12.994	-2.759	0.003
G, SubRev, GDP	Pt	-15.657	-7.743	0.000
G, SubRev, GDP	Pa	-16.840	-8.778	0.000
G, SubRev, OPN	Gt	-3.120	-5.268	0.000
G, SubRev, OPN	Ga	-14.024	-3.493	0.000
G, SubRev, OPN	Pt	-14.152	-6.285	0.000
G, SubRev, OPN	Pa	-15.253	-7.509	0.000

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Table A5 Cointegration Testing Using Westerlund's (2007) *Gt*, *Ga*, *Pt* and *Pa* statistic
(continued)

Variables	Statistic	Value	*Z*-value	*P*-value
G, SubRev, RP	Gt	-3.053	-4.946	0.000
G, SubRev, RP	Ga	-13.554	-3.158	0.001
G, SubRev, RP	Pt	-12.609	-4.792	0.000
G, SubRev, RP	Pa	-14.414	-6.838	0.000
G, SubRev, GOVEMP	Gt	-3.711	-7.047	0.000
G, SubRev, GOVEMP	Ga	-18.920	-6.048	0.000
G, SubRev, GOVEMP	Pt	-15.686	-8.765	0.000
G, SubRev, GOVEMP	Pa	-22.808	-11.736	0.000
G, SubRev, GDP, RP, OPN, GOVEMP	Gt	-5.766	-13.582	0.000
G, SubRev, GDP, RP, OPN, GOVEMP	Ga	-8.954	1.397	0.919
G, SubRev, GDP, RP, OPN, GOVEMP	Pt	-12.867	-4.566	0.000
G, SubRev, GDP, RP, OPN, GOVEMP	Pa	-9.537	-0.733	0.232

Note: The Westerlund's (2007) *Gt*, *Ga*, *Pt* and *Pa*, statistic were performed in Stata 13 using command *xtwest*.

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