Vertical Fiscal Imbalances and Fiscal Performance in Advanced Economies[1]

Luc Eyraud [a, *] *and Lusine Lusinyan* [b]

[a] *International Monetary Fund, Fiscal Affairs Department, 700 19th Street, N.W., Washington, D.C. 20431, USA*
[b] *International Monetary Fund, European Department, 700 19th Street., N.W., Washington, D.C. 20431, USA*

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Abstract

This paper tests whether the financing structure of subnational governments affects fiscal performance. Our empirical analysis suggests that fiscal discipline is strengthened as the subnational governments' reliance on transfers and borrowing diminishes. On average, the general government fiscal balance improves by 1 percent of GDP for every 10 percentage points decline in vertical fiscal imbalances, that is, when financing equivalent to one-tenth of subnational expenditure shifts from transfers and/or borrowing to own revenue. This result is based on cross-country econometric evidence in the OECD, and is stronger in the presence of regional disparities.

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* *Corresponding author*: Tel.: 202-623-5684; *E-mail address*: LEyraud@imf.org.

I. INTRODUCTION

Many OECD countries have undertaken fiscal decentralization reforms in recent decades, assigning more expenditure functions and revenue sources to lower levels of government. The decentralized provision of goods and services is generally intended to better take into account differing local preferences, increase the cost-efficiency of public service delivery, and enhance the accountability of subnational authorities (Oates, 1972).

However, the devolution of spending responsibilities has not always gone hand in hand with the devolution of revenues, resulting in "vertical imbalances." Subnational authorities have to rely on intergovernmental transfers and borrowing in order to finance expenditure. This paper uses the concept of vertical fiscal imbalance (VFI) to measure the gap between subnational governments' own revenue and spending.

Large VFIs may relax fiscal discipline. Although some degree of mismatch between subnational own revenue and expenditure is inevitable and may even be desirable, large gaps present risks. A common view in the normative literature is that a high reliance on intergovernmental transfers or borrowing "softens" the budget constraint of subnational governments, in particular because the cost of spending is not adequately internalized, and because high VFIs may generate bailout expectations. However, the empirical literature shows conflicting results. Some papers find that intergovernmental transfers do improve fiscal performance by strengthening control over local spending.

The main objectives of our paper are to test empirically the hypothesis that the financing structure of subnational governments affects fiscal performance, and to propose a quantitative estimate of this effect based on cross-country evidence. Our empirical analysis, applied to advanced economies, presents several novel elements. First, we adopt a cross-country approach, in contrast to the prolific case-study literature on VFIs. Second, we identify specific conditions under which the VFI impacts the general government fiscal balance. To our knowledge, this is the first international comparison of the combined effect of vertical and horizontal imbalances. Finally, we attempt to address the problem of endogeneity with an instrumental variable approach, which has been lacking in earlier cross-country studies.

Our empirical results support the view that decreasing VFIs can potentially generate large fiscal gains in advanced economies. On average, the general government fiscal balance improves by 1 percent of GDP for every 10 percentage points decline in the VFI, that is, when financing equivalent to one tenth of subnational expenditure shifts from transfers and/or borrowing to own revenue. We find that the impact of the VFI is more pronounced when regional disparities are large, suggesting that the effects of horizontal and vertical imbalances reinforce each other. Our results also suggest that spending decentralization is detrimental to fiscal performance when higher subnational own revenues do not accompany

it. This is a somewhat troubling result as history shows that spending decentralization outpaces revenue devolution almost systematically.

The paper is organized as follows: Section II reviews the economic literature on VFI and fiscal performance. Section III defines and discusses the indicator of VFI applied in Section IV to produce stylized facts. Section V uses econometric methods to relate the VFI to fiscal outcomes, and Section VI concludes.

II. Vertical Fiscal Imbalance and Fiscal Performance

A vertical imbalance exists when there is a gap between own spending (total spending minus transfers paid) and own revenue (total revenues minus transfers received) at a given level of government.[2] There is no consensus on the specific definition of the vertical imbalance. Most studies use the terms "VFI," "vertical fiscal gap" (VFG), or "transfer dependency" interchangeably. Researchers generally apply the VFI concept to subnational governments but gaps can also materialize at the central level.[3]

The theoretical literature generally emphasizes the risks associated with large VFIs. A common view is that the vertical structure of the public sector "softens" the budget constraint of subnational governments, leading them to overspend and lower their tax effort. This phenomenon is due to several factors discussed in Box 1. In particular, two main arguments relate the VFI to the general government fiscal position:

- Models with government resources as a "common property" show that fragmented fiscal policymaking may generate excessive fiscal deficits. This is the case because interest groups having access to the common pool of government resources do not fully internalize the cost of expenditure programs that benefit their constituency. For instance, individual spending ministries are likely to disregard the externality arising from their expenditure decisions during the budget negotiation process (Hallerberg and Von Hagen, 1999). Velasco (1999, 2000) applies this approach to a fiscal decentralization framework. One important implication of his models is that, when government income is a common pool from which decentralized fiscal authorities extract resources, fiscal deficits emerge without any intertemporal smoothing justification.

[2]In the paper, the word "transfer" always refers to intergovernmental (not interpersonal) transfers; it is used interchangeably with "grant." The term "subnational" refers to both the state and local levels of government. "Own revenues," which are measured as the difference between total revenues and intergovernmental transfers received by a given level of government, include both tax and nontax revenues (but exclude borrowing).

[3]Both gaps are often related, since the subnational "vertical deficit" is generally covered by intergovernmental transfers, and is likely to be associated with central government's "vertical surplus."

- The soft budget constraint literature also argues that the VFI affects fiscal performance. Subnational governments with high VFIs do not have sufficient tax and borrowing authority to cope with idiosyncratic shocks (Von Hagen and Eichengreen, 1996). They may enter into a fiscal crisis (be unable to pay wages or default on loans) when faced with adverse shocks. As they may claim that they are not responsible, the pressures from voters, civil servants, and creditors will likely be directed at the central government, which will have no choice but to bail them out. Anticipating this, subnational governments have an incentive to engage in riskier fiscal policies. Rodden et al. (2003) points out that "transfer-dependent governments face weak incentives to be fiscally responsible, since it is more rewarding to position themselves for a bailout."

Thus, VFIs may lead to excessive and unproductive spending, and inefficient revenue mobilization. Allowing subnational governments to access own revenue through local taxation is seen as essential to promoting fiscal discipline (Oates, 2006; IMF, 2009; Blöchliger and Petzold, 2009). However, closing the vertical gap is not always feasible or even beneficial (see Box 1). As the optimal degree of decentralization is generally larger on the spending than on the revenue side, it can theoretically be efficient to allow for some degree of VFI. In addition, transfers may be warranted to better control subnational spending, provide insurance for lower levels of government against external shocks, internalize spillovers, or pursue redistributive objectives.

The empirical literature on vertical imbalances is mostly country-specific. There are a large number of descriptive case studies (for instance, Rodden et al., 2003; Karpowicz, 2012). Fiscal performance is not the only focus of these studies. In some cases, the main purpose is to measure the VFI accurately (Bird and Tarasov, 2004). Other studies examine the relationship between VFI and equity or political sovereignty (Boadway, 2004). There are also numerous analyses of the driving forces of the VFI (Ruggeri and Howard, 2001; Dollery, 2002; Lazar et al., 2004). Some papers have a policy-related perspective, and present options to reduce existing gaps (Row and Duhs, 1998).

Another field of empirical research, the "flypaper effect" literature, estimates the impact of intergovernmental transfers on local spending in specific countries (Gamkhar and Shah, 2007). This literature generally finds that nonmatching grants stimulate spending more than an equivalent increase in private income. In other words, grants tend to "stick" with the recipient government and be used to purchase goods and services; they are not passed onto taxpayers in the form of lower taxes.

Box 1. Cost-Benefit Analysis of Vertical Imbalances in the Theoretical Literature

A high reliance on transfers or borrowing may undermine the fiscal discipline of subnational governments for a series of reasons:

- *Common pool effect*. When financed through transfers, subnational governments do not internalize the full cost of local expenditures, and tend to overspend/lower their tax efforts (Weingast et al., 1981; Velasco, 1999 and 2000).
- *Bailout expectations*. When subnational governments have limited tax capacity (high VFI), they have little room to accommodate adverse shocks, and are more likely to expect bailout transfers from the center, which may loosen fiscal policy (Von Hagen and Eichengreen, 1996; Rodden et al., 2003).
- *"Soft" borrowing*. Allowing subnational governments to borrow should not contribute to chronic deficits if financial markets were to impose discipline. However, sole reliance on market discipline requires a number of preconditions seldom met in practice (Ter-Minassian and Craig, 1997). Also, subnational governments may have access to "soft" forms of financing (borrowing from public banks or from state-owned enterprises, for instance), creating another form of soft budget constraint (Rodden et al., 2003; Oates, 2006).
- *Governance and accountability*. Discretionary grants are prone to undue subnational influence or interest. In addition, subnational authorities are more accountable and responsible when they have to tax their constituencies to fund local expenditures, as tighter and more transparent tax-benefit links increase the taxpayers' scrutiny of the subnational authorities' performance (Rodden, 2003).
- *Grant design*. Some grants have a matching dimension, with the grant allocation increasing when subnational governments spend more on the matched service. This cost sharing generates substitution effects, which may distort resource allocation, and create incentives to overspend (Shah, 2006).
- *Competition*. Expenditure decentralization without corresponding subnational taxing powers is unlikely to generate the tax competition that limits the subnational tax burden and encourages efficient public service delivery (Rodden, 2003).
- *Vertical linkages*. Indirectly, the VFI may also affect the central government's performance if excessive subnational borrowing crowds out available financing and/or increases the risk premium on government bonds. The central budget also may be impacted through the cost of bailouts (IMF, 2009).

However, some measure of VFI is inevitable, as the degree of spending decentralization called for by efficiency considerations tends to exceed the degree of revenue decentralization that would be consistent with optimal tax assignment (Ter-Minassian, 1997a, Boadway, 2002):

- *Tax centralization*. In line with the benefit principle, only a few tax bases seem to be well suited for subnational management, namely, those that are immobile, evenly distributed geographically, easy to administer, and that generate stable revenues. In most cases, nationwide taxes are preferable, as they have fewer distortionary effects on mobile factors, prevent excessive tax competition, permit a higher degree of progressivity, and exploit economies of scale in tax administration (Joumard and Kongsrud, 2003; Ter-Minassian, 1997b; Norregaard, 1997; McLure and Martinez-Vasquez, 2000).
- *Spending decentralization*. The case for increasing subnational spending on efficiency grounds seems stronger. First, local politicians know consumers' preferences in their jurisdictions better than the central government does, and therefore can better align the provision of local outputs to those preferences ("allocative efficiency," Oates, 1972). Second, subnational governments face competitive pressures to attract mobile residents, resulting in more cost-efficient provisions of public goods ("productive efficiency").

Vertical imbalances may even be desirable in some cases, as "transfers are important policy instruments for the central government to use to achieve legitimate objectives" (Boadway, 2002):

- *Fiscal adjustment*. Transfers are used to control subnational spending and, as such, could contribute to fiscal performance (Darby et al., 2005). More generally, fiscal consolidation policies conducted by the center may be undermined if a large share of taxes is devolved to subnational governments.
- *Stabilization against shocks.* Intergovernmental discretionary transfers are key instruments of centralized stabilization policies. Centralizing stabilization policies may (i) allow for better coordination with monetary/exchange rate policies; (ii) exploit scale economies (access to larger tax bases); (iii) provide risk-sharing opportunities in case of idiosyncratic regional shocks (Sanguinetti, and Tommasi, 2004); and (iv) reduce free riding.
- *Redistribution.* Equalization grants are needed to correct horizontal imbalances (revenue-raising capacity and expenditure

need disparities). In addition, subnational governments may be responsible for implementing national redistribution programs, although intergovernmental grants are probably not the most efficient means of achieving interpersonal redistribution objectives.

- *Prevent inefficient migrations.* Individual subnational authorities do not have the same capacity to deliver public services at similar revenue effort levels, resulting in "net fiscal benefit" differences. Vertical transfers can be used to compensate subnational governments with higher fiscal needs and/or smaller revenue-raising capacities, and prevent fiscally induced migrations (Boadway, 2002).

- *Internalize externalities.* Grants can be used to correct tax and expenditure externalities across subnational governments (horizontal externalities) or between levels of government (vertical externalities). For instance, matching grants may provide incentives for lower-level governments to invest in public goods that have positive spillover effects into other jurisdictions (Dahlby, 1996; Boadway and Keen, 1996).

The cross-country literature is less abundant and does not provide clear-cut results, although a consensus seems to emerge around the idea that large VFIs are detrimental to fiscal performance.[4] Most papers focus on public expenditure, as part of an effort to test the Leviathan hypothesis. Fornasari et al. (2000) show that subnational spending funded by transfers and borrowing is additional to central government spending, not a substitute for it. Jin and Zou (2001) find that transfer dependency increases the size of the subnational, national, and general governments. Rodden (2003) also shows that general government expenditure grows faster if subnational governments fund a larger proportion of their expenditure through transfers. Only a few papers have looked at the effect of VFI on the government's fiscal balance. Rodden (2002) provides evidence that higher reliance on intergovernmental transfers worsens the general government's overall balance, especially when subnational governments have strong borrowing autonomy.

Nonetheless, some empirical studies find that VFIs are associated with *better* fiscal outcomes. According to De Mello (2000), transfer dependency only deteriorates the fiscal position of the central government in non-OECD countries, while the opposite result is found in OECD countries. His interpretation is that, in the OECD sample, transfer dependency measures the ability of central governments to control subnational finances rather than signal common pool problems. This result is consistent with the findings of the comparative literature on successful (lasting) fiscal consolidations. Also focusing on OECD countries, Darby et al. (2005) show that central governments exert a strong influence on the expenditure of subnational governments through their grant allocations; grants are generally cut substantially during successful consolidations, in order to "force the hand" of sub-central tiers to adjust expenditure. Finally, Baskaran (2010) finds no effect of transfer dependency on public debt.

[4]Most of the empirical literature uses transfer dependency as a measure of the vertical imbalance, the former being defined as the ratio of transfers received by subnational governments to their total revenues (or spending).

III. MEASURING VERTICAL FISCAL IMBALANCES

Different indicators of VFIs are used in the empirical literature (Sharma, 2012). Transfer dependency is the most common indicator with transfers measured either as a share of subnational spending (Jin and Zou, 2002), as a share of subnational total revenue (Rodden, 2002; Baskaran, 2010), or even as a share of central government revenue (Bahl and Wallace, 2007). Some authors measure VFI as the difference between own revenues and own spending rather than their ratio, bringing the concept closer to a fiscal balance (Bird and Tarasov, 2004). Others distinguish between the VFG and VFI.[5]

In this paper, we define the VFI as the share of subnational own spending not financed through own revenues, as in Ahmad and Craig (1997), and Schroeder and Smoke (2002). By definition, the counterparts of VFI are subnational net borrowing and transfers received from other levels of general government, both expressed as shares of subnational own spending (Box 2). In contrast to most of the empirical literature focusing on transfer dependency, our measure of VFI also includes borrowing. Within the pool of subnational resources, we think that there is a strong case for distinguishing between borrowing and transfers on the one hand, and own revenues on the other hand. Subnational authorities generally have less control over transfers and borrowing. The envelope of both resources is also more flexible ("softer") than that of tax revenues and fees.[6] Finally, transfers and borrowing reduce the perceived cost of public funds. This happens because transfers are financed from national taxes, and because subnational borrowing is often pooled (either explicitly, or perceived as such), with financial markets unable or unwilling to significantly discriminate between individual credit risks.

Our VFI measure presents a number of advantages. First, it is an accounting concept, which is relatively easy to calculate in a cross-country sample; using more sophisticated theory-based indicators of VFIs would not be feasible.[7] Second, it extends the concept of "transfer dependency" to subnational borrowing, which is another kind of "soft" resource (see above),

[5]According to Boadway (2002), Lazar et al. (2004), and Boadway and Tremblay (2006), the existence of a vertical gap does not necessarily imply that there is an imbalance. A VFI appears when the actual gap differs from the optimal VFG, which is consistent with optimal revenue and expenditure assignments across levels of government. In the authors' view, the VFI and VFG are normative concepts, not just accounting identities. Our paper does not make this distinction. Thus, it is not possible to infer from the empirical results of Section V whether the negative effect of the VFI is due to the existence of a gap between own revenue and spending or to the fact that the gap is sub-optimal.

[6]According to Oates (2006), "Soft budget constraints manifest themselves both in terms of transfer dependency and a poorly functioning banking system that is subject to manipulation by public officials for funding deficits." Rodden et al. (2003) also claim that "if soft budget constraints exist and the subnational governments can appeal to the central government for additional resources through channels such as intergovernmental fiscal transfers, state-owned enterprises, and banking, they are likely to overspend, undertax, or overborrow. [….] In many cases, the open window is called borrowing."

[7]According to Dahlby (2005), "we are a long way from developing models that would allow us to determine whether there is a vertical fiscal imbalance […] as measured by the marginal cost of public funds at the two levels of government."

and is an important contributor to VFI dynamics (further discussed in Section IV, Fact 2). Third, our VFI indicator measures the mismatch between spending and revenue decentralizations; it widens when central governments devolve more spending than revenue responsibilities to lower levels.

Box 2. Vertical Fiscal Imbalance: Definition and Accounting Determinants

We define the VFI as:

$$VFI = 1 - \frac{SNG\ own\ revenue}{SNG\ own\ spending}$$

i. The VFI is covered by transfers from the center (including the social security level of government) and subnational net borrowing.

$$SNG\ spending = SNG\ own\ revenue + transfers\ received\ by\ SNG + SNG\ net\ borrowing$$

and $SNG\ spending = SNG\ own\ spending + transfers\ paid\ by\ SNG$, then:

$$\boxed{VFI = Transfer\ dependency + SNG\ deficit}$$

where:

$$Transfer\ dependency = \frac{Net\ transfers}{SNG\ own\ spending}$$

$$SNG\ deficit\ (as\ a\ share\ of\ spending)\ = \frac{SNG\ net\ borrowing}{SNG\ own\ spending}$$

ii. The VFI depends on the mismatch between revenue and spending decentralization.

$$\boxed{VFI = 1 - \frac{revenue\ decentralization}{spending\ decentralization} * (1 - GG\ deficit)}$$

where:

$$Revenue\ decentralization = \frac{SNG\ own\ revenue}{GG\ revenue}$$

$$Spending\ decentralization = \frac{SNG\ own\ spending}{GG\ spending}$$

$$GG\ deficit\ (as\ a\ share\ of\ spending) = \frac{GG\ spending - GG\ revenue}{GG\ spending}$$

Owing to data constraints, our VFI measure cannot be easily refined. Its main shortcoming (common to many empirical studies) is that it imperfectly measures the subnational governments' control over their financial resources in order to carry out their spending responsibilities. Several studies show that "own revenues" do not measure accurately the subnational governments' discretion over their resources (Rodden, 2002; Blöchliger et al., 2006). This is partly due to the fact that some countries record tax sharing arrangements

under taxes instead of transfers.[8] Another reason is that the tax/transfer split does not capture the whole range of tax devolution possibilities (for example, subnational governments may be given only restricted discretion over tax rates/bases). Similar measurement issues arise on the spending side, with a large part of subnational spending being in fact regulated, mandated or earmarked (Bach et al., 2009). Finally, our VFI indicator is based on actual spending and revenue, which may differ from assigned responsibilities owing to cyclical factors, administrative and capacity constraints, or simply the willingness of subnational governments to use the powers vested in them, including for strategic reasons (Sharma, 2012).

Some have argued that a necessary condition for accountability is the alignment of expenditure and own revenue *at the margin*, not for total subnational spending (for instance, Hancock and Smith, 2001; Martinez-Vasquez, 2007). Transfers could finance a fixed amount of "inframarginal" local spending, such as a standard package of services, provided that subnational governments keep "tax autonomy at the margin" and can levy additional revenues to tailor services to local needs. Accordingly, the behavior of subnational governments should barely be affected by the average financing structure, as measured by the VFI. However, this view relies on very restrictive assumptions, in particular, that transfers are inelastic to subnational expenditure decisions. Many of the problems presented in Box 1, including the soft budget constraint, would hold for the average VFI as well (Pisauro, 2001; Bird, 2011).

Finally, this paper focuses primarily on vertical rather than horizontal imbalances. In contrast to "horizontal fiscal imbalances" (HFIs),[9] VFIs measure differences in spending and revenue between levels of government, not across subnational entities. However, VFI and HFI cannot always be clearly separated (Bird and Tarasov, 2004). For instance, vertical balance can be achieved for the richest subnational government by balancing own expenditure and own revenues, but not for the other subnational governments when there are regional disparities. Another form of interdependence is generated by vertical equalization schemes: intergovernmental transfers often include equalization grants whose purpose is to reduce income disparities across subnational jurisdictions. This fact implies that, in general, measures of VFIs may also capture the presence of large HFIs. Our empirical analysis will explore possible interactions between these two variables.

IV. Stylized Facts on Vertical Fiscal Imbalances

This section presents stylized facts on vertical fiscal imbalances, their evolution over time, their dispersion across countries, and their relation to fiscal performance. We use data from the OECD General Government Accounts Database (OECD, 2011a) for the period 1995–

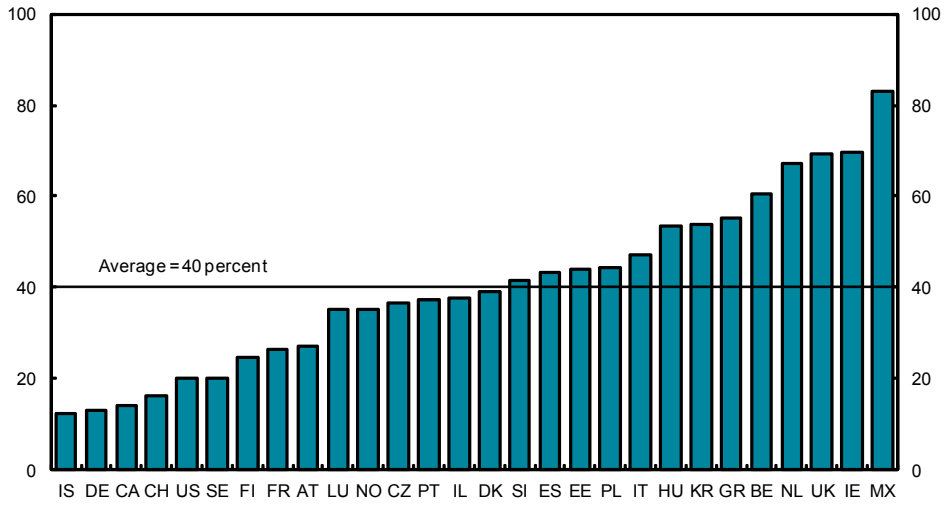
[8]In Sections IV and V, we show that our results are robust to the possible misclassification of shared taxes.

[9]Like the VFI, there is no set common agreement upon the definition of HFI in the literature. In this paper, we identify HFIs where there are significant differences between the revenue capacities of individual subnational governments.

2007.[10] We exclude post-2007 data, as the global financial crisis likely disrupted intergovernmental fiscal relations, creating breaks in the series.

Fact 1. The financing of subnational spending varies greatly across countries, resulting in sizeable differences in vertical imbalances. The average VFI was 40 percent over the sample between 1995 and 2007 (Figure 1). However, VFIs present a large dispersion, varying from 13 percent in Iceland to 83 percent in Mexico. Charbit and Goodspeed (2009) show that cross-country differences in the structure of subnational financing reflect idiosyncratic factors, such as the roles of subnational governments as providers of national public goods and services (especially health), regional imbalances, the presence of externalities, historical circumstances, collective preferences, and institutional features (in particular, the constitutional framework).

Figure 1. Average Vertical Fiscal Imbalance
(Percent; average over 1995–2007)



Sources: OECD; and authors' estimates.
Note: VFI = share of subnational own spending not financed through own revenue.

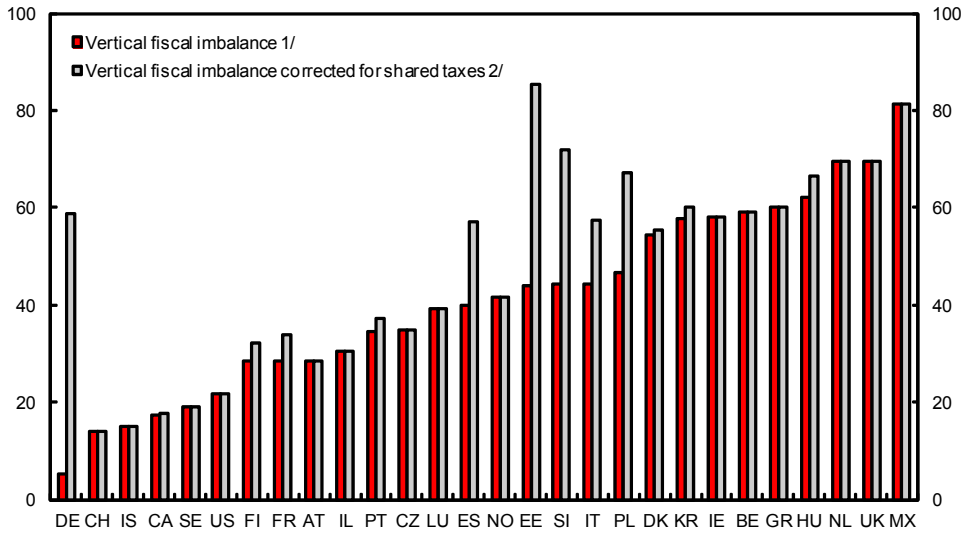
As explained above, our VFI indicator may be subject to measurement error, as some countries record shared taxes under own taxes.[11] For example, the degree of vertical imbalance in Germany, where shared taxes represent about 90 percent of the Länder tax

[10]To have the most complete country coverage, this section uses data from 1995, this being the starting year for one-third of the country series (see Appendix Table 1).

[11]Statistical manuals do not provide clear guidance as to how to record tax-sharing arrangements (Blöchliger and Petzold, 2009b).

revenue, is clearly misrepresented in Figure 1. Using the OECD Tax Autonomy Survey (OECD, 2011b), we correct the 2008 VFIs by deducting the amount of shared taxes from own revenues and rerecording them as transfers (Figure 2). Obviously, this correction is a bit radical, as some countries may already record all or part of their shared taxes under transfers, but this exercise provides an estimate of the maximum measurement error. Figure 2 shows that the correction does not dramatically affect the results, except in countries like Germany, Estonia and Slovenia, and, to a lesser extent, Poland, Spain, and Italy.

Figure 2. Vertical Fiscal Imbalance: Correction for Shared Taxes
(Percent; 2008)



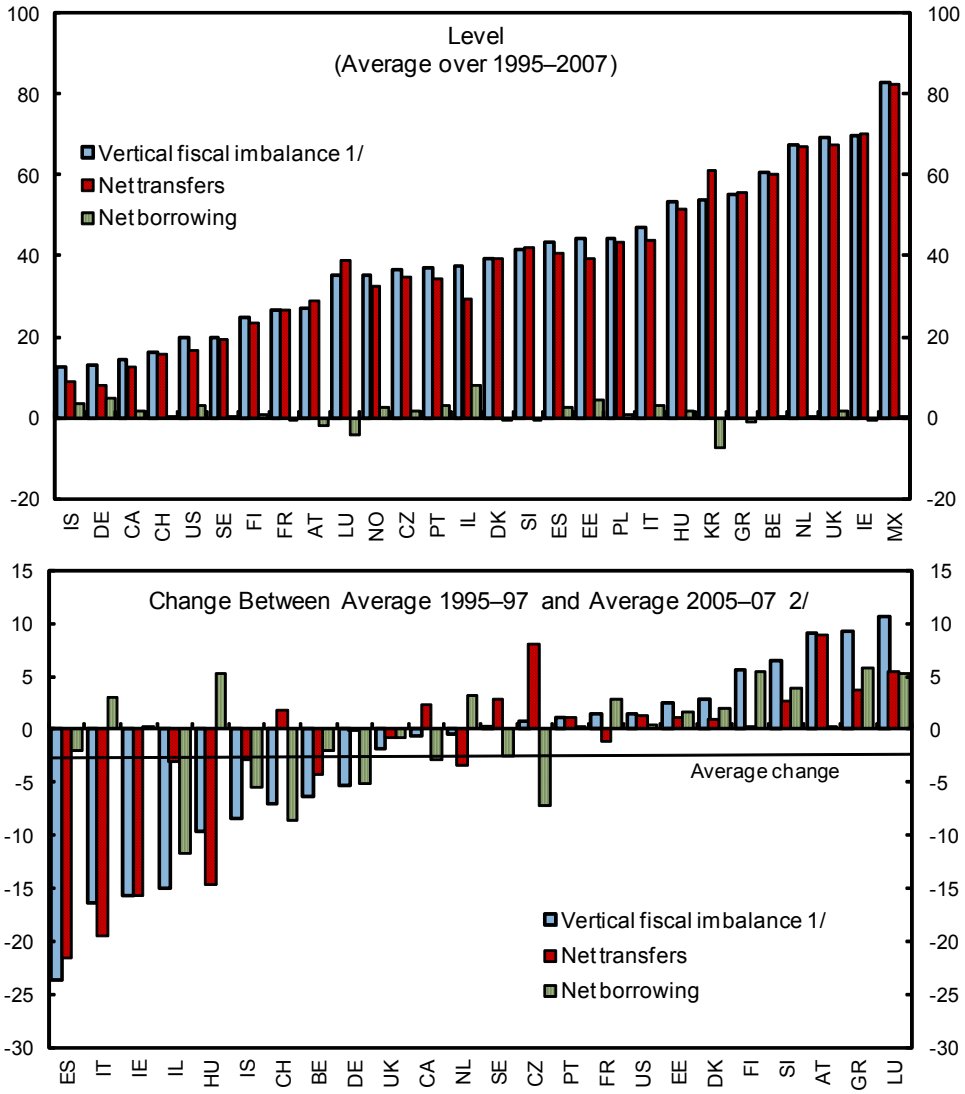
Sources: OECD; and authors' estimates.
Notes: 1/ Share of subnational own spending not financed through own revenue.
2/ Share of subnational own spending financed through transfers, net borrowing, and shared taxes.

Fact 2. Although vertical imbalances are mostly covered by transfers, subnational borrowing is essential to understanding the VFI changes over time. On average, subnational spending is almost entirely financed by transfers and own revenues (Figure 3, upper panel). In the sample, the share of subnational net borrowing was close to zero over the period, local authorities' borrowing capacity being constrained either by administrative procedures, explicit rules, financial market discipline, or cooperative arrangements (Ter-Minassian and Craig, 1997). However, the effect of borrowing should not be overlooked, as its contribution to the change in VFIs over the period is significant: between 1995 and 2007, the change in net borrowing was of comparable magnitude to the change in transfers[12]

[12]In the lower panel of Figure 3, the changes in VFI, transfer and net borrowing are computed between the average 1995–97 and the average 2005–07 (instead of 1995 and 2007), to ensure that our results are not too sensitive to the choice of the initial and final data points.

(Figure 3, lower panel). In other words, subnational borrowing is low on average but very volatile, which explains its relatively high contribution.[13] This result suggests that measuring vertical gaps with "transfer dependency," as it is done in many empirical papers, eliminates a significant part of the volatility that could be informative from a statistical standpoint.

Figure 3. Vertical Fiscal Imbalance: Level, Components, and Change
(Percent of subnational own expenditure)



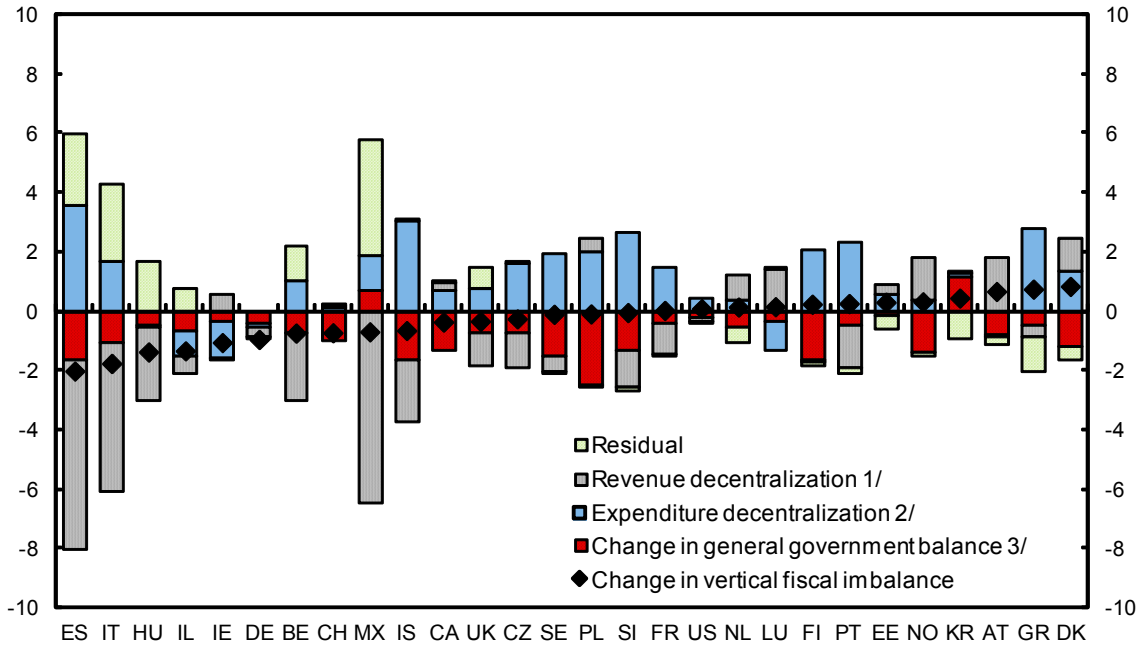
Sources: OECD and authors' estimates.
Notes: 1/ VFI = share of subnational own spending not financed through own revenue.
2/ The line represents the change in the VFI between 1995–97 and 2005–07 on average over the country sample (-2.4 percentage points of subnational own spending).

[13]Among financing sources of subnational governments, borrowing has the highest volatility relative to transfers (medium volatility) and taxes (lowest volatility).

Fact 3. Vertical fiscal imbalances have decreased over time. Between 1995 and 2007, VFIs decreased in most countries, with an average decline of about 2.4 percentage points of subnational own spending (Figure 3, lower chart). This result seems to contrast with the common view that vertical imbalances are increasing in most countries, driven by the mismatch of spending and revenue decentralizations. In fact, these two findings are not contradictory. Figure 4 shows average contributions to the annual changes in VFIs (based on the decomposition proposed in Box 3). Generally, the VFIs did widen due to the fact that spending decentralization outpaced revenue decentralization; however, this was more than offset by the improvement in the general government balance over the period. In other words, subnational governments received a larger share of general government spending responsibilities without receiving an equivalent share of taxes over the period. Nonetheless, the VFIs narrowed because general government spending increased less than general government revenues on average.[14]

Figure 4. Breakdown of the Average Annual Change in Vertical Fiscal Imbalances

(Average over the period of 1995–2007; percentage points)



Sources: OECD and authors' estimates.
Notes: 1/ Negative values = Increase in revenue decentralization.
2/ Positive values = Increase in expenditure decentralization.
3/ Negative values = Improvement in general government overall balance.

[14]This example suggests that the gap between revenue and spending decentralization may not be an accurate indicator of the VFI.

Box 3. Contributions to the Annual Change in the Vertical Fiscal Imbalance

According to Box 2:

$$1 - VFI = \frac{revenue\ decentralization}{spending\ decentralization} * (1 - GG\ deficit)$$

Taking the logarithm of this expression, and then the first difference, and using the approximation $\ln(1-x) \cong -x$, we compute the contributions of the three variables to the change in the VFI:

$$\boxed{dVFI \approx \mathrm{dln}(spend.decentralization) - \mathrm{dln}(rev.decentralization) + d(GG\ deficit)}$$

Changes in the VFI reflect the impact of two factors: the mismatch between spending and revenue decentralizations, and the changes in the general government deficit. This accounting decomposition does have an economic interpretation, as the two terms are relatively independent: the growth differential between spending and revenue decentralizations is an institutional feature, which can be considered as exogenous when decisions related to the annual overall deficit are made. Intuitively, countries first agree on how to share the spending and revenue pies between government levels before determining the size of these pies.

Fact 4. There is no evidence that revenue decentralization follows expenditure decentralization, at least in the short run. The conventional wisdom of "finance-follows-function" suggests that devolution of spending responsibilities should precede the decentralization of revenues. However, country experience sometimes points to a reverse sequencing, possibly because revenue devolution is easier to implement, and more attractive to subnational governments, or because there is a better understanding of, and agreement on, basic tax assignment principles across levels of government. On the other hand, assigning expenditure responsibilities is more politically driven with less well-established assignment rules (Bahl and Martinez-Vazquez, 2006). In our sample, bivariate Granger causality tests suggest diverse relationship patterns between spending and revenue decentralization (text table). As indicated by the lower-left section in the table, there seems to be limited support for the "finance-follows-function" rule. In most countries, we either find the opposite causality, bi-causality, or no causality. However, Granger tests can only detect short-term sequencing, as lag length is restricted to three years by the data.

Granger Causality Test Results

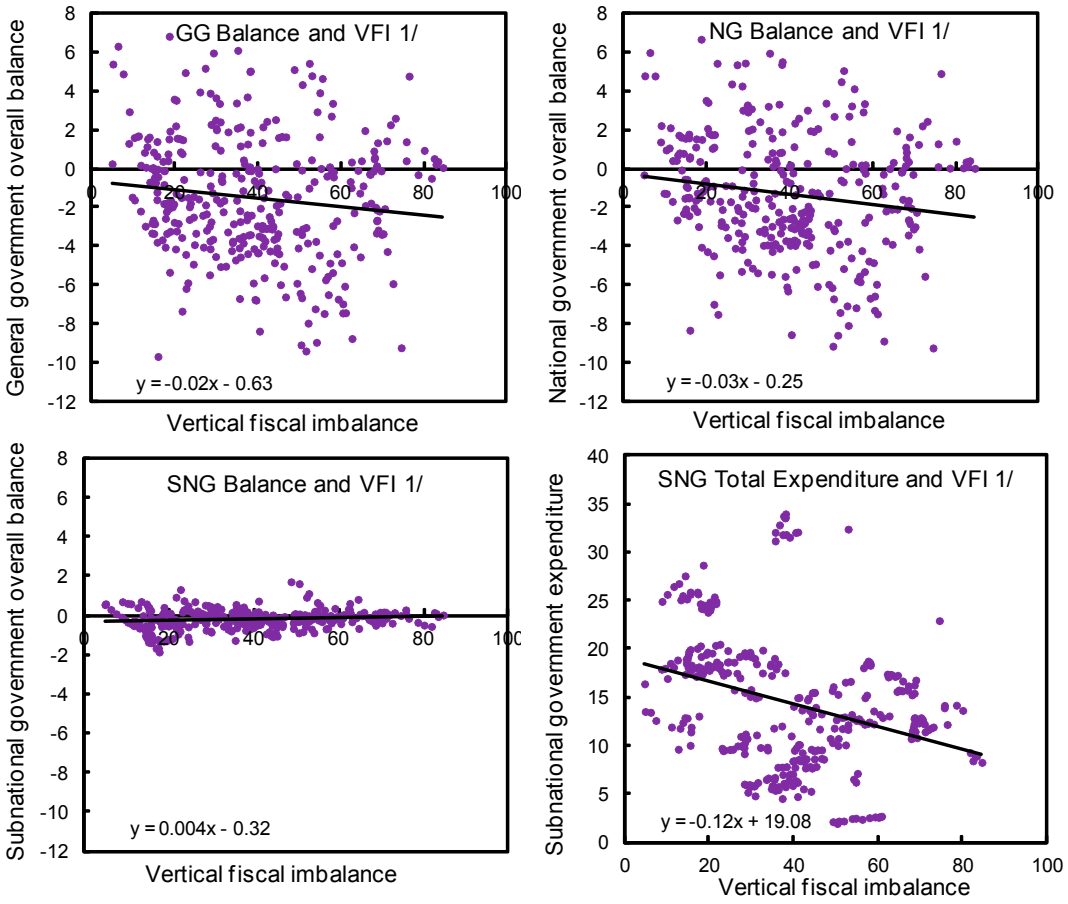
	Expenditure decentralization=> Revenue decentralization	Expenditure decentralization≠> Revenue decentralization
Revenue decentralization=> Expenditure decentralization	CZ, GR, IT, SL, EE	DK, FI, FR, IE, PT
Revenue decentralization≠> Expenditure decentralization	DE, IS, IL, LU, NL, ES, SE, UK, HU	AT, BE, CA, NO, CH, US

Notes:
1/ Decentralization variables in logarithms; lags=3.
2/ X=>Y: X Granger-causes Y; X≠>Y: X does not Granger-cause Y.
3/ Significant at least at 10 percent significance level.

Fact 5. Large vertical imbalances are associated with poorer fiscal performance. Consistent with the predictions of the normative literature, the higher the VFI, the lower the fiscal balance of the general government (Figure 5, upper-left panel). While subnational budgets are generally close to balance regardless of whether they rely on transfers or own

revenues,[15] fiscal performance at the national level (central plus social security) deteriorates slightly at higher levels of VFI (Figure 5, upper-right panel). As discussed in Section 2, one explanation could be that large VFIs relax the fiscal discipline of subnational governments, forcing central governments to fill their financing gap with transfers. However, it is not easy to reconcile this hypothesis with the negative correlation between subnational spending and the VFI (Figure 5, lower-right)—a somewhat unexpected result that seems inconsistent with the findings of the flypaper-effect literature. We also find a negative correlation between the VFI and the overall balance when both series are in first differences, suggesting that the speed at which VFIs change also matters (results not shown).

Figure 5. Fiscal Performance and Vertical Fiscal Imbalance
(Percent; 1995–2007)



Sources: OECD; and authors' estimates.
Notes: 1/ VFI = share of subnational own spending not financed through own revenue.
Fiscal variables (overall balance, expenditure) are in percent of GDP. Fiscal balances are defined as total revenue minus total expenditure of a given government level.
GG = General government; NG = National government (consolidates central government and social security funds); and SNG = Subnational government..

[15]This result should not be interpreted as reflecting the good performance of subnational governments, which are usually borrowing-constrained and may receive bailout transfers from the center.

V. ECONOMETRIC EVIDENCE

A. Model Specification

To assess the impact of vertical imbalances on fiscal performance, we specify an empirical relationship linking the general government primary balance to the VFI, spending decentralization, covariates, and interaction terms. Our purpose is not to model a full-fledged fiscal policy reaction function but to estimate the partial effect of VFI. We apply the following specification to a sample of 28 OECD countries over 1969–2007 (the sample period varies across countries, see Appendix Table 1[16]):

$$PB_{it} = \alpha \times VFI_{it} + \beta \times Decentralization_{it} + \mathrm{X}_{it} \times \delta + \varphi_i + \tau_t + \varepsilon_{it} \qquad (1)$$

where the indices i and t denote countries and years, respectively; PB_{it} is the primary balance of the general government as a share of GDP; and VFI_{it} is the vertical fiscal imbalance (defined in Section III), $Decentralization_{it}$ is spending decentralization (subnational own expenditure as a share of general government expenditure); X_{it} denotes control variables; φ_i represents country-specific fixed effects; τ_t signifies time dummies, and ε_{it} is a time- and country-specific error term.

Our econometric analysis, in aiming to capture a long-term equilibrium relation, does not cover the financial crisis period (2008-2011), which has disrupted intergovernmental fiscal relations. Including the most recent years would also create new estimation challenges due to the potential reverse causality from the overall balance to the VFI. During the crisis, the deterioration of fiscal outcomes has prompted the adoption of fiscal consolidation measures, which have often resulted in transfer cuts without equivalent reduction in subnational spending responsibilities, thereby lowering the VFI other factors being equal.

In our specification, the dependent variable is the *general government* fiscal balance. Since the balances of the national and subnational governments are interrelated—in part due to intergovernmental transfers, conducting separate regressions would be somewhat arbitrary, as well as potentially misleading. Using the general government balance as a left-hand side variable is also more relevant from a macro-fiscal policy point of view.

In addition, several indicators exist to measure fiscal performance. Our baseline regressions use the *headline* (unadjusted) fiscal balance, rather than the structural balance, due to possible measurement issues of the latter variable. The inclusion of the output gap in the

[16]In most regressions, the estimation period is reduced to 1995-2007 due to data availability constraints.

equation ensures that direct effects of the cycle are taken into account. The robustness check section reestimates the empirical model with alternative fiscal performance indicators, including the general government structural balance, the overall balance (as opposed to the primary balance), and the change in the debt ratio.

We tested the significance of a large set of covariates including government debt, output gap, political variables (including federal/unitary state structure), governance indicators, measures of regional disparities (income and unemployment), borrowing constraints,[17] GDP per capita, trade openness, inflation, and demographic variables, as well as multiplicative terms that allow the impact of VFI to interact with covariates. The variables used in the reported specifications are described in Appendix Table 2. We do not include revenue decentralization in equation (1) for two reasons. First, as shown in Box 3, when spending and revenue decentralizations are kept constant, a direct accounting relation relates the VFI to the fiscal deficit. A regression including all three variables would capture an artificial correlation between VFIs and fiscal performance. Second, interpreting the estimated coefficients "other factors being equal" is problematic when expenditure, revenue, and borrowing are all included in the same equation. Also, revenue decentralization is likely to generate multicollinearity with the VFI and spending decentralization.

A fixed-effect estimation of Eq. (1) detects some autocorrelation and groupwise heteroskedasticity in the residuals (as reported in Appendix Table 3). To ensure that the statistical inference is valid, our baseline regressions are estimated with the least square dummy variable (LSDV) estimator with robust standard errors clustered at the country level. An alternative strategy could be to estimate a dynamic model and use the Arellano-Bond-type GMM estimator or the LSDV estimator with the correction proposed by Kiviet (1995); this approach is adopted in the robustness check section.[18] In addition, we also report the results of a model in first-difference in Section V.D.

The VFI is related to the general government balance ratio through an accounting relationship. This could generate a country-specific reverse causality (see Boxes 2 and 3), and bias the estimation of the fiscal balance response to the VFI, which we assume to be identical across countries in Eq. (1). It is worth mentioning that the reverse "accounting" effect will only occur under restrictive assumptions: not only should revenue and spending decentralizations be constant, but the general government size—as measured by the ratio of

[17]The impact of fiscal rules other than borrowing constraints could not be tested due to data availability constraints for the OECD sample.

[18]Our baseline regressions estimate a static model for three main reasons. First, our objective is to estimate a long-term relationship, not an adjustment model. Second, dynamic specifications are less legitimate in causal analysis than in forecasting models. The lagged dependent variable is an imperfect way to capture the omission of explanatory variables. Third, dynamic panel estimators are generally less efficient when there are a small number of cross-section units (Behr, 2003).

public spending to GDP—should also be unchanged, given that the fiscal balance is expressed as a share of spending rather than GDP in Box 2. To assess whether this could impact our results, we reestimate Eq. (1) with transfer dependency instead of VFI, as no relevant accounting relationship relates the former variable to the fiscal balance (see Section V.D). We also check the robustness of our baseline results by conducting alternative estimations, including an instrumental variable approach which should address potential endogeneity problems (also in Section V.D).

B. Hypotheses

The empirical analysis tests six hypotheses related to the impact of the VFI on fiscal performance.

H1: Shifting the financing of subnational expenditure from transfers and borrowing to own revenue improves fiscal performance.

In line with the findings of the theoretical literature and the stylized facts, the VFI is included in Eq. (1) as a determinant of the general government fiscal balance. We expect that raising the share of subnational spending financed by own-revenues would improve fiscal performance.

H1 is tested within Eq. (1), by using the multiple regression framework and interpreting α other factors being equal.[19] The coefficient α measures the impact of the VFI keeping spending decentralization constant. Thus, α assesses the effect of a shift in the structure of subnational financing—from own revenues to transfer/borrowing—within a given envelope of subnational spending (as a share of general government spending). We expect the estimated α to be negative.

H2: Spending decentralization financed by own-revenue improves the general government fiscal balance.

Unlike H1, H2 does not assume that the subnational expenditure envelope is fixed. This hypothesis can be tested by interpreting the spending decentralization coefficient other factors being equal. β evaluates the effect of increasing spending decentralization while keeping the VFI constant; β therefore measures the impact of spending decentralization financed through own revenues.[20] As H1 and H2 rely on similar arguments, we expect the estimated β to be positive, as a matter of consistency.

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[19]The "ceteris paribus" analysis can only be conducted if the assumptions of the standard linear regression model are not violated. In particular, multicollinearity should not be too strong, which is the case in our sample (see test results in Appendix Table 3).

[20]More precisely, this interpretation would require that the VFI be measured as a share of general government spending. In that case, keeping the VFI constant while increasing spending decentralization would imply that

(continued)

H3: Too large vertical gaps are bad for fiscal performance, but too small as well.

H3 tests whether or not the effect of the VFI is linear. As outlined in Section II, there are costs and benefits to the VFI; although some degree of VFI may be desirable, high VFIs present risks. For instance, a small VFI may have adverse effect on fiscal performance, because of diseconomies of scale, while too high a VFI may also be detrimental in light of the common pool problem.

We test this hypothesis by including a quadratic term in the equation. If there is an "optimal" positive VFI maximizing the fiscal balance, we should find that the VFI coefficient is positive and the squared VFI coefficient is negative. In order to account for the possibility that the "optimal" VFI be country specific, we also run the regression with individual slopes for the VFI and the squared VFI.

H4, H5, and H6: The effect of the VFI is conditional on the capacity of subnational governments to extract additional resources from the center.

H4, H5, and H6 explore possible interactions between the VFI and other variables. The assumption that the VFI effect is contingent is better understood in the context of the soft budget constraint models (see Section II). Because subnational governments with large VFIs are more vulnerable to adverse shocks, they may expect, with some justification, to receive gap-filling transfers. This weakens their incentives to be fiscally responsible (Von Hagen and Eichengreen, 1996).

However, subnational governments will only develop such expectations, if they believe that they can actually extract additional resources from the central government (or from other entities, such as local public banks). For instance, small municipalities with limited tax capacity may still face a hard budget constraint because they do not represent a sufficiently large share of the electorate to expect assistance from the central government. H4, H5 and H6 examine three variables that could potentially reduce or increase the VFI impact.

H4: The effect of the VFI is stronger in countries with large HFIs.

VFIs and HFIs may interact with each other, and their combination could be particularly detrimental to fiscal performance. We test this hypothesis by adding an interaction term between VFI and HFI, and expect a negative coefficient on this term.

Subnational governments are more likely to get supplementary ("soft") resources in countries with high regional disparities. Indeed, large subnational authorities are in a better position to

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the share of subnational own revenues in subnational own spending increases. In the robustness analysis, we propose an alternative equation based on this definition of VFI, and β is still found positive.

claim bailouts.[21] For example, they may be "too big to fail" because they provide regional public goods benefiting people residing in other jurisdictions (Wildasin, 1997, 2004). They may have more political leverage, because their interests are over-represented in the central legislature, and because a central government seeking to maximize its chances of reelection will be more prone to bailout subnational authorities representing a larger share of the population (Goodspeed, 2002). Also, large subnational governments may get more easily subsidized loans from local SOEs or public banks to cover their financing gap.[22]

In the empirical analysis, we test the effect of the HFI, using different regional indicators (income level, income per capita, population from OECD, 2010d), different levels of disaggregation (TL2 and TL3 territorial levels), and different volatility indices (variance, coefficient of variation, min-max, max-average).[23]

H5: The effect of the VFI is stronger in countries where subnational governments enjoy higher borrowing autonomy.

The effect of the VFI may also depend on the degree of borrowing autonomy of subnational governments. This assumption is tested by adding an interaction term, as in Rodden (2002). We expect to find a negative coefficient.

Subnational governments are more likely to attract additional national funds if they can distort their budget decisions. For instance, Carlsen (1998) shows that local borrowing can be used strategically by subnational government to force the hand of the center. By preventing strategic deficits, borrowing regulations contribute to harden the subnational governments' budget constraint. According to Von Hagen and Eichengreen (1996), this is the reason why borrowing restrictions are more prevalent in countries with large VFIs.

We use two measures of borrowing autonomy: an indicator produced by Crivelli et al. (2010) based on OECD questionnaires, and a World Bank indicator (World Bank, 2012), which

[21]This argument is not symmetric. Small subnational governments are not expected to perform better than the average.

[22]On the other hand, the common pool problem is less pronounced for big subnational governments, because they represent a high share of national taxes, and the tax cost of transfers is larger for them (Garcia-Mila et al., 2002).

[23]There is another way of interpreting H4. It is well known that equalization transfers have distortionary effects, even when they are well designed (Smart, 1998; Dahlby, 2002). For instance, equalization transfers based on actual spending costs (rather than "expenditure needs") and independent of the quality of service provided, discourage the adoption of cost-saving measures by subnational governments, and may even create incentives to overspend. Accordingly, the adverse effect of the VFI should be stronger where vertical equalization transfers are more prevalent, that is in countries with large regional disparities. However, this assumption could not be tested, as the OECD database only provides regional GDPs including transfers (these are part of the public sector's value added).

distinguishes between different forms of borrowing constraints (administrative, rule-based, cooperative approach and market discipline). Both indicators have the drawback of being time invariant. We supplement them with a time-varying indicator from the World Bank (DPI, 2010), which measures the tax and spending authority of subnational governments, and hence is an indirect proxy for their capacity to distort their borrowing plans. We recognize that none of the three indicators is fully satisfactory.

H6: The effect of the VFI is stronger in election years.

Political factors are also important determinants of the capacity of subnational governments to pressure the center, and distort grant allocations. It is well known that budgets vary according to political cycles (Drazen, 2001). Increases in government spending or decreases in taxes are more common during election years, as opportunistic policymakers try to maximize their chance of being reelected. Accordingly, we test whether the effect of the VFI is stronger in election years.

C. Main Results

Baseline regressions

Table 1 presents the results of models without interaction terms. Column 2 includes other covariates, while column 3 also adds time dummies. The econometric analysis supports both H1 and H2. VFIs negatively affect fiscal performance, while spending decentralization financed from own revenues has a positive effect.

The estimated coefficients on other covariates are consistent with priors. The debt coefficient is positive, suggesting that fiscal policy incorporates debt sustainability constraints. The output gap also has a positive effect, possibly reflecting the effect of automatic stabilizers (this could also suggest that fiscal policy is generally countercyclical in the sample). Better governance (rule of law) improves fiscal performance.

We do not find empirical support for H3. In a model with identical slopes for all countries, the VFI and squared VFI variables are statistically insignificant (Table 1, column 4). With country-specific slopes, we do find a non-linear effect in most countries, but it does not present a U-curve shape. Instead, a decline in the VFI is always found to be beneficial, and this effect is more pronounced at higher VFI levels (results not reported).

Table 1. Vertical Fiscal Imbalance and Fiscal Performance: Main Results
(Dependent variable: General government primary balance, percent of GDP)

	(1)	(2)	(3) 1/	(4) 1/
VFI	-0.18***	-0.17***	-0.12***	-0.17
	(-5.46)	(-3.50)	(-3.06)	(-1.33)
Expenditure decentralization	0.21***	0.18***	0.22***	0.21**
	(3.39)	(3.08)	(3.49)	(2.51)
Lag debt-to-GDP ratio		0.11***	0.06***	0.06***
		(6.77)	(4.56)	(4.51)
Lag of output gap		0.42***	0.20*	0.20*
		(3.86)	(1.97)	(1.97)
Rule of law		5.79***	5.89***	5.72***
		(4.52)	(5.67)	(5.48)
VFI squared				0.00
				(0.43)
Overall R^2	0.05	0.17	0.22	0.22
Within R^2	0.29	0.32	0.54	0.54
Number of observations	485	273	273	273
Number of countries	28	25	25	25

Source: Authors' estimates.
Notes: Annual data over 1969–2007 (sample period varies, see Appendix 1); fixed-effects estimation; robust t-stat clustered at the country level; ***(**, *) = significant at the 1 (5, 10) percent level.
1/ Includes time dummies (not reported in the table).

Interaction terms

In the specifications with interaction terms, the effect of the VFI should be assessed by summing α and the coefficients of the interactive terms for different values of the covariates (Table 2 reports the combined average effect in a separate row). [24]

The econometric analysis validates hypotheses H4, H5, and H6:

- The VFI is more detrimental to fiscal performance in countries with high HFIs, whether the HFI be measured as the per capita income disparity (Table 2, columns 1 and 2) or the income level disparity (Table 2, column 3). Disparity in the population size has no significant effect.

- The effect of the VFI is also more pronounced where subnational borrowing autonomy is high (Table 2, columns 4 and 5), and if countries have more authority to tax and spend (Table 2, column 11). A separate regression with disaggregated

[24]When conditional effects are tested, all the variables—conditioning variables and interaction terms—are included in the initial estimation to avoid omitted variable bias. Conditioning variables are then dropped in the final specification if they are found statistically insignificant.

indicators (Table 2, column 6) finds that the cooperative approach to controlling subnational borrowing reduces the VFI effect. Market discipline, fiscal rules, and administrative controls are not found to be statistically significant in our sample.

- The effect of the VFI is more negative in times of legislative elections (Table 2, column 7), and when the government is more fragmented across political parties (Table 2, column 8).

Table 2. Vertical Fiscal Imbalance and Fiscal Performance: Interactions
(Dependent variable: General government primary balance, percent of GDP)

	Horizonal Fiscal Imbalances (HFIs)			Borrowing Autonomy			Other Factors			Combined	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VFI 1/	-0.08*	0.03	-0.09**	0.07*	-0.11**	-0.11**	-0.11**	-0.09**	-0.05	0.56***	0.50**
	(-1.80)	(0.45)	(-2.27)	(1.80)	(-2.63)	(-2.58)	(-2.66)	(-2.57)	(-0.45)	(4.30)	(2.71)
Expenditure decentralization	0.17**	0.19**	0.21**	0.23**	0.23***	0.23***	0.21***	0.23**	0.31**	0.27***	0.31***
	(2.51)	(2.62)	(2.57)	(2.75)	(2.91)	(2.89)	(3.50)	(2.34)	(2.28)	(3.68)	(5.59)
Lag debt-to-GDP ratio	0.09***	0.11***	0.06***	0.06***	0.07***	0.07***	0.06***	0.05**	0.06***	0.18***	0.12***
	(4.88)	(5.75)	(3.27)	(3.70)	(3.50)	(3.68)	(3.77)	(2.42)	(3.95)	(5.15)	(3.36)
Lag of output gap	0.26*	0.41**		0.42***			0.20*		0.17*		
	(1.91)	(2.22)		(4.05)			(1.91)		(2.01)		
Rule of law	5.22***	4.96***	5.55***		6.51***	6.14***	5.94***		5.73***		
	(5.77)	(4.99)	(3.66)		(5.27)	(4.43)	(5.70)		(5.17)		
Regional disparity (HFIs) 2/			0.00**								
			(2.31)								
VFI x Regional disparity (HFIs) 2/	-0.01*	-0.46**	-0.00**							-0.50***	-0.001**
	(-1.75)	(-2.53)	(-2.33)							(-5.63)	(-2.91)
VFI x Borrowing autonomy 3/				-0.003***	-0.17***					-0.01**	-0.01***
				(-4.18)	(-3.02)					(-3.05)	(-6.58)
VFI x Cooperative borrowing control						0.14**					
						(2.17)					
VFI x Election							-0.01*				
							(-1.88)				
VFI x Government fragmentation								-0.07**			
								(-2.61)			
VFI x Expenditure decentalization									-0.00		
									(-0.65)		
VFI x Subnational governments' authority to tax or spend										-0.21**	0.37*
										(-2.64)	(2.13)
Combined effect of VFI 4/	-0.11**	-0.10**	-0.10**	-0.15***	-0.10**	-0.10**	-0.11**	-0.14***	-0.11**	-0.14**	-0.18***
	(-2.78)	(-2.44)	(-2.41)	(-4.72)	(-2.54)	(-2.56)	(-2.74)	(-3.37)	(-2.53)	(-3.05)	(-4.71)
Overall R^2	0.20	0.13	0.30	0.14	0.20	0.26	0.25	0.12	0.21	0.42	0.30
Within R^2	0.55	0.59	0.46	0.53	0.45	0.45	0.53	0.38	0.54	0.64	0.58
Number of observations	232	221	249	290	272	272	260	354	273	104	152
Number of countries	22	21	23	20	25	25	24	27	25	11	13

Source: Authors' estimates.

Notes: Annual data over 1969–2007 (sample period varies, see Appendix 1); fixed-effects estimation; robust t-stat clustered at the country level; ***(**, *) = significant at the 1 (5, 10) percent level; time dummies are included but not reported here.

1/ Changes in the magnitude and sign of estimated coefficients do not reflect instability of relations; total effect should also take into account interaction terms (see combined effect row).

2/ HFI indicators used in columns:
- (1): HFI = Ratio of max to min regional real per capita GDP
- (2): HFI = Coefficient of variation of regional real per capita GDP
- (3): HFI = Variance of regional GDP
- (10): HFI = Weighted coefficient of variation of TL3 regional GDP per capita (OECD)
- (11): HFI = Ratio of max to average regional GDP

3/ Borrowing autonomy indicators used in columns:
- (4) and (10): Crivelli et al. (2010)
- (5) and (6): World Bank (2012).
- (11): Aggregate index based on World Bank (2012).

4/ Combined effect of VFI = VFI coefficient + interaction term coefficient(s) at average value of the interacted covariate(s) when significant.

Our findings also hold when several interaction terms are combined (Table 2, columns 10 and 11). We have some reservations about including the interaction term of spending decentralization and the VFI, as is done in some empirical papers. By construction, this variable is the VFI as a share of general government expenditure, which is highly correlated with the VFI and artificially reduces the statistical significance of the latter variable (Table 2, column 9).

D. Robustness Analysis

Sensitivity Analysis

Sensitivity tests confirm the robustness of the baseline results. First, to control for the stability of the relation and existence of possible outliers, we estimate the equation over sub-samples or exclude one country at a time. Results remain broadly unchanged. Second, removing time dummies does not significantly affect the estimates. Country-specific fixed effects, on the contrary, should not be excluded, as indicated by the Hausman test. Third, we reestimate Eq. (1) using alternative fiscal performance indicators, including the change in the general government debt ratio, the structural balance, and the overall balance. The main variables are still significant, with the expected signs, and the coefficients are of the same order of magnitude. Fourth, to assess whether or not the empirical correlation between decentralization and VFI affects the results, we exclude the former from the equation and note that the VFI coefficient does not change materially. Fifth, although stationary tests do not provide clear evidence that the variables are nonstationary, some of them present a strong persistence, such as the VFI. To avoid the risk of spurious relationship, we reestimate Eq. (1) in first difference with time and country fixed effects (Table 3, columns 1 and 2). The variables are still significant, and the VFI coefficient remains within the range of our previous estimates. Sixth, we run the regression on a sample excluding countries with large tax sharing schemes (Table 3, column 3). The VFI measurement error does not seem to have biased our previous results. Seventh, we re-estimate our equation with two alternative measures of the VFI: the vertical gap as a share of general government, rather than subnational, spending (Table 3, columns 4-5) and transfer dependency, defined as the share of net transfers received by subnational government in subnational own expenditure (Table 3, columns 6–7). Our estimates are generally unchanged. The signs of the VFI and spending decentralization coefficients remain the same, and the estimated elasticity of the transfer dependency is close to that of the VFI. Finally, results are not significantly affected if we estimate a dynamic model using the LSDV estimator with Kiviet (1995) correction (Table 3, column 8).

Table 3. Vertical Fiscal Imbalance and Fiscal Performance: Sensitivity Analysis
(Dependent variable: General government primary balance, percent of GDP)

	First-Difference Model 1/		Fixed-Effects Model					Dynamic Panel Data Model 3/
			Excluding Countries with Large Tax Sharing 2/	VFI as a Share of General Government Expenditure		Transfer Dependency as Alternative VFI Measure		
	(1)	(2) 4/	(3) 4/	(4)	(5) 4/	(6)	(7) 4/	(8) 4/
VFI	-0.28***	-0.19***	-0.12*	-0.54***	-0.32***	-0.11***	-0.09***	-0.08***
	(-4.39)	(-3.34)	(-2.04)	(-5.02)	(-3.62)	(-3.74)	(-4.05)	(-3.65)
Expenditure decentralization	0.32***	0.27**	0.22**	0.46***	0.34***	0.19***	0.12**	0.14***
	(2.79)	(2.36)	(2.75)	(4.65)	(4.50)	(3.31)	(2.46)	(4.03)
Lag debt-to-GDP ratio		0.14***	0.06***		0.07***			0.05***
		(5.11)	(3.97)		(3.73)			(3.71)
Lag of output gap		0.36***			0.35***		0.26***	
		(5.49)			(3.89)		(3.10)	
Rule of law			7.00***		4.90***			3.50***
			(7.75)		(4.65)			(3.32)
Lag of general government primary balance								0.59***
								(11.54)
Overall R^2	0.23	0.44	0.20	0.05	0.20	0.04	0.12	
Within R^2	0.23	0.45	0.49	0.33	0.45	0.15	0.43	
Number of observations	457	316	253	485	273	485	422	302
Number of countries	28	25	23	28	25	28	25	28

Source: Authors' estimates.

Notes: Annual data over 1969–2007 (sample period varies, see Appendix 1); robust t-statistics clustered at the country level for fixed-effects estimation; ***(**, *) = significant at the 1 (5, 10) percent level.
1/ Fixed effect estimation on variables in first differences, except time dummies in column (2) (not reported here).
2/ Excluding Germany, Slovenia, Spain, Estonia, and Poland, for which the tax sharing in total subnational revenue was higher than 15 percent in 2008.
3/ Bias corrected LSDV estimators for dynamic panel data model proposed by Bruno (2005) which extends Kiviet (1995) to unbalanced panels.
4/ Time dummies are included but not reported here.

Instrumental Variable Estimation

In Model (1), the VFI may be endogenous with regards to the fiscal balance for several reasons. First, the general government balance and the VFI are connected through an accounting relationship (Box 2). Second, some unobserved, omitted variables, such as governance, could affect both variables (although this bias is likely to be corrected by the fixed-effect estimation). Third, the design of some transfers, particularly matching grants, entails that spending and transfers are simultaneously determined (Gamkhar and Shah, 2007). Finally, when transfers are used to bail out subnational governments that overspend, there is reverse causality from fiscal performance to transfers.

Table 4. Vertical Fiscal Imbalance and Fiscal Performance: Instrumental Variable Model

(Dependent variable: General government primary balance, percent of GDP, unless otherwise indicated)

	Instrumental Variable Model				Fixed-Effects Model	
	Second-Stage Regression				(Robustness check)	
	(1)	(2)	(3)	(4)	(5)	(6)
VFI	-0.15*	-0.06***	-0.10**	-0.10*	-0.17***	-0.11***
	(-1.74)	(-3.21)	(-2.58)	(-2.02)	(-3.57)	(-2.96)
Expenditure decentralization	0.19**	0.17	0.17*	0.14*	0.23**	0.21*
	(2.30)	(1.65)	(1.80)	(2.06)	(2.42)	(1.89)
Lag debt-to-GDP ratio	0.05***	0.05***	0.05***	0.06***	0.07***	0.08***
	(4.08)	(3.31)	(3.24)	(3.68)	(5.02)	(4.12)
Lag of output gap	0.43***	0.46***	0.46***	0.47***	0.45***	0.45***
	(5.55)	(5.97)	(6.13)	(4.65)	(4.17)	(3.73)
Lag of VFI					0.03	0.02
					(0.81)	(0.63)
Fiscal autonomy					-0.71	
					(-1.48)	
School-age population					0.12	
					(0.41)	
Share of health spending						-0.02
						(-0.79)
	First-Stage Regression 1/ (Dependent variable: VFI)					
Included instruments						
Expenditure decentralization	0.22	0.36	0.27	-0.13		
	(0.47)	(0.91)	(1.43)	(-0.88)		
Lag debt-to-GDP ratio	-0.02	-0.01	0.02	-0.02		
	(-0.58)	(-0.21)	(1.46)	(-0.79)		
Lag of output gap	-0.08	-0.27	0.41	0.33***		
	(-0.25)	(-0.97)	(1.72)	(3.49)		
Excluded instruments						
School-age population	2.15***	1.13**	0.95**			
	(3.02)	(2.56)	(5.89)			
Fiscal autonomy		-7.41***	-1.77***			
		(-12.67)	(-3.77)			
Lag of VFI			0.73***	0.77***		
			(13.15)	(10.90)		
Share of health spending				0.11*		
				(1.82)		
F-test of excluded instruments 1/	9.10	145.13	420.11	119.47		
Partial R^2 of excluded instruments	0.10	0.36	0.73	0.67		
Hansen J-statistic 2/	-	0.46	3.97	0.96		
(p-value)	-	(0.50)	(0.14)	(0.33)		
Centered R^2	0.52	0.52	0.54	0.51		
Overall R^2					0.15	0.22
Within R^2					0.51	0.46
Number of observations	341	306	306	290	307	323
Number of countries	25	22	22	23	23	24

Source: Authors' estimates.

Notes: Annual data over 1969–2007 (sample period varies, see Appendix 1); fixed-effects estimation; robust t-stat clustered at the country level; ***(**, *) = significant at the 1 (5, 10) percent level; time dummies are included but not reported here.

1/ The first stage regression includes time and country fixed effects.

To assess whether endogeneity biases our results, we reestimate Eq. (1) with an instrumental variable method. Instruments should be time-varying (as the first stage uses a fixed-effects estimator), correlated with the VFI, and only indirectly related to fiscal performance. We are aware that in a macroeconomic setting, "exogenous" variables may be viewed with some (legitimate) skepticism. The following results should be seen as supplementing rather than superseding previous estimates.

Several variables were found to meet the standard instrument validity tests, while having reasonable interpretations. We report the results of the specifications using the most robust ones. The tests of instrument relevance and overidentifying restrictions are included in Table 4 (columns 1-4, lower panel). We also check that the instruments are not statistically significant in the main regression (columns 5-6). We use the following instruments:

- The share of school-age population (0 to 14 years) is an important explanatory factor of the VFI. In general, primary and secondary education functions are subnational responsibilities subject to strong central oversight, with limited revenue autonomy (Bach et al., 2009). School age population is also a parameter used in transfer formulas. By contrast, the rationale for including this variable as a direct determinant of the overall balance seems weak—an assumption confirmed by the test reported in column 4.

- The fiscal autonomy indicator of Hooghe et al. (2008) measures the extent to which the legal framework gives regional governments a free hand to tax its population. This time-varying factor reduces the need for transfers and borrowing without being directly related to the overall fiscal balance.

- The lag of the VFI is also used as an instrument, as the VFI presents a strong persistence and fiscal performance may impact current but not previous VFIs.

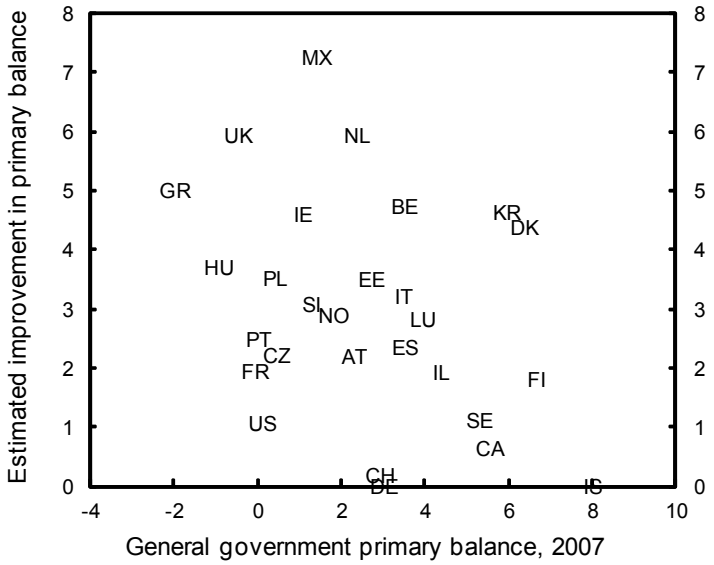
- The ratio of subnational health spending to national health spending reflects the role of subnational governments in the delivery of national public goods and services—a determining factor of the tax-grant balance across countries, according to Charbit and Goodspeed (2009). The distribution of competencies between government levels does not necessarily have a direct effect on fiscal performance, but it impacts the financing mix of subnational governments. When subnational governments receive large social spending responsibilities, more transfers from the center are generally needed given that the scope to raise revenues from local taxation is limited, and the central government wants to keep some control over national policies.

The two-stage least-squares models report estimated coefficients of α within the range of the baseline results of Table 2. Overall, we do not find evidence that endogeneity is a major issue in our sample.

Range of estimates for the VFI coefficient

Depending on the specification, the estimated coefficient of the VFI ranges from -0.06 to -0.18 (in the equations with interaction terms, we use the combined effect). Our estimates cluster around -0.1, which is also the elasticity produced by the instrumental variable estimations. This means that a 10 percentage point decline in the VFI should improve the general government primary balance by 1 percentage point of GDP. Based on this estimate, Figure 6 reports the fiscal gain that countries could expect from reducing their pre-crisis VFI to that of the least imbalanced countries in the sample (other factors being equal).

Figure 6. Potential Fiscal Gains from VFI Reduction 1/
(Percent of GDP)



Source: Authors' estimates.
1/ Assumes a reduction in VFI from its 2007 level to the average VFI of the three countries with the smallest VFI (DE, IS, CH). A -0.1 elasticity is used to derive the impact of VFI reduction on the general government primary balance.

Expenditure and Revenue Equations

Finally, we estimate the model separately on general government spending and revenue to determine whether the negative impact of the VFI is channeled through higher spending and/or a lower tax effort. Results are reported in Table 5.

We find that the VFI decreases revenue, but without significantly affecting spending. The latter observation is somewhat surprising given that the literature tends to emphasize the spending side (e.g., via the "flypaper effect"). These results would warrant further investigation, which is outside the scope of this paper.

Table 5. Vertical Fiscal Imbalance, Government Expenditure, and Government Revenue

(Dependent variables are in percent of GDP)

	Dependent Variable: General Government Primary Expenditure		Dependent Variable: General Government Revenue		
	(1)	(2)	(3)	(4)	(5)
VFI 1/	0.05	-0.16**	-0.07***	-0.08***	-0.12***
	(1.13)	(-2.13)	(-2.99)	(-3.30)	(-5.82)
Expenditure decentralization	-0.17		-0.01		
	(-1.38)		(-0.21)		
Lag debt-to-GDP ratio	0.05*		0.09***	0.09***	0.09***
	(1.97)		(6.65)	(5.35)	(4.58)
Lag of output gap	-0.35***	-0.58***	0.12**		
	(-4.23)	(-3.27)	(2.29)		
Openness	-0.05**		-0.03**		
	(-2.61)		(-2.55)		
Real GDP growth				-0.20**	
				(-2.23)	
VFI x Regional disparity (HFIs) 2/		0.001**			0.01**
		(2.41)			(2.07)
Combined effect of VFI 3/		0.01			-0.11***
		(0.32)			(-4.99)
Overall R^2	0.01	0.16	0.01	0.08	0.07
Within R^2	0.36	0.31	0.38	0.38	0.33
Number of observations	341	241	341	370	266
Number of countries	25	22	25	28	25

Source: Authors' estimates.

Notes: Annual data over 1969–2007 (sample period varies, see Appendix 1); fixed-effects estimation; robust t-stat clustered at the country level; ***(**, *) = significant at the 1 (5, 10) percent level; time dummies are included but not reported here.

1/ Changes in the magnitude and sign of estimated coefficients do not reflect instability of relations; total effect should also take into account interaction terms.

2/ HFI indicators used in columns:

(2): HFI = Ratio of max to average regional real per capita GDP

(5): HFI = Ratio of max to min regional real per capita GDP

3/ Combined effect of VFI = VFI coefficient + interaction term coeffiecient(s) at average value of the interacted covariate(s) when significant.

VI. Conclusions and Policy Discussion

We provide new evidence regarding the impact of the vertical imbalances on fiscal performance, focusing on OECD countries. Our econometric results confirm the widely-held view that spending decentralization financed through own revenues is beneficial and that reducing the share of subnational spending financed by transfers and borrowing leads to an improvement in fiscal outcomes. On average, the general government balance increases by 1 percent of GDP for every 10 percentage points decline in the VFI, that is, when financing equivalent to one-tenth of subnational expenditure shifts from transfers and/or borrowing to own revenue. Our findings also suggest that the combination of vertical and horizontal imbalances is particularly damaging to fiscal outcomes. Finally, we show that reducing VFIs increases revenue, which may create trade-offs for governments seeking to reduce the tax burden.

In practice narrowing vertical imbalances may be difficult to achieve. Our results naturally raise five questions:

i. *Is there scope to increase the revenue authority of subnational governments, given that the devolution of tax responsibilities faces specific challenges,* including tax base mobility, higher administrative costs, and horizontal disparities in revenue-raising capacity? The literature is generally skeptical about the possibility of leaving important revenue bases to the lower levels of government. Nonetheless, some papers question the dogma that subnational authorities should only rely on benefit taxation and that the largest tax bases cannot be transferred to them (Bird, 1999). Furthermore, not only the magnitude but also the quality of revenue decentralization is important; local taxes should be carefully selected, based on feasibility and efficiency considerations.

ii. *Would higher subnational tax autonomy translate into higher subnational revenues?* Aligning spending and revenue assignments is a necessary, but not a sufficient condition. Even when subnational governments have tax-raising autonomy, they may rationally decide not to raise revenues, because they expect to receive bailout transfers from the central government. Building a hard budget constraint is not an easy task. The fiscal institution framework can play an important role by creating the right controls and incentives (Pisauro, 2001; Rodden et al., 2003).

iii. *If subnational own revenues cannot be increased above a certain level, should the VFI be narrowed by recentralizing spending?* The conventional wisdom that functions should be carried out at the lowest political and administrative levels, and as close to citizens, as possible (subsidiarity principle) is much debated today, in particular in the area of health policy (Saltman, 2008). There may be tradeoffs between traditional gains of decentralization (better tailoring of spending to local

needs, increased accountability, transparency, competition) and the risks and opportunity costs that decentralization generates (agency problems, negative externalities, diseconomies of scale).

iv. *If subnational own revenues cannot be increased and spending should not be recentralized, can the transfer system be reformed to become less distortionary?* A large part of the empirical literature suggests that grant and tax-sharing designs actually can be improved (Bergvall et al., 2006; Blöchliger and Charbit, 2008; Blöchliger and Petzold, 2009). Well-designed grants should be based on objective criteria that are less prone to discretionary changes, and indendent on local choices.

v. *Are there other ways of enforcing fiscal discipline than raising subnational tax responsibilities, rationing transfers, or controlling local borrowing?* Additional hard budget constraint mechanisms have come under closer scrutiny, such as financial market and land market discipline, fiscal rules, and adequate political institutions (Ter-Minassian, 1997a, 1997b; Rodden et al., 2003).

Appendix. Data Sources and Definitions

Appendix Table 1. List of Countries and Sample Period

	Country	Sample period
1.	Austria	1995–2007
2.	Belgium	1985–2007
3.	Canada	1970–2007
4.	Czech Republic	1997–2007
5.	Denmark	1990–2007
6.	Estonia	1997–2007
7.	Finland	1975–2007
8.	France	1995–2007
9.	Germany	1991–2007
10.	Greece	1995–2007
11.	Hungary	1995–2007
12.	Iceland	1995–2007
13.	Ireland	1990–2007
14.	Israel	1995–2007
15.	Italy	1980–2007
16.	Korea	2000–2007
17.	Luxembourg	1990–2007
18.	Mexico	2003–2007
19.	Netherlands	1969–2007
20.	Norway	2002–2007
21.	Poland	2005–2007
22.	Portugal	1995–2007
23.	Slovenia	1995–2007
24.	Spain	1995–2007
25.	Sweden	1993–2007
26.	Switzerland	1990–2007
27.	United Kingdom	1987–2007
28.	United States	1970–2007

Notes: Sample period for OECD (2010a) data; subnational (state, where applicable, and/or local) fiscal data are not available for Australia (all years); Austria (1988–1994); France (1978–1994); Japan (all years); New Zealand (all years); and Poland (1995–2004); non-oil fiscal and GDP data for Norway (source: IMF).

Appendix Table 2. List of Variables, Definitions, and Sources

Variable	Definition	Source
VFI (vertical fiscal imbalance)	Share of subnational own expenditure (i.e., excluding transfers paid to other general government units) not financed with subnational own revenue (i.e., excluding transfers received from other general government units). Subnational government is a consolidated state (when applicable) and local government. Transfers include both current and capital transfers.	OECD (2010a)
Expenditure decentralization	Share of subnational own expenditure in total general government expenditure.	OECD (2010a)
Debt-to-GDP ratio	General government gross debt (percent of nominal GDP).	IMF (2011)
Output gap	Percentage difference between actual GDP in constant prices and estimated potential GDP.	OECD (2010b)
Rule of law	Indicators are measured in units ranging from about -2.5 to 2.5, with higher values corresponding to better governance outcomes. Values for the years 1997, 1999, and 2001 are interpolated; and 1995 is assumed equal to 1996.	Kaufmann et al. (2010)
Regional disparity (HFI)	Several measures are constructed (see notes to Tables 2 and 5) using the regional GDP, regional real per capita GDP, and regional population series.	OECD (2010d)
Borrowing autonomy	Index measuring six components of borrowing regulations (domestic/international borrowing prohibition; limits on government debt; limits on debt service; limits on borrowing for specific purposes; and Requirements of prior approval from higher levels of government).	Crivelli et al. (2010)
Cooperative borrowing control	Dummy variable = 1, if control over subnational government borrowing is cooperative, = 0 otherwise.	World Bank (2012)
Election	Dummy variable = 1, if there was a legislative election in this year, and =0 otherwise.	Beck et al. (2001)
Government fragmentation	Herfindahl Index Government (the sum of the squared seat shares of all parties in the government).	DPI (2010)
Subnational governments' authority to tax or spend	Dummy variable = 1, if state/provinces have authority over taxing, spending, or legislating, and =0 otherwise.	DPI (2010)
Transfer dependency	Share of subnational net transfers received in subnational own expenditure.	OECD (2010a)
Fiscal autonomy	{0,1,2,3,4} index measuring the extent to which a regional government can independently tax its population (with 0 if the central government sets base and rate of all regional taxes; and =4 if the regional government sets base and rate of at least one major tax).	Hooghe et al. (2010).
School-age population	Population between the ages of 0 and 14 as a percentage of the total population.	World Bank (2011)
Health spending share	Share of subnational (state and local) expenditure on health in total general government expenditure on health.	OECD (2010c)
Openness	Share of total exports and imports in nominal GDP.	IMF (2011)
Real GDP	GDP, constant prices.	IMF (2011)

Appendix Table 3. Residual Analysis and Model Specification Tests

(Based on the specification of Table 1, column 1)

Diagnostic / Specification Test	Test Result
Autocorrelation	
Wooldridge test for serial correlation (Ho: No first-order autocorrelation)	$F(1, 27) = 70.02$ *
Heteroskedasticity	
Modified Wald test for groupwise heteroskedasticity (Ho: Homoskedasticity)	$\chi^2(28) = 1189.11$ *
Cross-sectional dependence	
Breusch-Pagan LM test (Ho: Cross-sectional independence in the residuals)	$\chi^2(378) = 648.86$ *
Multicollinearity	
Variance inflation factors (VIFs)	
VFI	12.02
Expenditure decentralization	19.98
Mean VIF	4.39

Source: Authors' estimates.
Note: * = Ho is rejected at the 1 percent significance level.

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