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Fiscal equalisation schemes and sub-central government borrowing*

Salvador Barrios and Diego Martínez**

Abstract

This paper analyses the role played by the fiscal equalisation scheme in determining sub-national public borrowing in decentralised countries. We show theoretically how the regional income redistribution modifies the intertemporal budget constraint of the regions and discuss the conditions under which the federal equalisation arrangements are likely to lead to diverging borrowing between rich and poor regions. We test empirically the link between regional government primary balances and the level of GDP per capita in Canada, Germany and Spain. Our econometric analysis shows that this relationship can be either positive (as in the German case) or negative (as in the Canadian and Spanish cases), thus suggesting that either poor or rich regions can display higher regional public borrowing on average. We attribute these results to the differences in the design of the fiscal equalisation schemes and illustrate this through numerical simulations of our model. These results suggest that reforms of the federal financing schemes can prove instrumental in reducing regional heterogeneity in public borrowing.

Keywords: fiscal equalisation, public debt.
JEL Classification: H7, H6.

Resumen

Este artículo analiza el papel jugado por el sistema de nivelación fiscal a la hora de determinar el endeudamiento de gobiernos subcentrales, Mostramos teóricamente cómo la redistribución territorial de la renta modifica la restricción presupuestaria intertemporal de las regiones y discutimos las condiciones bajo las que los sistemas de nivelación fiscal pueden conducir a niveles de endeudamiento distintos en las regiones ricas y pobres. Comprobamos empíricamente los vínculos entre el superávit primario regional y la renta per cápita en Canadá, Alemania y España. Nuestro análisis econométrico muestra que esta relación puede ser positiva (Alemania) o negativa (Canadá y España), sugiriendo por tanto que tanto las ricas como las pobres pueden llegar a niveles de endeudamiento superiores. Atribuimos este resultado a las diferencias en el diseño de los modelos de nivelación fiscal y lo ilustramos con simulaciones numéricas. Estos hallazgos sugieren que las reformas en los modelos de financiación territorial tienen efectos sobre la heterogeneidad en los comportamientos de gobiernos regionales a la hora de endeudarse.

Palabras clave: nivelación fiscal, deuda pública.
Clasificación JEL: H7, H6.

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1. Introduction

Sub-central government public finances have deteriorated sharply in a number of developed economies since the start of the global financial crisis, contributing significantly to the deterioration of general government fiscal balances in countries with highly decentralised fiscal policies, see Ter-Minassian and Fedelino (2010). In some cases sub-central governments public finances have experienced diverging evolutions, casting doubts on the achievement of national fiscal objectives, see in particular European Commission (2012), Foremny and von Hagen (2012) for recent evidence. Existing sub-national borrowing rules and other fiscal restraints might play a role in ensuring a greater homogeneity in regional borrowing. However, the heterogeneity in regional fiscal constraints might be difficult to reduce when regions face very different fiscal needs and fiscal capacities. This paper investigates the way differences in fiscal capacities, which are primarily determined by regional differences in GDP per capita, influence regional public borrowing depending on the existing fiscal equalisation scheme.

The effective contribution of sub-central governments towards national fiscal consolidation objectives might be severely constrained for at least two major reasons. First, regions usually have only a loose control over their own fiscal policy. In some cases a large share of their revenues stems from central-governments, either through grants or shared taxes over which they usually have little discretionary power. The degree of flexibility in public spending is also limited given that spending attributions are often only delegated from the central government. Second, regions usually face long-lasting income differentials which make some of them largely dependent on intergovernmental grants to ensure a sufficient access to public goods and services according to nationally-set standards. This regional heterogeneity can be directly linked to differences in productivity and competitiveness levels which are arguably unlikely to vanish in the medium-run and, in many instances, even the long-run, see Barrios and Strobl (2009). Likewise, cross-regional income differences can have a protracted effect on public debt and public deficit given that the incentives to undertake structural reforms and/or to avoid budgetary slippages are notoriously low in presence of permanent fiscal transfers, see Duval and Elmeskov (2006). Factual evidence suggests that the latter is more likely if similar levels of public services are expected across constituencies with large differences in GDP per capita and if the fiscal equalisation scheme does not provide appropriate mechanisms to deter and/or to reduce excessive regional fiscal imbalances, see in particular Rodden (2006). The extent to which these permanent redistribution schemes may face the opposition of richer (i.e., net creditor) regions and/or may compromise the conduct of national fiscal policies remains an open source of discussion and controversy, however.

Generally speaking, the possibility for sub-national entities (i.e. states, regions or cities), to benefit from a financial rescue either through a bailout or grants modifies their intertemporal budget constraint. Regional fiscal policy decisions might thus be more distorted than, say, country-level fiscal policy decisions, since regions naturally set their fiscal policy

objectives by anticipating the resources stemming from the central (or federal) government. For instance Buettner and Wildasin (2006) show that according to the size of their population, large cities are more dependent on federal grants than small cities which tend to rely more on own-resources financing. The authors argue that differences in administrative regulations and institutional constraints, together with the possibility to exert stronger lobbying influence in case of financial stress, might explain why city size affects the conduct of municipal fiscal policy in the US. Other authors have also put forward the degree of political fragmentation in local and regional governments which could possibly explain differences in fiscal policy decisions across constituencies, see for instance Alt and Lowry (1994), Rattsø and Tovmo (2002) and Ashworth and Heyndels (2005). The differences in fiscal policy making at sub-national level might also be due to the voters´ and/or governments´ misperception on the true cost of public services which might lead to different spending propensities (through the so-called flypaper effect) and biased tax policy decisions at regional level, see for instance Strumpf (1998), Smart (1998), Martínez (2005) and Egger et al. (2010).

In this paper we argue that another possible bias in regional fiscal policy making might come from the way fiscal policy attributions of the central (or federal) and regional (or state) governments are designed. On the one hand, the rules governing the fiscal relations between the different layers of governments are deeply rooted on institutional grounds which differ across countries. On the other hand, regional fiscal policy choices might also depend on the fiscal capacity. The conduct of regional fiscal policies might thus differ depending on both the country and region-specific features. We show that in federal or quasi-federal countries relatively rich and poor regions can display significantly different fiscal behaviour. This result can be directly traced back to the specific features of a country´s territorial financing system. In order to highlight the basic mechanisms at stake we first sketch out a simple model considering the case of a country with two regions where fiscal policy is determined at both the national and regional levels. We show that the regional income redistribution modifies the intertemporal budget constraint of the regions, which may incur into higher or lower indebtedness depending of the expected tax revenues redistributed through central government grants and the degree of public revenues harmonisation within the country. We use these theoretical findings to motivate our empirical analysis on Canada, Germany and Spain. All these countries have experienced a substantial decentralisation of their public finances either on the spending side, tax revenue side or both.[1] The public finances of these countries have also reacted differently to adverse macroeconomic shocks and, in some cases, regional budgetary slippages have played a significant role in these evolutions, especially since the onset of the current financial crisis, see Canuto and Liu (2010). Our econometric results suggest that in Germany poorer regions tend to run higher primary deficits while in the Canadian and Spanish case the opposite happens. We further conduct a number of numerical

[1] Local and state government public represented more than 40% of general government expenditure and revenues in these countries in 2010, Sources: IMF, World Bank and OECD.

simulations to illustrate the mechanisms that might explain the link between these results and the fiscal equalisation schemes in place in these countries.

The rest of the paper is organised as follows. In Section 2 we present a simple model of fiscal decentralisation using as benchmark the case of a unitary state and comparing the corresponding level of public borrowing when regional equalisation grants are considered. In Section 3 we provide a description of the territorial financing system in Canada, Germany and Spain. In Section 4 we undertake an econometric analysis of the link between these two variables and interpret our results by means of numerical simulations of the model. Section 5 summarises our results and concludes.

2. A simple model of fiscal decentralisation with unequal regional fiscal capacities

From a theoretical perspective, the main reason why one would expect regional government borrowing to differ from national government borrowing behaviour is that regional governments are usually net receiver (or net payer) of fiscal equalisation transfers. These transfers in turn directly affect the regional intertemporal budget constraint and borrowing behaviour. In order to analyse the basic mechanisms at play we build a simple model in order to consider the effect of alternative fiscal arrangements in a decentralised country. We take explicitly into account the interactions between the different layers of government stemming from tax-sharing arrangements in the presence of persisting differences in income per capita. In the sequel we describe the model structure and the case of a unitary government which is used as benchmark to determine the change in government debt (our main variable of interest) compared to the case where regional fiscal equalisation is introduced in the model.[2]

2.1. Model structure

Let consider a two-period model where economic agents work, produce and consume in period 1 (the present) and only consume in period 2 (the future). Let a country made of two regions (A and B), with each administrative level being embodied with its own government. Regions may have different sizes in terms of population, denoted by N^A and N^B. Technology in region j (j=A, B) is given by the production function $y_1^j = f^j\left(N^A l, k^j\right)$, where y_1^j is the output in the period 1, l labour and k^j private capital. Output y can be used interchangeably as private good (that includes both labour and capital) or public good. The regional production functions differ between regions in the productivity level only[3]. It is also assumed that labour is immobile across regions while private capital is perfectly mobile both internally and

[2] The interested reader will find a more detailed description of the model in the Appendix.

[3] The production function and total factor productivity parameters are left unspecified in order to simplify the presentation.

abroad. Therefore the representative household will enjoy a higher wage rate w in the most productive region (say region B) whereas the return of capital r will be the same across the federation thanks to cross-regional capital flows.

The preferences of the representative household are identical in both regions A and B, and given by the following utility function:

$$U = \log(x_1^j) + \gamma \log(L - l) + \eta \log(g_1^j) + \beta\left[\log(x_2^j) + \eta \log(g_2^j)\right], \quad 1)$$

where, for the region j and period t, x_t^j is the level of consumption of private good, g_t^j is the consumption of public good g, L the total endowment of time by the household in period 1, γ and η are parameters of the utility function measuring the preferences for leisure and public goods, respectively, and β is the discount factor denoting the relative preference for current vs. future consumption. The budget constraints of the household in periods 1 and 2 are given by:

$$x_1^j = w^j l(1 - \tau_l) - S^j \quad 2)$$

$$x_2^j = S^j(1 + r(1 - \tau_S)), \quad 3)$$

where S^j is the level of saving and τ_S and τ_l ($0 \le \tau_S \le 1$, $0 \le \tau_l \le 1$) are the tax rates on saving income and labour income, respectively. Standard optimisation implies to maximise (1) subject to (2) and (3), and to obtain the optimal values $\left(x_1^j\right)^*$, $\left(x_2^j\right)^*$, l^* and $(S^j)^*$.

2.2. The case of unitary government

As usual in the literature, the case of unitary government is first considered as benchmark to assess the efficiency of equilibrium when decentralisation of public spending and public revenue is introduced in the model. The central government maximises the social welfare function given by:

$$W = \delta N^A U^A + (1 - \delta) N^B U^B, \quad 4)$$

where δ is the weight of region A's utility over the national utility, reflecting the degree of inequality aversion of the central government. The public budget constraints at national level in each period are:

$$g_1^A + g_1^B - N^A \tau_l l w^A - N^B \tau_l l w^B - D = 0 \quad 5)$$

$$N^A \tau_S r S^A + N^B \tau_S r S^B - g_2^A - g_2^B - D(1 + r) = 0, \quad 6)$$

where D is the government debt level. After deriving the first order conditions for the decision variables, we obtain the optimal values $\left(g_1^A\right)^*$, $\left(g_2^A\right)^*$, $\left(g_1^B\right)^*$, $\left(g_2^B\right)^*$, $(\tau_l)^*$, $(\tau_S)^*$ and D^*, which is reported next:

$$D^* = -\frac{L(N^A w^A + N^B w^B) l \beta \eta}{(1+\beta+\gamma) l + (1+\beta) L \eta}. \qquad 7)$$

From equation (7) one can see that in the unitary government case, the sign of D^* is unambiguously negative. The main reason for this relates to the distinctive distortionary nature of capital vs. labour taxation. The optimal tax rate on capital income is zero since capital taxation is more distortionary in this model than labour taxation. It follows that labour is the only production factor that is taxed in this model. As a consequence, no tax revenues are expected in the second period such that the unitary government must save in the first period in order to obtain resources to finance the public good g in the second period. In the sequel we analyse the borrowing behaviour of regional governments when these are introduced in the model.

2.3. Regional borrowing with equalisation in the Federation

We now compare the optimal public debt level obtained in the case of unitary government with the one when financial transfers are operated between the central government and the two regions A and B. Both levels of government share the labour income tax (at rates t_l^j and T_l^j chosen, respectively, by the regional and the central government with $0 \le t_l^j \le 1$ and $0 \le T_l^j \le 1$). Regions are also allowed to borrow from financial markets. The main difference with respect to the case of a unitary government is that regional governments are now exclusively responsible for providing g_1^j and g_2^j. In order to finance the provision of the public good, regional governments also benefit from fiscal equalisation grants transferred from the central government. Fiscal equalisation is indirectly used to equalise the fiscal capacity of regions given that the tax bases on labour income are inherently unequal due to differences in productivity levels between the two regions. The equalisation of regional governments´ revenues takes place in the second period only.

The optimisation problems of each sub-national government can be solved simultaneously using the regional budget constraint in each period as by:

$$g_1^j - N^j t_1^j w^j l - D^j = 0 \qquad 8)$$

$$g_2^j - Z^j + D^j (1+r) = 0, \qquad 9)$$

where Z^j is an equalisation transfer from the federal to the regional government of region *j*. The role of Z^j is central in our discussion. Following the existing literature, Z^j can be defined generally as in equation (10) below:

$$Z^j = N^j \alpha \left(\frac{N^j}{N^j + N^{i \neq j}} - (w^j - \bar{w}) \bar{t} \, l \right), \qquad 10)$$

where α is the degree (if partial or total) of fiscal equalisation, $\bar{t}_l$ the normative income tax rate at regional level ($0 < \bar{t}_l < 1$), and $\bar{w}$ the normative wage rate at regional level.[4] Both $\bar{t}_l$ and $\bar{w}$ can be thought as representing the level of fiscal effort and fiscal capacity, respectively, which the central government sets as benchmark.

The interpretation behind (10) is rooted on the institutional design usually followed in existing federations. As such, the equalisation transfer is a proportion α of the relative spending needs (measured by the size of the population) not covered by the tax revenues raised by the regional government with respect to a given (normative) level of fiscal capacity. The degree of fiscal equalisation will thus depend on the extent to which the central government is seeking to equalise the level of public goods available in each region, given the size of the population and the existing difference in income per capita which determine ex-ante the fiscal capacities of each region. Note that the labour income is the only tax base available to the regions whereas the federal government can levy a tax on the capital income as well.

Each regional government therefore maximises (1) subject to (8) and (9). Optimisation gives the expression for $\left(g_1^j\right)^*$, $\left(g_2^j\right)^*$, $\left(t_l^j\right)^*$ and $\left(D^j\right)^*$ chosen by the regions.[5] In particular, the value of the optimal regional debt D^j is given by the following function:

$$D^j = D^j\left(\mathbf{T}, \mathbf{\Omega}, r\right), \qquad 11)$$

where T is a vector of fiscal and institutional variables $\left(\alpha, \bar{w}, \bar{t}, T_l^j\right)$ and Ω a vector of regional and preferences parameters $\left(N^A, N^B, L, \beta, \gamma, \eta\right)$, see the Appendix for a more complete derivation of (11). By contrast to the unitary case described in sub-Section 2.1, it is no longer straightforward to determine the sign of regional borrowing because this sign depends on the consumer preference parameters, the interest rate as well other exogenous

[4] See Boadway and Flatters (1982), Zabalza (2003) and Ahmad and Searle (2005) as illustrations of the properties of this type of intergovernmental grants.

[5] These expressions are available upon request.

variables determined at federal level (such a T_l^j) and the extent of equalisation determined by equation (10).

Notwithstanding, some interesting results can already be highlighted using simple comparative statics. First, it is clear that the level of regional debt is positively affected by the standard fiscal capacity $\bar{w}$ (see expression A21 in the Appendix). Ceteris paribus, the higher the standard wage used as benchmark in the equalisation scheme, the higher the regional debt in both regions. This occurs as result of the specification of interregional solidarity mechanism. Interestingly, the equalisation formula may well result in positive federal transfers for the rich regions as well when $\bar{w}$ reaches high enough values (or equivalently when the rich region contribution to the equalisation scheme decreases). In this context, rich regions receiving positive transfers in the second period may behave as poor regions: they would smooth their consumption over time by increasing their borrowing in the first period in order to match the higher level of consumption obtained thanks to the intergovernmental transfer in the second period.

Things become more intricate when the impact of the degree of equalisation α and the normative fiscal effort $\bar{t}_l$ on the regional public debt are considered. As can be seen in the Appendix, the sign of the corresponding partial derivatives (expressions (A19) and (A20)) is indeterminate and clearly depends on the difference $(\bar{w} - w^j)$. It follows that changes in the parameters of the equalisation scheme given by equation (10) may have a different impact on regional debt depending on whether a given region is relatively poor or relatively rich. When the normative fiscal effort rises ($\bar{t}_l$), the poor region increases its borrowing. The poor region has thus incentives to increase its public spending in the first period thanks to higher borrowing given that it will benefit from larger revenues in the second period allowing a higher level of public goods in both periods. The opposite situation holds for the rich region. One must note that the impact of changes in the degree of equalisation α on the regional public debt is not analytically unambiguous (see the expression (A19)).Numerical simulations conducted in Section 4 provide additional insights on the effect of these parameters on the fiscal behaviours of Spanish and German regions.

In sum, our theoretical model provides a number of results on the different behaviours of rich and poor regions which appear to depend on the parameters of the fiscal equalisation scheme. Although some of the exercises of comparative statics show how the territorial redistribution unambiguously impacts on regional public debts, these theoretical findings face a number of limitations. On the one hand, the significance in the relationship between regional productivity differentials and regional public borrowing is left undetermined. While we have explained the mechanism underlying this relationship, we do not know whether these are strong enough to influence regional fiscal behaviour in a significant way. On the other hand, the degree of homogeneity in regional fiscal behaviours given the equalisation system

in a specific country is also left unanswered. One must admit that, in the real world, the link between the debt level and regional differences in income per capita is more complex than the situations described in our model. An important reason for this is that the normative parameters setting regional financial transfers are either not clearly stated, left open to (varying) political discretionary choices or both. Ultimately, the relationship between regional income differences and public debt is largely conditioned by the practical implementation of the fiscal equalisation systems in place. Given the wide variety of possible relationship between public borrowing and the level of GDP per capita it is therefore reasonable to investigate these issues empirically given that countries with a federal or quasi-federal political system are likely to provide different case-studies. These country-specific studies are needed in order to analyse the way fiscal equalisation schemes may (or may not) lead to different relationships between regional public borrowing and regional differences in income per capita.

3. Fiscal policy and equalisation schemes in Canada, Germany and Spain

Before turning to the econometric analysis in this section we provide a summary of the regional financing systems of Canada, Germany and Spain and their impact on regions´ public finances which is necessary to highlight the country-specific features governing the nature of intergovernmental fiscal relationships between the regions in these countries, leaving aside the municipal level.

3.1. Fiscal decentralisation and equalisation.

Table 1 provides a synthetic view on the different elements which, according to our previous theoretical analysis, are likely to influence the relationship between public borrowing and regional income differences. Canada, Germany and Spain seem to be at first sight rather different in terms of fiscal equalisation grants, tax and expenditure decentralisation. The first salient difference concerns the degree of tax revenues decentralisation. Considering 2010 figures, Canada stands out as the country where regions have the highest level of own-tax revenues in relation to the total revenues of the general government and where the degree of tax autonomy is also the most advanced. By contrast, German and Spanish regions have a significantly lower degree of tax autonomy and tax revenues in relation to the general government total tax revenues. Spanish and German regions, on the contrary, have also less leeway in the determination of their own tax rates or tax bases.

Table 1: Fiscal frameworks

	Public expenditure *(% of general gov. exp,)*		Tax revenues *(% of general gov. tax rev.)*		Intergov. Transfer revenues *(% total regional revenues)*		Tax autonomy [δ] *(% total regional revenues)*	
	1995	**2010**	***1995***	***2010***	***1995***	***2010***	***1995***	***2010***
Canada	40.44	46.88	37.06	39.52	18.37	21.19	37.1	38.9
Germany	18.74	21.41	21.64	21.16	17.20	18.05	21.6	22.9
Spain	21.60	34.42	4.8	18.24	73.3	49.0	4.8	22.3

Sources: OECD and authors´calculations. Δ See OECD (2012) a definition of the Tax autonomy indicator.

Considering the evolution of tax revenues decentralisation between 1995 and 2010, Spain clearly stands out as the country where the shift of tax revenues towards the regions as well as the increase in regional tax autonomy have been the most pronounced. Regional tax revenues in this country represented only 4.8% of total general government tax revenues in 1995. This percentage rose up to 18.24% in 2010 in parallel with the increase in regional public expenditure that have gone from 21.60% to 34.42% during the same period. Despite these evolutions the gap between the regional governments´ revenues and expenditure was still the highest in Spain compared to Canada and Germany. Total expenditure represented 4.5 times total tax revenues in Spain in 1995. Still in 2010 total regional expenditure were covered only by about half of total regional tax revenues in this country. The situation in Canada and Germany appears to be much more balanced with a nearly exact matching between the regional tax revenues and expenditure throughout the period 1995-2010.

The importance of inter-governmental transfer revenues in the total revenues available to regions to finance their public spending is also markedly different between Canada and Germany on the one hand, and Spain on the other hand. This is shown in Column 3 of Table 1. In Canada and Germany the share of regional revenues stemming from federal grants ranged between 17% and 21% of total revenues over the period. These shares were also rather stable during the period 1995-2010 suggesting that the cross-regional fiscal equalisation remained relatively identical. In Spain, on the contrary, the share of total revenues stemming from central government grants was largely dominant in 1995, representing 73.3% of total regional revenues, and still substantial in 2010 at 49%.

These figures reflect important differences across these three countries in terms of design and implementation of intergovernmental transfers. In Canada, these transfers are formula-based grants from the federal government which are set according to the differences in fiscal capacities, see Bird and Tassonyi (2003). In addition to these vertical transfers, Canadian provinces receive substantial funds to ensure the provision of healthcare and social services which considered together represent around 65% of total transfers to the provinces, see Dahlby (2008).

In Germany fiscal equalisation takes place after the splitting of the revenues from shared taxes between the federal and Länder level in three successive stages. The

redistribution criteria depend on the tax capacities and financial needs of the Länder. Horizontal redistribution is topped up by vertical redistribution from the federal state to further smooth per capita tax revenues between regions. These vertical grants became especially relevant as of 1995, when East German Länder (as well as for some small Western Länder) were entitled to receive these resources. In the case of East German States, this financial support followed the transitory post-reunification specific funds, see Zipfel (2011) and Federal Ministry of Finance Germany (2009).

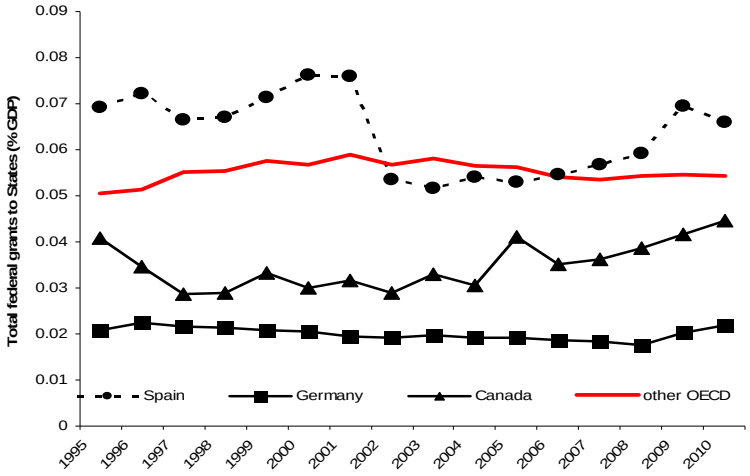
In Spain the regional financing is essentially vertical through central government grants. Following the 1978 Constitution, the Spanish regional financing system main principle has been to guarantee the financing of the public services at a level comparable to the one prior decentralisation.[6] From the early 90s onwards, the implicit criterion has evolved towards providing similar per capita financing across regions through a myriad of funds. Overall the Spanish regional financing system has moved towards more financial autonomy through a greater regional share of tax revenues and spending competences (most notably in the area of education and health) which de facto translated into a greater dependence of Spanish autonomous communities towards vertically redistributed funds. The complexity of the calculation of vertical transfers and the delay in the final settlement of net transfers (which normally takes place after two years of the budget execution) created significant uncertainty to the whole budgetary planning. Overall the regional financing system has been characterised by a high degree of arbitrariness in terms of intergovernmental transfers, evolving towards a strategic game between the different administrative levels.[7] As a result, the imbalance between the regional expenditure attributions and the financial means allocated for this purpose has tended to increase, see Vallés and Zárate (2004).

Given the above evidence one would expect that possible changes in the inter-governmental transfers to have a substantial impact in Spain compared to Canada and Germany. Figure 1 suggests indeed that, both the size and variability of financial transfers to the regions have been higher in Spain compared to Canada and Germany. In all these countries the financial crisis has also had a significant impact on regional borrowing, especially so in Canada and Spain, see Figure 2. In the Spanish case this illustrates the successive periods of tax revenues windfalls and shortfall linked to the housing boom that impacted more specifically Spanish regions´ public finances, see Barrios and Rizza (2010). In the Canadian case this was mainly due to increased financing of current expenditure through regional borrowing, see Guillemette (2010).

[6] The exceptions to this system are the Basque Country and Navarre who have a chartered regime. These regions hold large autonomy in terms of tax collection (apart from customs tariffs) and send to the central government a pre-arranged amount (*cupo*) in proportion to their relative income and population.. As a consequence, these two regions do not participate to the Spanish fiscal equalisation scheme (see Ruiz-Huerta and Herrero, 2008).

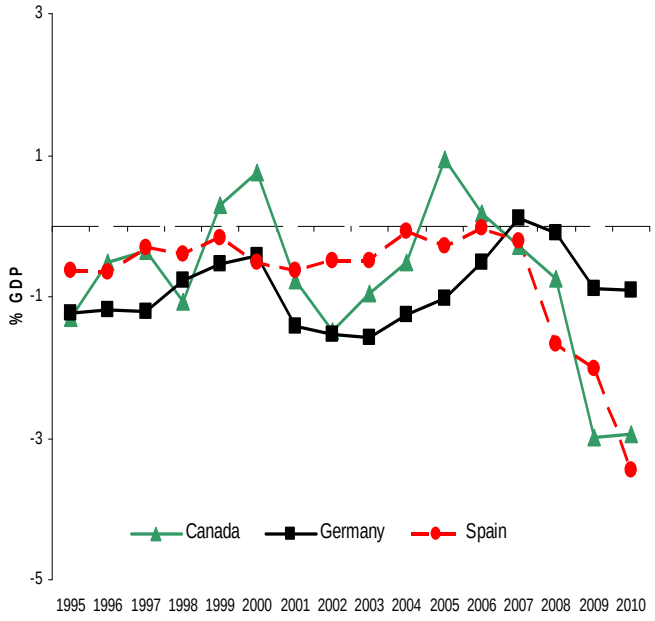
[7] See Colomer (1998) for an analysis of the strategic political bargaining game between the Spanish regions and the central government.

Figure 1: Financial transfers from federal to State governments (percentage of national GDP)



Sources: OECD and authors´ calculations. "Other OECD" is the simple average figure for the US, Switzerland, Belgium and Austria.

Figure 2: The evolution of net lending (+)/net borrowing (-) in Canadian, German and Spanish regions. 1995-2010



Sources: OECD and authors´ calculations

Finally one should note that a large degree of tax and expenditure autonomy might lead to very different fiscal outcome and public borrowing depending on the degree of central and regional government budgetary monitoring and fiscal rules. The degree of access to financial markets and private bank credits might also impinge on the true fiscal autonomy of the regions. These other, arguably relevant, questions are not analysed in this paper. In practice there are no major differences regarding regional fiscal rules and access to financial markets between the three countries considered here. While some recent measures have taken

in the aftermath of the global financial crisis, especially in Germany and Spain, these do not concern the period considered in the empirical analysis presented in the sequel.[8]

3.2. Fiscal equalisation and sub-central government borrowing: a preliminary assessment

The regional fiscal framework and fiscal policy in Canada, Germany and Spain can be thought as being rather different as shown in the previous discussion. Of course this is unsurprising since these three countries have different institutional and historical backdrops. Whether or not the resulting differences in regional financing systems may eventually lead to a different relationship between regional fiscal capacity and regional public borrowing remains unclear, however. According to our simple model, it would be reasonable to expect that the intensity of the regional redistribution effort will depend on the extent of regional disparities in GDP per capita and the fiscal framework in place. The political choices made in terms of the desired level of regional redistribution and the application of normative criteria introduce a high degree of uncertainty regarding the possible borrowing behaviour of relatively rich vs. poor regions, however.

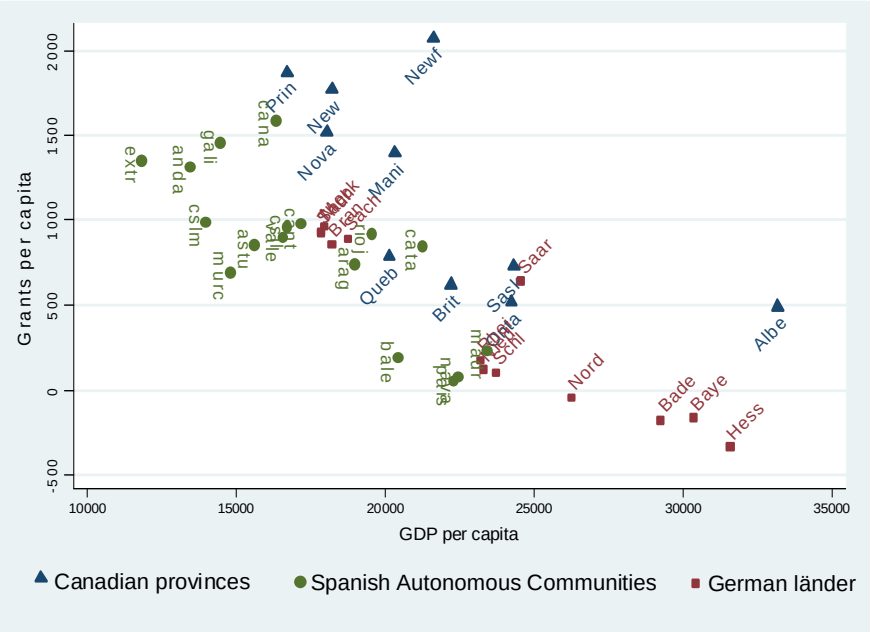
The previous sub-section tends to show that these choices are rather heterogeneous in the three countries considered here. In practice, the regional financing schemes in Canada, Germany and Spain lead to similar pattern of income redistribution across regions, however. This is illustrated in Figure 3 which displays the relationship between the amount of intergovernmental grants (measured in per capita terms) and the level of GDP per capita at a regional level. Baring the national differences in GDP per capita levels, it is rather remarkable to observe that, despite the country-specific features discussed previously, the relationship between the degree of regional income redistribution and the regional level of GDP per capita in these three countries is rather similar. Some regions could be considered as specific cases such as for instance the two Canadian provinces of Newfoundland and Labrador and Alberta which benefit from large tax revenues (royalties) thanks to abundant natural resources (mainly oil and gas). The Spanish Navarre and Basque Country regions or the German city-states of Hamburg, Bremen and Berlin could equally be considered as specific cases. However, omitting these regions would further reinforce the similarity of the link between federal grants and differences in GDP per capita in Canada, Germany and Spain. Simple OLS regressions between the (log) level of grant per capita and the (log) GDP per capita indicate that the redistributive effect of inter-governmental grants tends to be similar in Germany and Spain, whereby a decrease in the level of GDP per capita of 10% entails an increase of 40%

[8] A more detailed analysis of fiscal rules and borrowing for Canada, Germany and Spain can be found in Sutherland et al. (2005), Guillemente (2010), Zipfel (2011), Balassone and Zotteri (2002) and Argimon and Hernandez de Cos (2012).

and 38% of the inter-governmental grant per capita, respectively. In Canada this increase is about half these figures (22%).[9]

According to our theoretical analysis the existence of fiscal equalisation grants in presence of large regional differences in income per capita are likely to increase regional public borrowing in poor regions and in some cases also in rich regions. Figures 4-6 partly illustrate this by considering the link between the GDP per capita and the change in public debt over 1995-2010 for Germany, Canada and Spain (for this country the data available ends in 2009). In Canada and Spain the relationship between the regional GDP per capita and change in public debt appears at first sight positive, i.e. suggesting that richer regions tend to have experienced higher increase in public borrowing during this period. On the contrary, in the German case the opposite seems to hold. It is of course very premature to draw conclusions from this evidence, given the influence of a number of factors not accounted for, such as for instance the starting level of debt or the influence of the business cycle, which may well condition the relationship between indebtedness and regional income per capita differences. These other factors are considered in the next section

Figure 3: Federal grants vs. GDP per capita in Canadian, German and Spanish regions

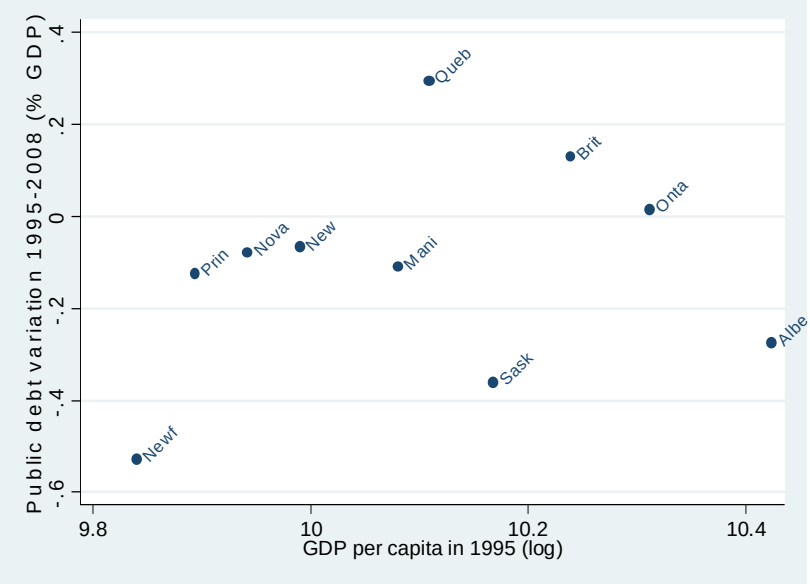


Note: Average figures for 1995-2009. All monetary values are expressed in current euros. Values for Canada converted into euros using average exchange rate between euro and Canadian dollar during 1995-2009.

Sources: STATCAN (Canada), DESTATIS (Germany), Ministerio de Economía y Finanzas (Spain) and authors´ calculations.

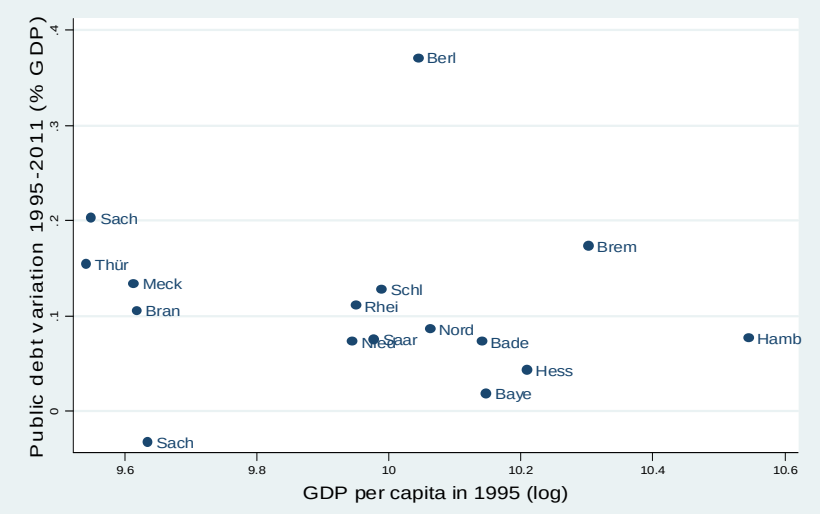
[9] The result for Germany has been obtained including the city states of Berlin, Bremen and Hamburg. When excluding these City States the redistributive nature of the German system appears slightly more pronounced going from 40% to 54%.

Figure 4: Regional debt variation between 1995 and 2011 vs. level of GDP per capita in 1995 Canadian provinces*



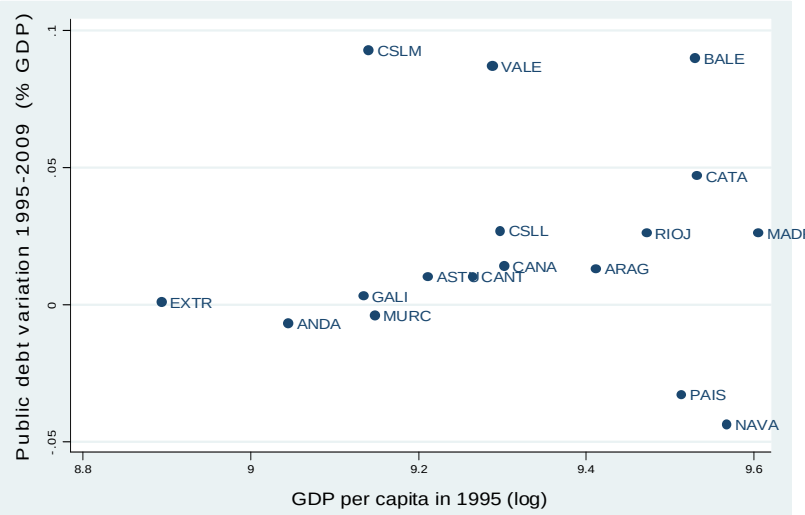
Sources: STATCAN (Canada) and authors´ calculations.

Figure 5: Regional debt variation between 1995 and 2011 vs. level of GDP per capita in 1995 German Länder*



Sources: DESTATIS (Germany) and authors´ calculations.

Figure 6: Regional debt variation between 1995 and 2009 vs. level of GDP per capita in 1995 Spanish Autonomous Communities*



Sources: Ministerio de Economía y Finanzas, Instituto Nacional de Estadística and authors´ calculations.

4. Econometric analysis of the determinants of regional government borrowing with fiscal equalisation

In order to analyse the link between differences in income per capita and regional borrowing we adopt the approach now widely used in the literature, see Bohn (1998). We specify an econometric model where regional borrowing represented by the primary balance (i.e. net lending minus interest payment expressed in percent GDP) is a function of past borrowing, the debt level and business cycle factors. The equation to be estimated can be written as follows:

$$pb_{i,t} = \beta_1 + \beta_2 pb_{i,t-1} + \beta_3 D_{i,t-1} + \beta_4 OG_{i,t} + \beta_5 Ycap_{i,t} + \beta_6 X_{i,t} + \varepsilon_{i,t}, \qquad \text{(E1)}$$

where the indices indicate the region (i) and the year (t), the dependent variable is the primary balance, which is regressed on its past level (at *t-1)*, D is the debt level, OG is the output gap and $Ycap$ is the regional GDP per capita while $\mathbf{X}$ is a vector of control variables and ε is a time and region-specific error component. Usually the main parameter of interest in such fiscal reaction function is the coefficient β_2 whereby a positive coefficient would indicate that fiscal policy is sustainable. The output gap captures the impact of the business cycle on fiscal policy and is indirectly intended to reflect the size of automatic stabilisers. The output gap has been obtained here for each region using the Hodrick and Prescott (1997) filter with a smoothing parameter λ=6.25 as suggested by Ravn and Uhlig (2002) for annual data. We use

the nominal GDP to build this indicator such that the output gap also includes the effect of inflation (and therefore of seigniorage revenues).[10]

In our case, the main coefficient of interest in equation (E1) is β_5, which is expected to be either positive or negative depending on whether poor or rich regions (i.e. regions with a low or high value of *Ycap*) tend to incur into higher net borrowing respectively. By estimating equation (E1) for each country separately we aim to check whether cross-country institutional differences might influence the sign of the estimated coefficient β_5 as discussed in the theoretical analysis carried out in Section 2. The primary balance is measured net of the grants received through regional equalisation. In practice, however, it is difficult to know precisely whether these grants influence regional fiscal policy by modifying the intertemporal budget constraint as discussed in the model presented in Section 2 or simply because they reflect the differences in income per capita as their ultimate goal is to smooth cross-regional differences in fiscal capacities. We thus face a clear identification problem when attempting to interpret the coefficient β_5 of the GDP per capita variable. In order to deal with this issue we include a number of control variables (represented by X in equation E1) to reflect structural differences in financing capacity and regional public services needs following the literature on regional fiscal policy, see in particular Buettner and Wildasin (2006) and Buettner (2009). The first control variable is the share of each region in the total population of the country reflecting the fact that regions with larger population will tend to face higher public spending needs. In addition political factors may also have a bearing on fiscal policy decisions, see for instance Fátas and Mihov (2003). We thus include as additional control a dummy variable indicating whether in a given year regional elections took place. One could in addition consider that the influence of a regional election process on regional fiscal behaviour might differ when it coincides with general elections given that the latter might condition national fiscal policy and impact either directly or indirectly on regional public finances. Consequently, we add another control variable taking a value equal to 1 when the regional election year coincides with a general election year and zero otherwise. For both these election variables we use the data provided by Schakel (2011). Finally, we also control for the amount of grants received during the period (t-1), which may affect the amount of revenues expected by the region in period (t).

The time period available for each of the variables listed above differs across countries. We avail of data for 1985-2011 for Germany, for 1994-2009 for Spain and 1982-2008 for Canada. In order to be able to compare results across countries more accurately we focus on the post 1994 period and leave regressions including more years for robustness checks. In the sequel we present result of the estimations of equation (E1) by country, pooling all regions and years together. The estimation method plays an important role in such a

[10] The statistical sources for Spain are the Instituto Nacional de Estadística and the Ministerio de Hacienda for the fiscal data. For Germany we have used data from the Ministry of Finance of the fiscal variables and from DeStatis for the other variables. In the Canadian case we have used data from STATCAN, the Department of Finance and the Royal Bank of Canada for the fiscal variables.

context. When dealing with such pooled data it is natural to pay specific attention to the error in term $\varepsilon_{i,t}$ of equation (E1). In a panel data context this term can be considered as being made of two components, an *i.i.d.* term $\phi_{i,t}$ with the classical statistical properties ensuring that equation (E1) is correctly estimated and a panel-specific (or fixed) effect such as μ_i which is assumed to be region-specific and invariant such that:

$$\varepsilon_{i,t} = \phi_{i,t} + \mu_i .$$

The parameter μ_i includes region-specific effects which, when not properly accounted for, can lead to biased estimates. This region-specific parameter plays a specific role since it represents the potential elements specific to a given region *i* that do not vary across time but that could also possibly bias the estimated relationship between regional borrowing and the GDP per capita. This could be the case for regions with a special status, such as the city-states in Germany or overseas regions entitled to specific grants such as the Canary Islands in Spain. It is therefore necessary to account for these region-specific effects in order deal with these unobserved elements. Therefore we estimate (E1) by controlling for region-specific effects with a panel fixed effect estimation removing the potential influence of region-specific unobserved parameters μ_i. However, the potential endogeneity bias resulting from the estimation of (E1) (e.g. between the dependent variable and its lagged value and the level of debt) requires the use of instrumental variables. For this reason we also use a bias corrected least-square dummy variable dynamic panel data estimator based on Blundell and Bond (1998) system estimator which allows us to account for both endogeneity and region-specific fixed effects, while correcting the standard errors based on Kiviet (1995) methodology (this is the so-called LSDV estimator indicated in Tables 3-6).[11] Standard OLS estimations are also reported for information only.

Table 2: Summary statistics of variables used for the estimation of the regional fiscal reaction functions (1995-2010): average value and standard errors (in parentheses)

	Primary balance (net of gov. grants)	GDP per capita	Output gap	Public debt (Gross debt, in % GDP)	Intergovernment grants (% GDP)
Canada	-0.0324	10.3503	0.00005	0.5862	0.0611
	(0.0350)	(0.2710)	(0.0020)	(0.1927)	(0.0405)
Germany	-0.0411	10.0279	0.00002	0.2128	0.0198
	(0.0325)	(0.2395)	(0.00154)	(0.0921)	(0.0251)
Spain	-0.0533	9.7058	0.0002	0.0529	0.0478
	(0.0427)	(0.3144)	(0.0007)	(0.0234)	(0.0377)

Sources: OECD and authors´calculations

[11] See Celasun and Kang (2006) for a discussion of the advantages of the LSDV estimator over other panel-estimators when estimating a fiscal reaction function, and Bruno (2005) for a description of the STATA command used for the regressions reported here.

4.1. Main econometric results

Our main results are reported in Tables 3-5. The relationship between the regional GDP per capita and the primary balance (primary surplus in our econometric analysis) displays different signs across countries when using the panel fixed effect model according to Column (1). The results indicate that in Spain and Canada the richer regions tend to have lower primary surplus (i.e. higher primary deficit). The results for Germany go in the opposite direction: the poorer Länder tend to have higher deficits. In both the German and Spanish cases the coefficients obtained on the GDP per capita variable are highly significant (at 1% level). The same coefficient is statistically insignificant in the Canadian case. In the German case, our results indicate that a Länder with a GDP per capita greater by 10% than the average will have a primary budget balance of 0.361pp higher per year which is arguably an economically significant figure. In the Spanish case, the result suggests on the contrary that richer regions would incur into higher borrowing in absence of intergovernmental transfers. The coefficient is also economically significant since Spanish regions with an average GDP per capita of 10% higher than the average will also have on average a -0.245 pp lower primary surplus.

These findings are consistent with previous works. Lago (2005) for instance obtains a similar result for the Spanish regions over the period 1984-1999.[12] For Germany, Schuknecht et al (2009) also show that the poorer Länder (also net-recipients of intergovernmental transfers) have experienced a softer budget discipline from financial markets and tended to run higher budget deficits than richer regions. The paper by Schuknecht et al (2009) also includes Canada and show a similar pattern at provincial level. The federal government in Canada is principle not allowed to bail-out its provinces while the German experience suggests that such bail-out can formally happen as shown in the case of Bremen and Saarland and the recent Constitutional Court decisions.[13] The evidence reported by Heppke-Falk and Wolff (2008) indeed suggests that after these Constitutional court decisions favouring a bail-out of the Bremen and Saarland, the Länder with a high interest debt burden tend to have lower risk premia. This question is further investigated below.

The estimation of the fiscal reaction function (E1) also allows us to check whether regional fiscal policy was sustainable during the period considered. A positive coefficient on the (lagged) debt variable would indicate for instance that a given region reacts to an increase in debt by increasing its primary surplus. On the contrary a negative coefficient on the debt variable would indicate that a given regional government would tend to run larger deficit (or lower surpluses) as a consequence of a rise in public debt. In all three countries we find that regional governments tend to run unsustainable fiscal policies, although this characteristic is

[12] Lago (2005) considers in addition a variable measuring the spending responsibilities of Spanish regions, which were rather different across regions during the period covered by this author.

[13] The Saskatchewan and Alberta provinces were the only to be bailed-out in the Canadian case, although these bails-out took place in the 1930s and 1940s respectively, see Bird and Tassonyi (2003).

especially pronounced in the Spanish case where the coefficient estimate on the public debt variable is both large and significant. A common result for all the three countries is also that the regional fiscal policy appears to be largely pro-cyclical as well (i.e. a deterioration of the output gap leading to an increase in the primary surplus and vice versa) although this feature is especially pronounced in the Spanish case where the coefficient obtained is especially large in absolute terms.

Columns (2) of Tables 3-5 deal specifically with the impact equalisation transfers on the regional primary balance. To do so we re-estimate the regressions reported in Column (1) by including the federal grants (lagged one period to avoid a potential endogeneity bias) as explanatory variable. The sign and size of the coefficient on the GDP per capita variable obtained previously still holds. It is worth observing also that the coefficient estimated on the lagged grant variable is only significant in the case of Germany and Canada although with opposite signs. In Canada the level of federal grants received in the previous period tends to lower the primary surplus in the subsequent period while the opposite holds in the German case. In all cases, however, the inclusion of the grants received from the federal government level as additional control variable does not change the results reported in Column (1) concerning the link between the GDP per capita variable and the primary surplus.

In Column (3) of Tables 3-5 we re-estimate our fiscal reaction function including the additional control variables represented by the share of each region in the national population together with the two electoral dummy variables. Including these variables does not alter our main result regarding the sign and size of the coefficient estimate for the GDP per capita variable. These additional control variables are not significant neither excepting in the German case where the congruence of regional and general elections tend to deteriorate regional primary balances.

Columns (4)-(6) report results on the same specification tested in Columns (1)-(3) but using the Blundell-Bond/LSDV estimator correcting for potential endogeneity. In substance the coefficient estimated on the GDP per capita variable remains very similar and is only significant in the German and Spanish cases although the size of this coefficient is slightly lower for the latter. A similar conclusion regarding the sustainability of fiscal policy also holds according to the coefficient estimated for the debt variable although with the LSDV estimator the coefficient on the debt variable is no longer significant for Spain.

Table 3: Econometric results for Canada. Dependent variable: Provincial primary balance net of federal grants (1994-2008)

	(1) Fixed-effects	(2) Fixed-effects	(3) Fixed-effects	(4) LSDV	(5) LSDV	(6) LSDV	(7) OLS
Primary balance (t-1)	0.800***	0.668***	0.671***	0.967***	0.852***	0.851***	0.812***
	(0.0822)	(0.0974)	(0.0966)	(0.0455)	(0.0600)	(0.0461)	(0.0818)
GDP per capita (t-1)	-0.00493	-0.00751	-0.00739	-0.00860	-0.0113	-0.0111	0.00121
	(0.00664)	(0.00660)	(0.00667)	(0.00634)	(0.00802)	(0.00891)	(0.00561)
Output gap (t-1)	-1.263**	-1.185**	-1.133**	-1.350**	-1.189**	-1.125*	-1.343**
	(0.561)	(0.551)	(0.547)	(0.562)	(0.588)	(0.594)	(0.532)
Public debt (t-1)	-0.0258	-0.0170	-0.0204	-0.0234	-0.0199	-0.0228	0.00128
	(0.0162)	(0.0163)	(0.0166)	(0.0241)	(0.0280)	(0.0281)	(0.00817)
Grants (t-1)		-0.246**	-0.216**		-0.178	-0.150	-0.126*
		(0.101)	(0.102)		(0.120)	(0.115)	(0.0755)
Regional elections year (t)			-0.00393			-0.00434	-0.00366
			(0.00239)			(0.00277)	(0.00246)
Congruence regional/general elections (t)			-0.000746			-0.000649	-0.00236
			(0.00522)			(0.00665)	(0.00520)
Population share (t-1)			-0.516			-0.479	0.000837
			(0.366)			(0.361)	(0.0112)
Observations	140	140	140	130	130	130	140
R-squared	0.486	0.510	0.530	-	-	-	0.887
F-test for no fixed-effects ($\mu i = 0$)	1.60 [0.1211]	1.91 [0.0561]	2.11 [0.0333]	-	-	-	-
Difference-in-Sargan statistic (level IV)	-	-	-	19.29 [0.056]	18.76 [0.066]	23.17 [0.017]	-
Difference-in-Sargan statistic (Difference IV)	-	-	-	3.57 [0.312]	3.53 [0.474]	8.07 [0.327]	-
Number of regions	10	10	10	10	10	10	

*Note: Bootstrap standard errors in parentheses for the LSDV estimations; *** p<0.01, ** p<0.05, * p<0.1. P-values for t F and Sargan test in square brackets.*

Table 4: Econometric results for Germany. Dependent variable: Länder primary balance net of federal grants (1994-2011)

	(1) Fixed-effects	(2) Fixed-effects	(3) Fixed-effects	(4) LSDV	(5) LSDV	(6) LSDV	(7) OLS
Primary balance (t-1)	0.424***	0.535***	0.491***	0.572***	0.677***	0.633***	0.755***
	(0.0622)	(0.0663)	(0.0660)	(0.0641)	(0.0534)	(0.0508)	(0.0609)
GDP per capita (t-1)	0.0361***	0.0325***	0.0359***	0.0283***	0.0273***	0.0302***	0.0308***
	(0.00705)	(0.00687)	(0.00663)	(0.00925)	(0.0104)	(0.00994)	(0.00489)
Output gap (t-1)	-1.508***	-1.237***	-1.086***	-1.463***	-1.175***	-1.065***	-2.149***
	(0.389)	(0.381)	(0.369)	(0.315)	(0.326)	(0.313)	(0.368)
Public debt (t-1)	-0.00591	-0.0129	-0.0214	-0.00923	-0.0182	-0.0237	-0.0178**
	(0.0193)	(0.0187)	(0.0180)	(0.0228)	(0.0245)	(0.0234)	(0.00881)
Grants (t-1)		0.255***	0.215***		0.253***	0.212***	0.0716
		(0.0643)	(0.0635)		(0.0902)	(0.0787)	(0.0520)
Regional elections year (t)			-0.000102			-0.000393	0.000399
			(0.00143)			(0.00224)	(0.00160)
Congruence regional/general elections (t)			-0.00695***			-0.00682**	-0.00769***
			(0.00233)			(0.00286)	(0.00258)
Population share (t-1)			-1.279***			-0.998**	0.0192
			(0.421)			(0.400)	(0.0125)
Observations	221	221	221	208	208	208	221
R-squared	0.497	0.533	0.578	.	.	.	0.945
F-test for no fixed-effets ($\mu i = 0$)	3.56 [0.000]	5.02 [0.000]	5.77 [0.000]	-	-	-	-
Difference-in-Sargan statistic (level IV)	-	-	-	3.24 [0.999]	3.81 [0.997]	4.20 [0.997]	-
Difference-in-Sargan statistic (Difference IV)	-	-	-	0.75 [0.861]	1.46 [0.8333]	8.63 [0.280]	-
Number of regions	13	13	13	13	13	13	13

*Note: Bootstrap standard errors in parentheses for the LSDV estimations; *** p<0.01, ** p<0.05, * p<0.1. P-values for t F and Sargan test in square brackets.*

Table 5: Econometric results for Spain. Dependent variable: regions primary balance net of central government grants (1994-2009)

	(1) Fixed-effects	(2) Fixed-effects	(3) Fixed-effects	(4) LSDV	(5) LSDV	(6) LSDV	(7) OLS
Primary balance (t-1)	0.756***	0.943***	0.933***	0.921***	1.019***	1.044***	0.951***
	(0.0633)	(0.139)	(0.141)	(0.0375)	(0.0348)	(0.0280)	(0.138)
GDP per capita (t-1)	-0.0245***	-0.0255***	-0.0258***	-0.0180**	-0.0177***	-0.0176***	-0.00622
	(0.00604)	(0.00606)	(0.00614)	(0.00771)	(0.00624)	(0.00673)	(0.00517)
Output gap (t-1)	-7.646***	-7.075***	-7.053***	-7.219***	-6.478***	-6.570***	-9.342***
	(2.038)	(2.067)	(2.088)	(2.466)	(2.218)	(2.238)	(2.098)
Public debt (t-1)	-0.247**	-0.219**	-0.238*	-0.169	-0.152	-0.177	-0.0125
	(0.106)	(0.107)	(0.124)	(0.150)	(0.126)	(0.139)	(0.0711)
Grants (t-1)		0.236	0.233		0.271***	0.286***	-0.0268
		(0.157)	(0.159)		(0.0758)	(0.0649)	(0.139)
Regional elections year (t)			0.00150			0.00140	0.000776
			(0.00316)			(0.00414)	(0.00326)
Congruence regional/general elections (t)			0.00356			0.00462	0.00260
			(0.0119)			(0.0146)	(0.0113)
Population share (t-1)			0.261			0.377	0.0340
			(0.789)			(0.734)	(0.0327)
Observations	238	238	238	238	238	238	238
R-squared	0.540	0.545	0.546	.	.	.	0.786
F-test for no fixed-effets ($\mu i = 0$)	2.03 [0.0125]	2.18 [0.006]	2.09 [0.009]				
Difference-in-Sargan statistic (level IV)	-	-	-	24.74 [0.025]	11.02 [0.609]	11.55 [0.565]	-
Difference-in-Sargan statistic (Difference IV)	-	-	-	4.55 [0.208]	5.43 [0.246]	11.40 [0.122]	-
Number of regions	17	17	17	17	17	17	17

*Note: Bootstrap standard errors in parentheses for the LSDV estimations; *** p<0.01, ** p<0.05, * p<0.1. P-values for t F and Sargan test in square brackets.*

How do these results fit the country-specific features of the fiscal equalisation schemes? We have conducted a number of numerical simulations of the model presented in Section 2 in order to interpret our econometric results according to the mechanisms highlighted in the theoretical analysis. It should be noted that these numerical examples are not intended to provide an exact replication of real-life cases, however. We focus on the two polar cases, i.e., Spain and Germany where alternatively rich and poor regions tend to display higher primary deficits. Let consider first the Spanish case. There are two particular features of the Spanish financing territorial system which are relevant for our purpose. Firstly, Blöchliger and Charbit (2008) show that the Spanish equalisation scheme is especially focussed on spending needs, that is, on the regional population. Secondly, the fiscal effort used in the Spanish system tends to be low with respect to the actual tax bases in practically all the regions (Ruiz-Huerta and Herrero, 2008). In addition, the richest Spanish regions are also the most populated ones (e.g. Madrid and Cataluña). In order to illustrate these features we have chosen a number of exogenous parameters whereby the fiscal effort ($\bar{t}_l$) is set at a significantly low level and the population size of the rich region is moderately larger (see more details in the Appendix A2 for the specific numerical values chosen).

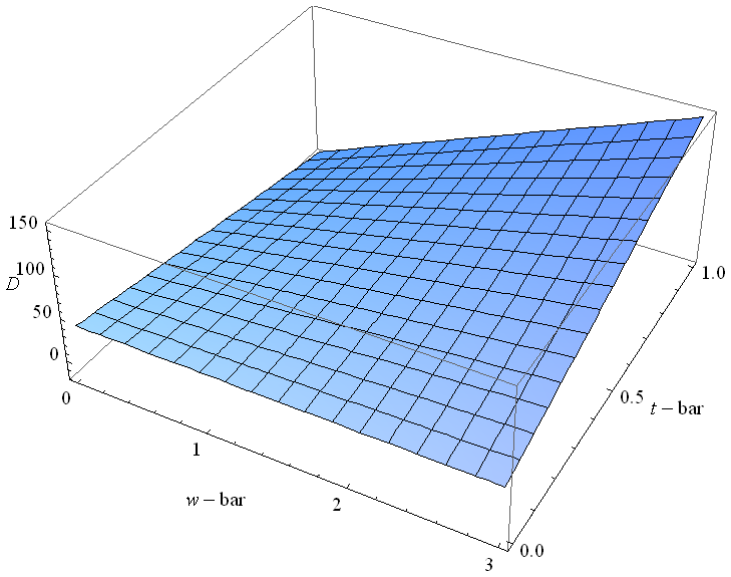
Under these conditions, the rich region borrowing appears to be larger than the poor region´s (see also two rows of Table A2). Figures 7 and 8 show the extent of borrowing chosen by poor and rich regions, respectively, when the normative fiscal effort ($\bar{t}_l$) and the standard fiscal capacity ($\bar{w}$) are allowed to vary, leaving the remaining parameters constant. As can be seen in Figure 7, given a normative level of fiscal capacity, the level of public debt of the poor region increases with the fiscal effort; in other words, the lower the standard value of fiscal effort, the lower the public borrowing of the poor region.[14] By contrast, this relationship turns opposite when rich regions are considered instead, see Figure 8. Here for a given level of fiscal capacity, regional borrowing increases (or, as in Figure 8 the regional public saving decreases) as the normative fiscal effort decreases.

A similar exercise can be conducted in the German case. As discussed previously, the German Federal system has an explicit aim of providing sufficient resources to ensure an equal access to public services by all Länder. Despite the fact that fiscal equalisation is topped-up, the German territorial financing system is based on a strong horizontal redistribution of tax revenues, especially through the redistribution of the VAT tax revenues such that no single regional government will have less than the 95% of the average per capita budgetary resources. This means that, in this case, the parameter α can be thought as being relatively high. There is no explicit benchmark tax rate for the equalisation as *de facto* the

[14] Geometrically, the slope of the surface is negative as $\bar{t}_l$ decreases for a given value of $\bar{w}$.

Länder enjoy very little tax autonomy such that little can be said about the influence of $\bar{t}_l$; consequently, we have chosen a value of $\bar{t}_l$ identical to that of federal government tax rate. The German fiscal equalisation system is also very much focused on fiscal capacities, see Federal Ministry of Finances (2009). This suggests that the gap between w and $\bar{w}$ (which proxy differences in fiscal capacities) plays an important role in Germany and that $\bar{w}$ is set at relatively high level, which in a sense is unsurprising given the high level of regional inequalities in this country, especially since the reunification in 1991. As opposed to the Spanish case, we have assigned the same spending needs to both regions and moderately increased the standard fiscal capacity.[15] Here the results of our simulation indicate that poor regions tend to borrow more than the rich ones as indicated by the last two rows of Table A2. In Figure 9 one can observe that for a relatively high value of degree of equalisation, the public debt in poor regions increases as the normative fiscal effort increases. By contrast, the opposite result is found when rich regions are considered instead: given a high value of α, when $\bar{t}_l$ becomes higher, the regional government increases its savings, see Figure 10.

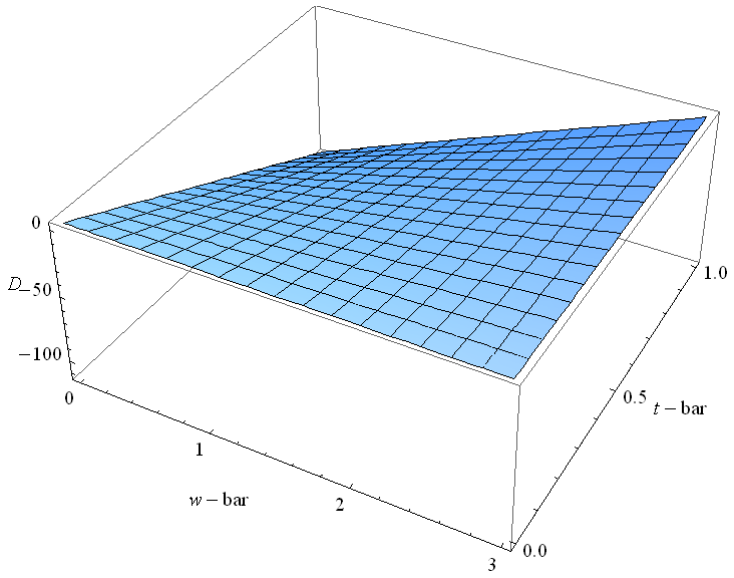
Figure 7. Illustration of the Spanish case: Borrowing (D) of the poor region with varying normative fiscal effort (t-bar) and normative fiscal capacity (w-bar)



Note: Simulation based on numerical values for the Spanish case, see Appendix A2

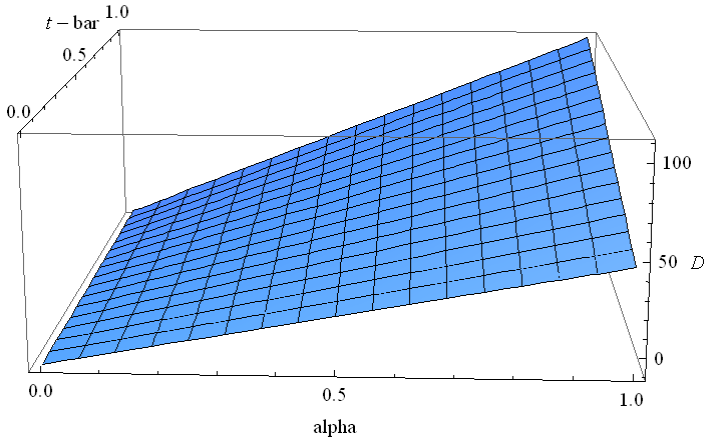
[15] As long as the relative spending needs are not among central criteria in the German territorial financing system, we have chosen an identical value for this variable for the two region-types.

Figure 8. Illustration of the Spanish case: Borrowing (D) of the rich region with varying normative fiscal effort (t-bar) and normative fiscal capacity (w-bar)



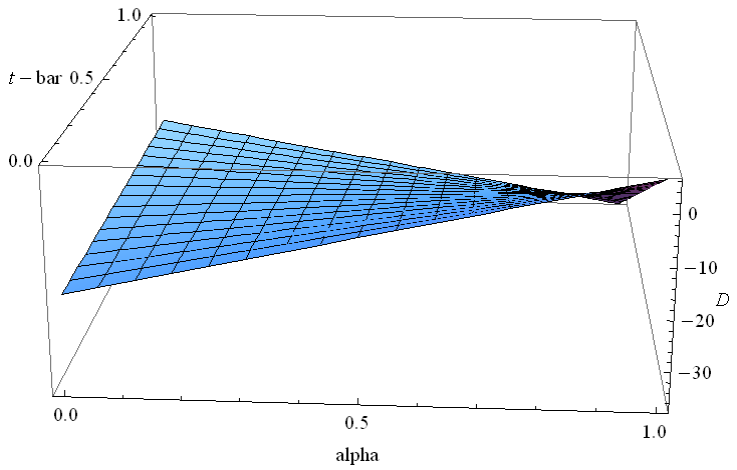
Note: Simulation based on numerical values for the Spanish case, see Appendix A2

Figure 9. Illustration of the German case: Borrowing (D) of the poor region with varying degree of fiscal equalisation (alpha) and normative fiscal effort (t-bar)



Note: Simulation based on numerical values for the German case, see Appendix A2

Figure 10. Illustration of the German case: Borrowing (D) of the rich region with varying degree of fiscal equalisation (alpha) and normative fiscal effort (t-bar)



Note: Simulation based on numerical values for the German case, see Appendix A2

Things become more complex when considering the econometric results for Canada. The Canadian equalisation system is in principle clearly focused on equalisation of fiscal capacities (i.e. α in our model) without apparently giving much importance to differences in spending needs across provinces. However, a large share of intergovernmental transfers is represented by the two programmes devoted to Health and Education spending and these have a clear link with fiscal needs. In addition the scope of the intergovernmental grants is not as general as in the German and the Spanish cases given that only a third of the Canadian population lives in net recipient provinces and a number of provinces do not benefit from these grants.[16] As evidenced earlier (see Figure 3) the intensity of redistribution is also not very high given that the richer regions are not equalised down (Dahlby, 2008). Concerning the fiscal effort (i.e. the $\bar{t}_l$ variable), tax policy in Canada is highly decentralised and provinces have large tax autonomy. Finally the role played by the difference between the benchmark fiscal capacity and the actual one (i.e. the difference between w and $\bar{w}$) remains unclear given the characteristics of the Canadian fiscal equalisation system combining generic and programme-oriented grants. Finally, since the mid-nineties, the standard parameters of fiscal capacity is not computed over the all the Canadian provinces but excludes the richest Province and the five poorest ones. In such context, our econometric analysis would suggest that richer Canadian Provinces tend to borrow relatively more, although this relationship is far from being statistically and economically significant.

[16] See Dahlby (2008).

4.2. Robustness checks of the econometric results

A number of robustness checks were conducted in order to check whether our result hold to changes in regions and periods covered. In the Spanish case we removed the two regions with a specific fiscal regime, namely Navarre and the Basque Country. Our result did not vary significantly in this case. For instance considering the specification reported in Column (2) and (4) of Table 5, the elasticity obtained was -0.0245 in the fixed effect estimation and -0.0180 when using the LSDV estimation instead. These results are very close to the ones reported in Table 5 and are equally significant (at 1% level). In addition, we have considered the fact that as from 2002 the spending attributions have been broadened to all regions in a number of areas, in particular health expenditure, see Lago (2005). With this aim, we have included a dummy variable equal to 1 for the years before 2002 (inclusive). The results remained very similar to the ones reported here.

The robustness check exercise is maybe more relevant in the German case, in particular regarding the importance of the bail-out decisions and the reunification process pointed out in Section 3. The longer time series available for this country (from 1986 to 2011) allow us to estimate a number of alternative specifications. These results are reported in Table 6 where we only consider the LSDV specification including all control variables.[17] Column (1) of Table 6 first considers all Länder including the three city states during the period 1994-2011 period. The result concerning the coefficient on the GDP per capita is similar to the results reported in Table 4. This variable displays a positive and significant (at 5%) coefficient.

An important robustness check for Germany concerns the impact of the Constitutional Court decision on the bail-out of Länder facing financing problems. In 1988 two German Länder with high public debt, Bremen and Saarland, turned to the Federal Constitutional Court asking for financial support. In 1992 the Court decided that financial assistance should be provided to these two Länder and several decisions were taken in the subsequent years reinforcing the legal implications of these bail-outs which de facto lowered the financing cost of Länder with a high interest burden. [18]

In order to capture these effects we have multiplied the GDP per capita variable with a dummy variable equal to one for the years starting from 1992 onwards and equal to zero for the years before 1992.[19] The results of this estimation are reported in Column (2) of Table 6. A positive albeit non-significant coefficient is obtained for the level of GDP per capita. The coefficient obtained is also clearly lower than in the main result reported in Table 4. This

[17] Fixed-effect estimations yielded similar results.

[18] See Heppke-Falk and Wolff (2007).

[19] Alternatively we have used the year 1988 as starting point which is when financial assistance by Saarland and Bremen was formulated by these Länder. Results remain similar in both cases.

result is however not surprising given that the Constitutional Court decision concerned two regions with relatively high (Bremen) and medium (Saarland) GDP per capita thus suggesting that the potential consequences of the Constitutional Court decision were more related to political considerations. Alternatively we have also estimated our fiscal reaction function for the Western Länder during the period 1986-2011. In this case the GDP per capita variable remains equally positive although it now becomes insignificant, see Column (3) of Table 6. The estimates reported in Column (4) of Table 6 tend to confirm this result by including in addition a dummy variable equal to 1 from the German reunification year onwards. To summarise, in Germany the divide between poor and rich regions´ public borrowing behaviour holds during the most recent period (i.e. after 1994). While the Constitutional Court ruling might have had an influence on this result, it does not seem to have changed fundamentally the pro-deficit bias that the territorial financing system tend to exert on relatively poor German regions. Therefore the German reunification and the subsequent inclusion of significantly poorer regions into the regional equalisation system may have played a more decisive role to explain regional borrowing during the recent period.

Finally we conducted a number of robustness check in the Canadian case as well. Given that we avail of longer time series, our main regression could be estimated over the period 1982-1994. Unreported results suggest that the coefficient estimate of the GDP per capita variable was again insignificant although its sign changed, being now positive. The low value of this coefficient (0.0036) and its lack of significance suggest however that no fundamental change has taken place during this period compared to the 1994-2008 period considered in Table 3. As additional robustness check we also dropped from our sample the Provinces rich in fossil fuels which in turn affect significantly their tax revenues through royalties, namely Alberta, British Columbia and Saskatchewan. The coefficient obtained (-0.0122) was very close the one reported in Column (6) of Table 3 thus suggesting that the influence of resources-rich regions does not alter the negative (albeit insignificant statistically) relationship between the GDP per capita and the regional primary surplus in the Canadian case.

Table 6: Robustness checks for Germany. Dependent variable: Länder primary balance net of federal grants

	(1) All Länder post 1994 incl. city states	(2) Western Länder 1986-2011 incl. city states Constitutional Court decision	(3) Western Länder 1986-2011 incl. city states	(4) Western Länder 1986-2011 incl. city states Reunification dummy
Primary balance (t-1)	0.600***	0.504***	0.521***	0.499***
	(0.0850)	(0.0457)	(0.0484)	(0.0450)
GDP per capita (t-1)	0.0234**	0.00691	0.00486	0.00684
	(0.0117)	(0.00816)	(0.00551)	(0.00679)
Output gap (t-1)	-0.712*	-0.573**	-0.681**	-0.529**
	(0.412)	(0.276)	(0.298)	(0.265)
Public debt (t-1)	0.0256	0.0126	0.0143	0.0128
	(0.0224)	(0.0202)	(0.0186)	(0.0192)
Grants (t-1)	0.187	-0.0982**	-0.102**	-0.101**
	(0.139)	(0.0473)	(0.0515)	(0.0470)
Regional elections year (t)	-0.00144	2.23e-05	3.96e-05	0.000176
	(0.00152)	(0.00131)	(0.00130)	(0.00130)
Congruence regional/general elections (t)	-0.00553**	-0.00501***	-0.00502***	-0.00529**
	(0.00217)	(0.00191)	(0.00195)	(0.00214)
Population share (t-1)	-0.889	-0.198	-0.210	-0.199
	(1.119)	(0.448)	(0.456)	(0.450)
GDP per capita * Constitutional Court Decision		-0.000139		
		(0.000215)		
GDP per capita * Reunification				-0.000180
				(0.000181)
Observations	256	230	230	230
Difference-in-Sargan statistic (level IV)	5.37 [0.988]	2.22 [1.00]	2.16 [1.00]	2.49 [1.00]
Difference-in-Sargan statistic (Difference IV)	9.84 [0.198]	2.87 [0.942]	2.14 [0.952]	2.85 [0.943]
Number of regions	16	10	10	10

*Note: Bootstrap standard errors in parentheses for the LSDV estimations; *** p<0.01, ** p<0.05, * p<0.. P-values for t F and Sargan test in square brackets*

5. Summary and conclusions

In this paper we have analysed the determinants of public borrowing under alternative fiscal equalisation schemes. In order to analyse the main mechanisms at hand we build a simple model of fiscal federalism where both the central and regional governments can borrow in financial markets to fill budgetary gaps and where the central government redistributes part of the tax revenues among regions. We show how the federal income redistribution modifies the intertemporal budget constraint of the regions and under which conditions regional governments may incur into higher or lower borrowing as a result. We then test econometrically the link between the fiscal capacity (measured by the level of GDP per capita) and public budget balances in Canada, Germany and Spain, i.e. three countries with notoriously decentralised fiscal policies. Our analysis suggests that the relationship between these two variables can be either positive (as in the German case) or negative (as in the Canadian and Spanish cases) thus suggesting that either poor or rich regions tend to have on average higher primary deficits. We find however that the relationship between regional primary balance and the level of GDP per capita is significant only in the German and Spanish cases. We show that the features of the fiscal equalisation schemes can help explain these results as illustrated by means of numerical simulations of our model.

More generally, from a fiscal policy perspective, it seems reasonable to think that on average the conduct of fiscal policy should be independent from the levels of fiscal capacity. However, in practice, the differences in fiscal capacities are directly linked to the entitlement to intergovernmental grants which, by definition, alter the intertemporal budget constraint and influence the fiscal policy of sub-central governments. It is therefore not surprising to find that the GDP per capita can in some cases be a good predictor of public deficits. Importantly however, we show that the nature of this relationship depends on the country considered and can go both directions (i.e. either positive or negative) depending on the specific fiscal equalisation scheme in place. This also means that reforms of the territorial financing system can prove instrumental in reducing cross-regional heterogeneity in public borrowing, thus possibly contributing to meet nationally-set fiscal policy objectives.

Our results are of course subject to further scrutiny and refinement at the theoretical level given the simplicity of the assumptions made and the importance of country-specific features in determining the nature of fiscal relations between different levels of government. At the empirical level an analysis including more federal or quasi federal countries would be equally warranted. Furthermore we have not considered the relevance of regional tax or spending autonomy in our estimations since these were run on a country basis. The latter could arguably influence the conduct of regional fiscal policy while calling for reforms aimed at strengthening regional fiscal discipline. These other questions are left for future research.

Appendix A1: Details on the theoretical model

The first optimisation problem is that of representative household, which consists of maximising the utility function (1) subject to two budget constraints (2) and (3). The last two expressions can be re-arranged to yield

$$x_1^j + \frac{x_2^j}{1+r(1-\tau_S)} = w^j l(1-\tau_l)\,. \tag{A1}$$

Once the corresponding Lagrangian function is built, the first order conditions for the decision variables are obtained:

$$FOC\left(x_1^j\right): \frac{1}{x_1^j} - \lambda = 0 \tag{A2}$$

$$FOC\left(x_2^j\right): \frac{\beta}{x_2^j} - \frac{\lambda}{1+r(1-\tau_S)} = 0 \tag{A3}$$

$$FOC(l): -\frac{\gamma}{L-l} - \lambda w^j(1-\tau_l) = 0 \tag{A4}$$

$$FOC(\lambda): -x_1^j + w^j l(1-\tau_l) - \frac{x_2^j}{1+r(1-\tau_S)} = 0\,, \tag{A5}$$

where λ is the Lagrange multiplier. Solving this four-equation system for x_1^j, x_2^j, l and λ as auxiliary variable, the optimal values shown are obtained:

$$\left(x_1^j\right)^* = \frac{w^j(1-\tau_l)L}{1+\beta+\gamma} \tag{A6}$$

$$\left(x_2^j\right)^* = \frac{\beta w^j(1-\tau_l)L\left(1+r(1-\tau_S)\right)}{1+\beta+\gamma} \tag{A7}$$

$$l^* = \frac{L(1+\beta)}{1+\beta+\gamma}\,, \tag{A8}$$

where the value for λ is not reported for brevity. Saving is retrieved from any of the budget constraints: $S^j = \frac{\beta w^j(1-\tau_l)L}{1+\beta+\gamma}$.

Optimisation problem by the unitary government implies to maximize (4) subject to (5) and (6). Again, on the basis of the lagrangian function, the following first order conditions are derived:

$$FOC(\tau_l): \frac{(1+\beta)(N^A\delta + N^B(1-\delta))}{-1+\tau_l} + \frac{L(N^A w^A + N^B w^B)\mu(1+\beta+r(1+\beta-\beta\tau_S}{(1+r)(1+\beta+\gamma)} \quad \text{A9)}$$

$$FOC(\tau_S): r\beta\left(-\frac{L(N^A w^A + N^B w^B)\mu(-1+\tau_l)}{(1+r)(1+\beta+\gamma)} + \frac{N^A\delta + N^B(1-\delta)}{-1+r(-1+\tau_S)}\right) = 0 \quad \text{A10)}$$

$$FOC(g_1^A): -\frac{N^A\delta\eta}{g_1^A} - \mu = 0 \quad \text{A11)}$$

$$FOC(g_1^B): -\frac{N^B(-1+\delta)\eta}{g_1^B} - \mu = 0\,, \quad \text{A12)}$$

$$FOC(g_2^A): -\frac{\beta N^A\delta\eta}{g_2^A} - \frac{\mu}{1+r} = 0 \quad \text{A13)}$$

$$FOC(g_2^B): -\frac{\beta N^B(-1+\delta)\eta}{g_2^B} - \frac{\mu}{1+r} = 0\,, \quad \text{A14)}$$

where we have omitted the corresponding condition for the Lagrange multiplier μ. The optimal values for the decision variables of the unitary government can be derived by solving the above system of equations. With the exception of the optimal public debt, they are not reported here because they involve rather cumbersome expressions but the corresponding .nb files from Mathematica are available upon request. The aforementioned optimal public debt in the unitary case (equation (7) in the main text), is retrieved by using the optimal values of endogenous variables in one of the expressions concerning budget constraints: (5) or (6).

In turn, each regional government maximizes (1) subject to an intertemporal budget constraint obtained as a combination of (8) and (9):

$$N^j t_l^j w^j l - g_1^j + \frac{Z^j - g_2^j}{1+r} = 0\,. \quad \text{A15)}$$

The first order conditions at regional level are as follow:

$$FOC(t_l^j): (1+\beta)N^j\left(\frac{1}{-1+t_l^j+T_l^j} - \frac{Lw^j\mu}{1+\beta+\gamma}\right) = 0 \quad \text{A16)}$$

$$FOC(g_1^j): \frac{N^j\eta}{g_1^j} + \mu = 0 \quad \text{A17)}$$

$$FOC\left(g_2^j\right): \frac{\beta N^j \eta}{g_2^j} + \frac{\mu}{1+r} = 0\,, \tag{A18}$$

where the corresponding expression linked to the Lagrange multiplier μ has again been omitted for simplicity. Solving this equation system we find the optimal values for the regional decision variables, which anew are available for the interested reader. As in the unitary case, regional public debt is computed on the basis of any of the period budget constraints and implicitly shown in the expression (11) of the main text.

Regarding comparative statics for the optimal regional public debt with respect to the parameters involved in the equalization formula (10), we obtain the following derivations:

$$\frac{\left(\partial D^j\right)^*}{\partial \alpha} = \frac{N^j\left[N^j\theta + LN^T(\bar{w} - w^j)\bar{t}(1+\beta+\eta)\right]}{N^T\theta(1+r)(1+\beta)\left(1+\eta\right)} \tag{A19}$$

$$\frac{\left(\partial D^j\right)^*}{\partial \bar{t}} = \frac{LN^j(\bar{w} - w^j)\alpha(1+\beta+\eta)}{\theta(1+r)\left(1+\eta\right)} \tag{A20}$$

$$\frac{\left(\partial D^j\right)^*}{\partial \bar{w}} = \frac{LN^j\alpha\bar{t}(1+\beta+\eta)}{\theta(1+r)\left(1+\eta\right)}\,, \tag{A21}$$

where $N^T = N^A + N^B$ and $\theta = 1+\beta+\gamma$.

For a complete characterisation of the sub-national equilibrium, the optimisation problem of the federal government needs to be solved. To do so it then needs to maximise (4) subject to:

$$\left(N^A T_l^A w^A + N^B T_l^B w^B\right)l + D^F = 0 \tag{A22}$$

$$\tau_S r\left(N^A S^A + N^B S^B\right) - D^F(1+r) - Z^A - Z^B = 0 \tag{A23}$$

A combination of (A22) and (A23) yields the intertemporal federal budget constraint:

$$\left(N^A T_l^A w^A + N^B T_l^B w^B\right)l + \frac{\tau_S r(N^A S^A + N^B S^B) - Z^A - Z^B}{1+r} = 0\,. \tag{A24}$$

First order conditions derived from this problem are:

$$FOC\left(T_l^A\right): \frac{N^A(1+\beta)\delta}{-1+t_l^A+T_l^A} + \frac{LN^A w^A \mu(-(1+r)(1+\beta)+r\beta\tau_S)}{\theta(1+r)}) = 0 \quad \text{A25)}$$

$$FOC\left(T_l^B\right): \frac{N^B(1+\beta)(1-\delta)}{-1+t_l^B+T_l^B} + \frac{LN^B w^B \mu(-(1+r)(1+\beta)+r\beta\tau_S)}{\theta(1+r)}) = 0 \quad \text{A26)}$$

$$FOC(\tau_S): r\beta\left[\frac{L\mu(N^A w^A(-1+t_l^A+T_l^A)+N^B w^B(-1+t_l^B+T_l^B))}{\theta(1+r)} - \frac{N^A+N^B(1-\delta)}{1+r(1-\tau_S)}\right. \quad \text{A27)}$$

where that corresponding to the auxiliary variable of the langrangian has again been omitted. Equation system (A25)-(A27) and the federal budget constraint are then solved for the endogenous variables, which are available upon request. Federal public debt $\left(D^F\right)^*$ is determined using these optimal values in any of the budget constraints:

$$\left(D^F\right)^* = -\frac{\left[\left(N^A\right)^2+\left(N^B\right)^2+L\left(N^A(\bar{w}-w^A)+N^B(\bar{w}-w^B)\right)\right]\alpha(1+\beta)\bar{t}}{N^T\theta(1+r)} \quad \text{A28)}$$

Appendix A2: Values of parameters used for the numerical simulations

The choice of the values of parameters for the numerical simulations has been guided by three criteria: 1) ensuring a determined proportionality in the results to keep them as simple and general as possible; 2) approximating the institutional features of the national equalisation systems to the stylised parameters used in the model; and 3) minimizing the differences between the country-specific case studies (in particular Germany and Spain) and a more general case. Thus, the variables differing between the country-specific and the general cases are the differences in fiscal capacity $w^j - \bar{w}$, the normative fiscal effort $\bar{t}$ and the size of the population N^j (with j= A,B). Each numerical example leads to different levels of regional indebtedness in the poor (A) and the rich region (B), as indicated by the last two rows of the table below.

Table A2: Results of numerical simulations of the theoretical model

	General case	Spanish case	German case
L	1	1	1
w^A	1	1	1
w^B	3	2	2
$\bar{w}$	2	1.5	1.8
N^A	120	85	100
N^B	80	115	100
$\bar{t}_l$	0.3	0.05	0.3
α	0.9	0.9	0.9
β	0.9	0.9	0.9
r	0.11	0.11	0.11
γ	0.8	0.8	0.8
η	0.5	0.5	0.5
$0 \leq T_l^i = T_l$	0.3	0.3	0.3
D^A	57.124	19.075	37.893
D^B	-8.348	25.879	15.701

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