Fiscal Decentralization and Economic Growth in OECD Countries: A Bayesian Model Averaging Approach

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Abstract*

I will examine the empirical relationship between fiscal decentralization (FD) and economic growth in a Bayesian framework. While recently many theoretical and empirical studies emerged with the growing importance of the topic, they generally failed to provide a clear-cut evidence on the existence and direction of such a relation. There are two main reasons behind such inconclusiveness: first, cross-country studies failed to use a consistent proper set of measures of sub-central government's real fiscal autonomy, and, secondly, the relative absence of guidance from economic theory on channels through which FD should affect growth left most researchers to choose their explanatory variables on an arbitrary basis.

I attempt to tackle these issues by adopting a new panel dataset for 23 OECD countries from 1975 to 2001, whichmeasures sub-national governments' real fiscal autonomy, defined as the share of tax revenues over which local governments posses the authority to set the tax rate and the tax base. The new dataset allows the construction of two competent measures of FD and eleven hypothetical determinants of economic growth.

I adopt the Bayesian Model Averaging technique, which provides a coherent mechanism for accounting for model uncertainty. Standard statistical practice selects a model assuming that it has generated the data, which typically leads to over-confident inferences and, consequently, to policy recommendations that are more risky than appear to be. BMA helps to test the robustness of the estimates, when there is an inclusion uncertainty over a considerable number of explanatory variables..

My results indicate that in 23 OECD economies from 1975 to 2001, FD negatively affects per capita GDP growth rates, when the measure of FD is limited to the share of tax revenues, over which sub-national governments administer full autonomy.

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Contents

1. Introduction

A couple of decades ago decentralization used to be a matter of marginal importance for public economics scholars and policy makers around most governments. Countries were constitutionally divided into federal or unitary systems and there were hardly any political or economic initiatives for restructuring (Tanzi 2000). This was the post-World War II period, characterized with rapid growth in public spending. The resulted large governmental involvement in the economy eventually raised concerns over its efficiency. Starting from 1970's, the academic debate on public economics has gone beyond Paul Samuelson's, Kenneth Arrow's and Richard Musgrave's Keynesian perspectives. Since then, public economists have been intensively searching for un-utilized sources to enhance the performance of public sectors, which was partially due to a reaction against large governments (Tanzi 2008). Among these new considerations, the issue of optimal allocation of authority between different government layers quickly came to prominence in the academic debate, as major programs to shift decision-making away from the center and closer to people started to appear in reform agendas of many governments.

Today the evolving public sector is exposed to two sharply contrasting forces (Oates 2005). On one hand, we see in both industrialized and developing nations widespread efforts to decentralize, as countries seek to develop more efficient governance systems by bringing decision-making closer to the

citizens. In the United States, the national government has turned back considerable amount of central authority to the states (Oates 2002). In the United Kingdom, the establishment of Welsh and Scottish regional assemblies was a significant shift towards local power (Oates 1999). Recognizing the benefits of localized preferences has led to major movements toward decentralization in Italy, Spain and other OECD countries. On the other hand, in Europe we witness centralization processes that shift policy-making to new supra-national layers of government, namely the European Union (Oates 2002).

Hence, the multi-level government architecture is increasingly taking a more complex character. Nevertheless, one thing is clear; these processes have significantly reduced the role of national governments. Moreover, understanding the economic implications of the change in basic responsibilities of various government layers turned out to be an extremely delicate, but interesting and important task for public economists and researchers concentrating on the field of FD. Motivated by this same reasoning one of the 'fathers' of this research area Wallace E. Oates not so long ago wrote: "These are fascinating times for the study of fiscal federalism".

Up to this point I have developed a general concept, decentralization, which is commonly viewed as a shift of authority towards local governments and away from central governments, with total government authority over society and economy imagined as fixed. This typical characterization of decentralization has many economic and political dimensions. However, attempts to define and measure decentralization have primarily focused on fiscal and to a lesser extent on policy and political authority (Rodden 2003). I also remain in this track and henceforth narrow my focus on the fiscal side of decentralization. The difference in fiscal assignments between government layers attracts much academic and policy attention, because the lower-level governments are lacking a very important policy tool compared to the central government. Decentralized governments face hard budget constraints: they have neither the capacity to create money nor access to unlimited credit. In a federal system, if the central government controls the common currency, then lower-level governments will be limited to fiscal instruments and will not have access to the "soft" option of monetized debt (Oates 1999).

It is obvious that decentralization may have a large set of various economic and non-economic effects, but exploring the full set of these effects lies outside the scopes of this study. I will examine the effects of decentralization on economic performance and more specifically on economic growth. It is important to analyze the growth dimension of FD for two reasons. First, enhancing economic growth is often cited as a major objective of FD (Oates 1989). Secondly, one of the most important functions of many governments is to adopt policies that lead to a sustained increase in income levels. In fact a very central question in economics is (Bahl and Linn 1992): what causes economic growth and thus prosperity for the people of the World? In that context, it is important to recognize which level of government contributes more to economic growth (Davoodi and Zou 1998).

Recently, many benefits have been claimed for federalist institutions, generating a growing demand for increasing degrees of FD. It is widely accepted to be part of a reform package to improve efficiency in the public sector and, thus, to stimulate economic growth (Davoodi and Zou 1998). In fact, he World Bank has come to be known as a prominent supporter of FD with a recent statement: "Decentralization of government is a pivotal force that will shape global development policy in the twenty-first century" (Schwarcz 2002).

And so, decentralization is being promoted by well-meaning interest groups, often reacting to highly centralized regimes, as well as by influential international agencies. But, there is also substantial

skepticism, especially from the practitioners' side. Tanzi (1995) writes: "there is a danger, that decentralization may be perceived by policy makers, especially donors, as the latest mantra – the magic potion to cure many government problems." So the question is: does it work? Can it really serve as a superior policy tool for achieving higher growth rates?

Economists have developed a wealth of theories to explain the causes of FD on economic growth. Earliest theoreticians to address the issue were Tiebout (1956), Musgrave (1959) and Oates (1972). Whereas, the first empirical analyses on the direct impact of FD on economic growth appeared only in 1990's with Oates (1994) and Davoodi and Zou (1998).

According to Breuss and Eller (2004), the uncertain results of empirical papers may be interpreted as the theoretical trade-off construction that reflects the various gains and drawback of FD. I take a different position. The empirical estimations had crucial limitations and cannot be very reliable. This paper aims at enhancing our understanding of the empirical linkage between FD and economic growth by shedding light on some of the major shortcomings of the previous literature.

In particular, there are two central issues that I address. The first challenge of empirical estimations was to find an accurate measure of the prevailing degree of FD. This turned out to be an extremely delicate task. Almost all empirical studies used IMF's Government Finance Statistics to quantify FD by computing the ratio of sub-national government's expenditure and revenue to the total government's expenditure and revenue. In the data section I show that these GFS measures do not properly identify sub-central government's real fiscal autonomy, because they do not distinguish between sub-central government's real functions and administrative duties, a task that is tightly regulated by the central government. I attempt to tackle these issues by adopting a new panel dataset for 23 OECD countries from 1975 to 2001, which supposedly captures the 'true' amount of sub-central autonomy. The data goes back to OECD (1999) which differentiates tax revenue according to the degree of autonomy that the sub-central government posses over the associated tax rates and tax bases. However, this data was originally available for 19 OECD countries only for 1995. Fortunately, Stegarescu (2005) took the important job to extend the dataset to a panel of 23 OECD countries from 1975 to 2001 by using the same OECD (1999) logic, but taking into account time varying fiscal restructurings in these 23 governments.

The second major shortcoming is that the theoretical foundations of FD's impact on economic growth have in principal remained under-developed and have therefore limited the legitimacy of the empirical work (Breuss and Eller 2004). The relative absence of guidance from economic theory on channels through which FD should affect growth left most researchers to choose their explanatory variables on an arbitrary basis. Moreover, these studies do not sufficiently involve new results of the empirical growth theory (Breuss and Eller 2004). The vast amount of literature on the determinants of economic growth has identified over 60 or more variables to have explanatory power and has accordingly developed new methodological approaches of analyzing such amount of regressors, in the extreme cross-country cases even exceeding the number of observation. Ironically, FD has never had its place among these determinants of economic growth. Furthermore, what is surprising is that the empirical FD, by definition closely being linked to empirical growth literature, did not follow these newest trends. Hence, my second purpose is to contribute to the existing decentralization literature by applying the refinements of the growth empiricism.

The remainder of this paper is organized as follows. In the next section I review the existing theoretical and empirical literature. Section 3 discusses the measurement challenges of FD and the debate on the determinants of economic growth, and describes the data. In section 4, I first intuitively, then in a more formal manner describe the analytical framework of the empirical analysis. Section 5 presents my empirical findings and discusses their implications. Finally, the last section summarizes and concludes.

2. Literature Review

2.1. Theoretical Literature

This chapter assesses the theoretical FD literature from the prospective of its impact on economic development. I depart from the pioneering work of Oates (1972) to shape the central trade-off facing the theory: the benefits from making decisions at appropriate levels versus the costs of duplicating efforts[1].

Decentralization is a complicated phenomenon, but the economic theory generally agrees that decentralization leads to more efficient provision of public services, by better resource allocation and a more productive and possibly smaller public sector. Practitioners' perspective, on the other hand, is somewhat different and conservative to some extent. Many argue that if countries are not already committed to decentralization, they should consider alternatives to it (Ahmad and Tanzi 2002). Such skepticism is based on the argument that decentralization is often a response to failed macroeconomic policies, while the solution may be to improve the current policies, for instance skewed or inefficient spending.

A first and most recognized economic argument in favor of FD is the Oates' (1972) 'decentralization theorem'. The theorem states that the marginal benefits of public service differ in diverse communities due to the difference in their demand schedules. Hence, the level of social welfare can be increased if Pareto-efficient levels of public good consumption are provided in each jurisdiction in accordance with local demands than if any single, central level of consumption is preserved across all of the diverse communities. The magnitude of gains from decentralization increases with both the divergence of preferences and heterogeneity in cost conditions across regions.

The benefits of differentiation, however, are based on two central assumptions of the decentralization theorem: i) the central government is itself unable to differentiate appropriately (Oates 1972), due to information asymmetry (local governments posses better knowledge of local costs and preferences) and political pressures or constitutional constraints (which prevent the central government from providing diverse levels of public output to different regions) and ii) the population will ensure the

[1] An essay-style paper from Oates (1999) intuitively presents the historical development of this field. Additionally, Oates (2004) is an excellent reference for the most recent trends and future projections of, as he puts, the emerging second generation theory of fiscal federalism.

matching of preferences of local communities and local governments (Tiebout 1956); only mobile households can choose a jurisdiction of residence according to their individual needs of public output and fiscal package and so ensure a first-best outcome, which would not be relevant in a unitary system of governance.

A second and perhaps the best studied effect is the induced vertical (central vs. sub-central) and horizontal (among lower levels) competition between different layers of governments. Whereas, they may well behave as profit maximizers to the detriment of taxpayers, competition among government levels may prevent such revenue maximization (Brennan and Buchanan 1980), i.e. the 'Leviathan restraint' hypothesis. Its immediate implication is that, competing governments will have an additional incentive to set more benevolent objectives (rather than profit maximization), such as maintaining optimal tax systems, inducing efficient production of public goods and services and, most importantly, avoiding excessive governmental regulation (horizontal competition and vertically shared fiscal responsibilities imply that no government has monopoly power over economic regulation any more)[2]. However, just like in the case of the decentralization theorem, the 'Leviathan restraint' hypothesis also relies on capital and labor mobility assumption. Decentralization can constraint the lower units in their attempts to place political limits on economic activity, only in the case where resources are free to move to other jurisdictions (Weingast 2004)[3]. In countries with de facto fragmented national markets, the positive outcomes of the Leviathan hypothesis will diminish significantly, because, given hard budget constraints, sub-national governments can rely on excessive quasi-fiscal regulation (zoning laws, rules on business entry and exit etc) to meet their expenditure objectives (Ahmad and Tanzi 2002)[4].

In addition to the decentralization theorem and the Leviathan restraint hypothesis, FD has many other, less conventional, dimensions. One argument, that was absent in Oates' decentralization theorem, but came to prominence with the rise of political economy. is that FD enhances economic development through improved government accountability, strengthened social capital and more political participation (see for instance McNab 2001). FD is also considered to enhance institutional quality and promote democracy by reducing the concentration of political power and weakening the influence of vested interests on public policy. Fukasaku and DeMello (1999) argue that FD promotes economic performance by enhancing macroeconomic stability, whereas, Ter-Minassian (1997) points to the significant costs associated with insuring macroeconomic stability through FD.

While the traditional FD literature seems to be weighed with pro-decentralization arguments, there have been significant considerations on the potential risks of decentralization recently. First, the concerns over the validity of the 'decentralization theorem' are growing, as research is failing to prove the comparative advantage of sub-national governments over the national government in terms of being a better differentiator (Prud'homme 1995).

[2] A whole line of empirical and theoretical literature emerged to show the inverse relation between FD and government size; see Rodden (2003) for anoverview.

[3] Weingast (1995) calls this 'Market Preserving Federalism'.

[4] Although, this typically happens in poorer countries with a weaker tradition of respect for free markets (China, Russia and to some extend India), high income OECD countries are also not guaranteed from some autonomous subnational jurisdictions implementing aggressive protectionist policies in the extreme case (e.g. like Spain, Italy or Belgium).

Secondly, contrary to the macroeconomic stability and government accountability hypotheses, poorer regions may be at a further disadvantage in delivering efficient policies, are more likely to promote a lower quality of government decisions and more corruption (Ahmad and Tanzi 2002). The reason is that especially in countries with unevenly developed communities, local institutions lack human resources and the adequate expertise to implement competent policies and organize efficient governance[5]. Moreover, richer regions have the advantage of extracting more resources, either through using their greater political influence to negotiate with the national government for more shared revenues or through the taxation of their own citizens (Rodrigues-Pose and Ezcurra 2010). Local governments are also more likely to be influenced by special-interest groups and, thus, promote corruption, nepotism and clientelism (Rodriguez-Pose and Ezcurra 2010).

Finally, the well-known scale argument may also be well relevant. As soon as large economies of scale are implicated, especially in cases of infrastructure provision, lower governmental layers may be too small to efficiently deliver these public goods and services (Prud'homme 1995). The benefits of centralized provision are thus expected to be superior for capital intensive goods, where large amount of investment is required to facilitate per-unit low costs of delivery (Rodriguez-Pose and Ezcurra 2010).

2.2. Empirical Literature

With the growing interest on FD among academic scholars and practitioners, many empirical studies on the effects of FD on economic growth have appeared in the last decade, which, however, yield conflicting results. They do not grant clear-cut evidence whether there is such a relation at all, how strong it is, and whether the effect is positive or negative[6]. Existing empirical papers virtually fit every possible theoretical position (Rodriguez-Pose and Ezcurra 2010).The reason behind such inconclusiveness is that the impact of decentralization on growth has hardly been analyzed in a systematic manner (Feld et al 2009). Each paper basically analyzes a different dataset with various measures of decentralization and with diverse methodologies. Appendix 1 summarizes the review of the empirical literature presented below in a convenient way. Davoodi and Zou (1998) have created one of the most prominent works in the field, because they have developed a comparatively more solid analytical framework which is often used by other authors as a starting point. They depart from a neoclassical production function with two inputs: private capital and public spending, and analytically show that what matters for growth is not only total public spending, but also how this spending is allocated among different layers of the government. Therefore growth can be maximized by optimal reallocation of fiscal spending without altering the total budget's share in GDP. Their empirical results show a negative but weakly significant effect of GFS's expenditure decentralization on economic growth for developing countries and no clear relationship for developed countries in the period from 1970 to 1989.

[5] For instance, a trivial explanation is that the brightest people tend to join the national government where their long-run career interests and salaries tend to be higher (Tanzi 1995).

[6] Feld et al (2009) presents a detailed literature review. This literature meta-analysis does not show a strong FD-growth relation.

Iimi (2005) uses a similar methodology to extend the analysis to 1997–2001. He reports a significantly positive relation and concludes that FD has become a determinant of growth starting in the late 1990's. A major limitation of this study is that Iimi does not take into account FD's long term effects, instead he carries out the analysis on an annual basis.

Woller and Phillips (1998) report no significant relationship between the ratios of sub-national revenues and expenditure to total revenue and expenditure using annual and five-year averaged data for 1974–1991 for 23 developed and developing countries. They additionally hypothesize that the process of FD has a historical tendency to increase and so, they consider a common time trend variable.

Thornton (2007) reports a statistically insignificant effect in a cross-country study on 19 OECD countries. Although his findings have merely marginal importance due to the small number of observations, a major contribution is the first attempt to improve the measure of FD. In particular, he adopts data on decentralization measures from a 1999 OECD tax policy study (OECD 1999), where the extent of real revenue autonomy of sub-central governments is evaluated by identifying the amount of sub-central government's tax revenue over which they had autonomy to determine the tax rate and the tax base.

Baskaran and Feld (2009) continue this line of research by using similar measures of FD but for a panel data of 23 OECD countries from 1975 to 2001. The data comes from Stegarescu (2005), who adopts the principles suggested by OECD (1999) and by considering cross-time changes in the assignment of decision-making competencies (e.g. tax reforms effecting vertical division of fiscal authority) constructs a new panel dataset. Baskaran and Feld (2009) initially find a negative relation, but show that this effect is not robust, when the measure of FD is limited to the revenues over which sub-national governments have 'full' autonomy.

Rodriguez-Pose and Ezcurra (2010) is another recent study focusing on OECD during the period between 1990 and 2005. A major contribution is that they are looking at decentralization from a multi-dimensional perspective: They find that GFS's FD negatively affects growth, whereas the influence of the two other dimensions of decentralization,political and administrative decentralization,on economic growth is weaker and sensitive to the measurement.

Studies that have reported a significantly positive impact of FD on growth include Yilmaz (2000), who distinguished between unitary and federal states in a panel study of 46 countries with 1971 to 1990 annual data, and found that FD had a positive and statistically significant impact on growth in unitary states, but none in federations.

Thiessen (2003) uses an averaged cross-sectional data of high-income OECD economies for 1973–1998 and a panel of 26 countries for the period from 1981 to 1995 in a companion study (Thiessen 2003a). He finds an inverse U-shaped non-linear relationship between FD and growth.

Enikolopov and Zhuravskaya (2003) additionally consider institutional aspects in a 1978-2003 cross-section averaged data of 21 developed and 70 developing countries. They report that for the developing countries in particular, the strength of national political parties significantly improves the outcomes of FD, whereas administrative subordination (i.e. appointing local politicians rather than electing them)weakens the effects of FD.

3. Data

3.1 Measuring Decentralization

In recent years, many studies have attempted to quantify the impact of FD. However, decentralization is difficult to measure (Ebel and Yilmaz 2002). In vast majority of the studies examining the relationship between FD and macroeconomic performance, the degree of FD is measured by the share of state and local governments' expenditure and/or revenue in those of the total government.. The primary data source for these measures is the IMF's Government Finance Statistics Yearbook (GFS).

Despite its merits and popularity among researchers, concerns are rising over these widely used measures of FD recently, as they fail to provide enough confidence among researchers to be a useful composite measure of decentralized authority. Particularly, they severely overestimate fiscal independence of sub-central governments by failing to make an appropriate distinction between the real fiscal autonomy and the sub-central government's organizational activities. This is what Thornton (2006) calls "substantive" and "administrative" decentralization. For instance, although GFS provides a breakdown of expenditure by function and economic type, the measure of expenditure decentralization makes no distinction between state or local governments' 'own-decision' spending and those tightly regulated by the center. Similarly, revenue decentralization makes no distinction between sub-central government's sources of grants, tax and non-tax revenues.

This criticism has been quite substantial and has seriously questioned the results of those empirical cross-country studies that construct their decentralization measures from the GFS data. However, it should be noted, that to date there are no alternative datasets of governmental finance that consistently cover a large set of countries; good quality of data on sub-national governmental finance is especially lacking for developing countries. So, the authors aiming to study a large set of countries had to (and currently still have to) choose their decentralization measures from a pool of bad albeit the only limited possible variables

Fortunately, this is not the case for OECD countries.Jourmard and Kongsrud (2003) and Darby et al (2003) show that central government's imposed limits on the sub-national governments' ability to decide on tax rates and tax bases significantly reduces the true sub-national fiscal autonomy. In a 1999 tax policy study the OECD measured the extent of revenue autonomy of sub-central governments in 19 OECD member countries for 1995 by identifying the amount of their tax revenue over which the sub-central governments had autonomy to determine the tax rate and the tax base. Thornton (2006) was the first to apply these datasets to empirical FD research; however his results had only a marginal contribution due to the small sample size. Stegarescu (2005) adopts the principles suggested by OECD (1999) to construct a panel dataset of 23 OECD countries in the time period between 1975 and 2001, by taking into account cross-time changes in the assignment of decision-making competencies (e.g. tax reforms affecting vertical division of fiscal authority) and by running the same procedure for four new OECD countries.

The OECD (1999) study classifies different categories of taxes (e.g. personal income tax, corporate income tax etc) in terms of the class of autonomy they provide to sub-national governments. In the case of tax categories (a) to (c) sub-central government has total control over its taxes (SCG has the authority

to set the tax rate and/or the tax base) and in the case of revenue sharing categories (d.1) to (d.2) it has limited, but still significant control (SCG itself or partly with the CG co-decides on splitting the revue). Whereas for tax revenue categories (d.3) to (e), the sub-central government's tax autonomy is limited or non-existent.

Table 2: Classification of tax revenue (in decreasing order of control over revenue sources)

a) SCG sets tax rate and tax base
b) SCG sets tax rate only
c) SCG sets tax base only
d) tax sharing arrangements
d.1) SCG determines revenue-split
d.2) revenue-split can only be changed with consent of SCG
d.3) revenue-split fixed in legislation, may unilaterally be changed by central government
d.4) revenue-split determined by central government as part of the annual budget process
e) central government sets rate and base of SCG tax.

Source: OECD (1999)

From the above I define the following two measures of FD. Revenue autonomy of first degree (RAut1), is the sub-national government's share of 'own' tax revenue and other non-tax revenue in general governments total revenue (tax, non-tax and capital revenue):

$$RAut1 = \frac{\text{SCG own tax rev (a) to (c)} + \text{non tax \& } capital\ revenue}{\text{GG total tax tev} + \text{non tax \& } capital\ revenue}$$

It is probable that the relationship between FD and economic growth is non-linear, however, surprisingly, with the exception of Thiessen (2003)[7], all the other mentioned authors are restricting their analysis to the linear case. I also allow for a nonlinear relationship by defining a quadratic term of indicator RAut1, denoted RAut1sq.

RAut1is based on quite strict definition of the sub-central government's fiscal autonomy and, therefore might underestimate the existing level of decentralization. Hence, I use a second weaker measure Revenue autonomy of second degree (RAut2), which is the sub-national government's share of the sum of 'own' tax revenue, shared tax revenue and other non-tax revenue in general governments total revenue (tax, non-tax and capital revenue):

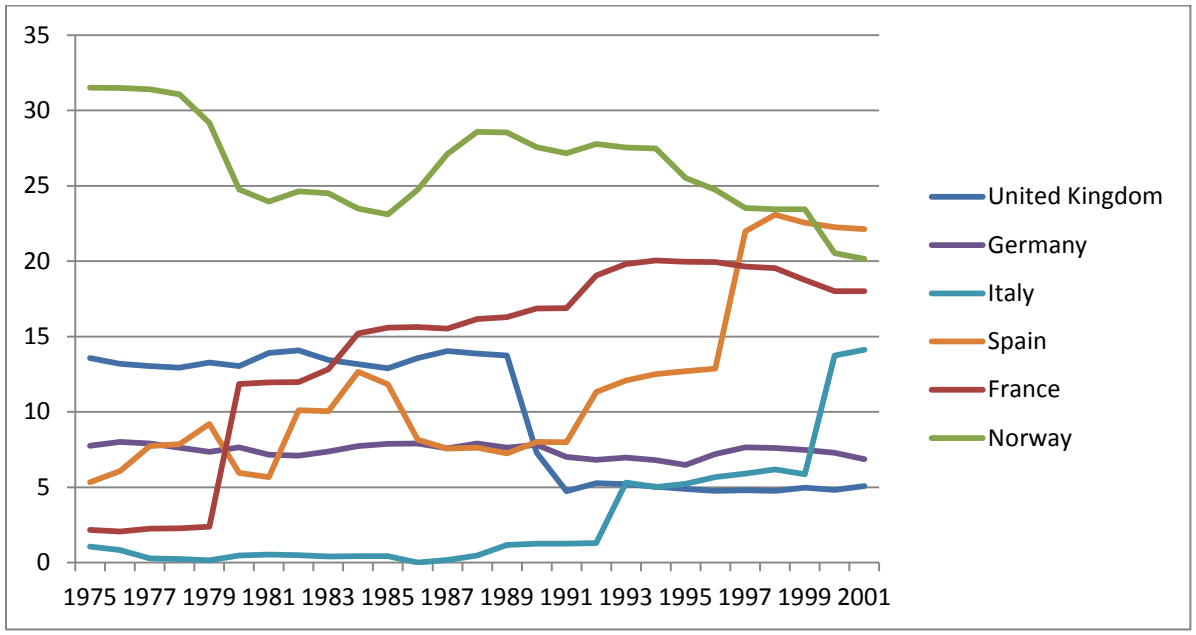
$$RAut2 = \frac{\text{SCG own tax rev (a) to (c)} + \text{shared tax rev (d. 1)to(d. 2)} + \text{non tax \& } capital\ revenue}{\text{GG total tax tev} + \text{non tax \& } capital\ revenue}$$

[7] Thiessen (2003) shows an inverse U-shaped relation.

The latter two measures, although valuable, are not without their critiques. Particularly, they do not address the important issue of how the revenue of shared taxes are allocated (OECD 1999). Moreover, horizontal (between jurisdictions at the same level of government) and vertical (between different levels of government) intergovernmental grants are not captured by the OECD (1999) and Stegarescu (2005) studies. This is due to the fact that intergovernmental grants are not reported as tax sharing arrangements, since provided grants are counted as expenditure in the budget of the dispensing government unit and as a grant in the budget of the receiving government unit (rather than shared taxes). Finally, Stegarescu (2005)'s methodological quality (the extent of cross-country consistency) of tracking changes in the assignment of decision-making competencies is still to be evaluated.

Figure 4 shows the evolution of FD measured by RAut1 for selected economies. Governments of Italy, Spain and France significantly shifted their fiscal power towards lower governmental layers, whereas Norway and Finland (not reported) became more centralized. Germany stagnated at a low 7.4% average level. This is probably due to the fact, that the intermediate level of the Länder (States) has no power to directly change tax bases or tax rates autonomously. However, the Länder do have a strong position in the tax law-making process, as the Federal government (the 'Bund') needs the majority of the 'Bundesrat' (the second chamber of Parliament, an elected body representing the Länder) to pass any legislative changes on the tax laws affecting the Länder (OECD 1999). Note also that in Germany the RAut2 measure also did not suffer any shocks remaining at an average of 21.5%, 14 percentage points higher than RAut1. This is twice as high as the sample average of the difference of the two measures and is the result of the intensive use of revenue sharing mechanisms: the Länder have a 50% share in the corporate income tax and the withholding tax on interest and dividends, 44% share in value added tax, 42.5% share in the revenue of the wage withholding tax and, finally, they keep 5% of the revenue from the local business tax (OECD 1999).

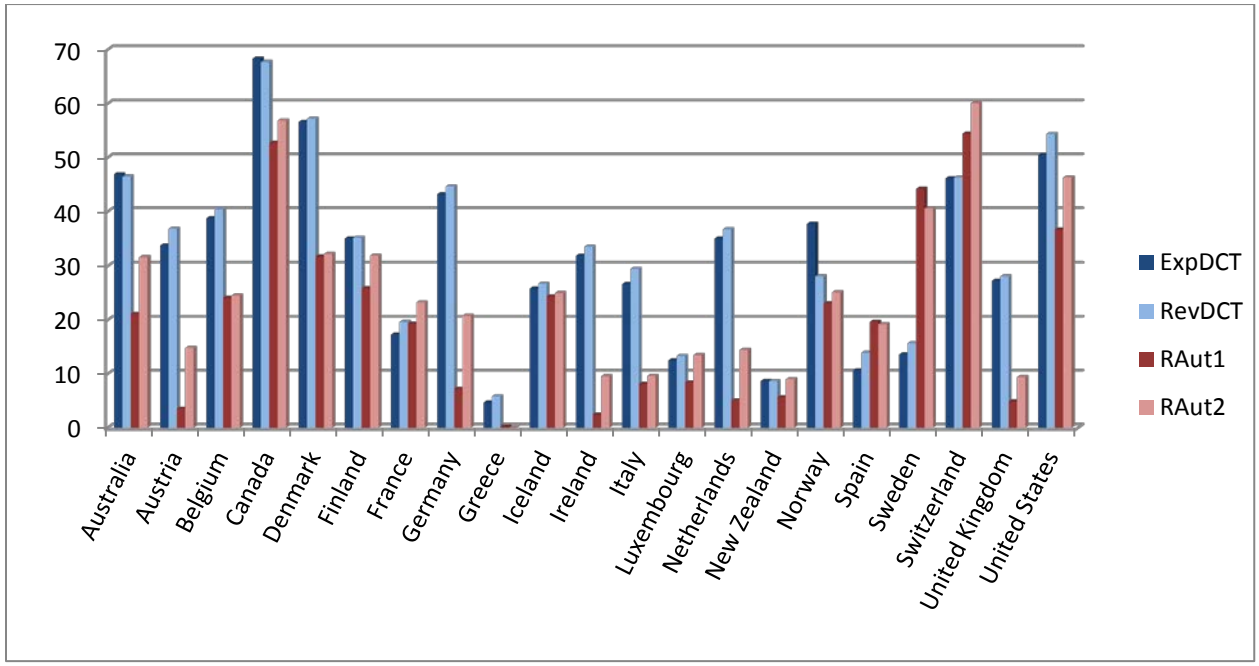
Figure 4: Evolution of FD for selected OECD economies measured by RAut1.



Source: Own calculations based on Stegarescu (2005) data.

The following figure (5) aims to conclude this section by illustrating i) the variation of FD between 21 OECD countries, and ii) the within country correlation among the four basic FD measures.

Figure 5: Four cross-country measures of FD, averaged over 1995-2001.



Source: Own calculations based on data from GFS and Stegarescu (2005).

3.2. Determinants of economic growth

This section briefly describes the dependent variable and the economic control variables taken from the World Bank's World Development Indicators report. The dependent variable is the annual growth rate of GDP per capita based on constant local currency.

At the explanatory side, in addition to the six decentralization measures, I include a number of economic control variables. Over the last two decades different studies in empirical growth literature have identified over 60 variables that have significant correlation with GDP growth for a large sample of countries. Compared to these large samples my data on 23 OECD countries is fairly homogenous, therefore I pick 17 of these 60 variables and drop the rest due to low cross-country variation and/or data availibility.

The first economic control variable that enters into my model is the initial level of per capita GDP. The convergence hypothesis of neoclassical growth models is that growth is negatively related to the initial level of per capita GDP[8].

Empirical growth literature also frequently showed a negative correlation between population growth rate and average fertility rate. A common argument is that increased resources must be devoted to child rearing rather than to production and investment.

Human capital plays a special role in a number of endogenous growth models. In Romer (1990) human capital is the key input to the research sector. Lucas (1988) draws attention on the adoption of new technologies facilitated by a highly skilled workforce. Barro (1991) argues that human capital reduces fertility rates. As proxies for human capital I take four variables and expect them to positively affect growth: secondary (rather than primary, as it has low variation among OECD countries) school enrollment rate, labor participation rate (proportion of the population ages 15 and older that is economically active) and an indicator of life expectancy at birth.

The rate of accumulation of physical capital has been empirically proven to be one of the main factors determining the level of output in OECD countries (Bassanini and Scarpetta 2001). For physical capital I take two proxies: the gross capital formation (% in GDP) or also known as gross domestic investment and the net inflows of foreign direct investment (% of GDP).

In a macro perspective, three policy aspects have been controlled for: monetary side (inflation), financial system (interest rate on lending) and economic integration (trade openness). The standard arguments for lower and more stable inflation rates are reduced economic uncertainty and improved efficiency of the price mechanism (Barro 1990, Bassanini and Scarpetta 2001). Healthy financial systems are also hypothesized to contribute to economic growth. I take lending interest rate, the average rate charged by banks on loans to prime customers, assuming that accessibility to cheap money positively affects capital accumulation and, thus, economic growth. To control for the economic benefits of exploiting comparative advantages of foreign trade and other gains of economic integration, I adopt merchandise trade as a share of GDP (sum of merchandise exports and imports) as a proxy for economic openness.

Appendix 2 presents the summary statistics of dependent variables, FD measures and economic control variables.

4. Analytical Framework

4.1. Basic Intuition

[8] Recent critiques of the neo-classical growth model have brought forward the concept of conditional convergence, i.e. a relation between growth rate and initial conditions after controlling for other variables (see for example Bassanini and Scarpetta, 2001).

Over the last two decades, hundreds of empirical studies have attempted to identify the factors explaining the differences in growth rates, i.e. determinants of growth. This line of research is heavily influenced by seminal works from Kormendi and Meguire (1985), Grier and Tullock (1989) and Barro (1991), which have identified a substantial number of variables that are partially correlated with the rate of economic growth (Sala-i-Martin et al 2004). The basic analytical framework consists of using cross-country or panel datasets to regress GDP growth on a host of country characteristics:

$$y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + \varepsilon \qquad (1)$$

where y is the rate of per capita real GDP growth, α is a constant term, x_i (*j=1,…,k*) are vectors of explanatory variables with β coefficients and ε is a vector of the error terms. The problem faced by this line of empirical growth economists is that growth theories are not explicit enough about what variables x_i belong in the 'true' regression (Sala-i-Martin 1997). The relative absence of guidance from economic theory as to which variables to include in the regressions, resulted in a new series of papers trying to tackle this issue. A particularly contentious issue was the robustness of growth regression methods, which was first addressed by Levine and Renelt (1992) and later on works by Sala-i-Martin (1997 and 1997a), Fernandez, Ley and Steel (2001), Sala-i-Martin, Doppelhofer and Miller (2004) and others contributed to accounting for model uncertainty in estimation procedures. Briefly, one way to think about model uncertainty is to apriori declare that the 'true' model is unknown, which immediately implies a departure from the classical methodology in which conditioning on a specified model is essential (like the model in equation 1). Consequently, instead of traditional conditioning, the employed Bayesian inference attaches probabilities to all possible models (Sala-i-Martin et al 2004). This method has been recently referred to as 'Bayesian Model Averaging' (BMA).

The traditional empirical growth literature has identified fiscal policies to be a significant determinant of economic growth. Researchers typically include the level of public spending or taxing systems as proxies for fiscal policy, but they did not pay attention on the assignment of fiscal responsibilities to various vertical layers of the government structure. The empirical literature on FD attempts to show that this division of fiscal power actually matters for growth. In particular, Davoodi and Zou (1998) depart from Barro (1990)'s model to show that for a given share of total government spending in GDP, a reallocation of public spending among different levels of government (their measure of FD) affects economic growth. Therefore, as long as the actual level of FD is different from the growth maximizing one, an optimal decision of FD can lead to higher rates of economic growth. In the last decade, the empirical literature on FD – growth relationship has always departed from Davoodi and Zou (1997)'s argument by regressing growth rates on different measures of FD and on different control variables.

The problem in empirical FD literature is similar to the one in empirical growth literature: what method should be employed to determine which measures of decentralization and which control variables have a significant effect on economic growth? Surprisingly, while the growth literature has paid considerable amount of attention to the issue of model uncertainty, decentralization literature has exceptionally relied on traditional estimation techniques. I apply one of the ways to tackle the issue of model uncertainty, namely Bayesian Model Averaging (briefly discussed above), to the empirical FD literature. This new approach is beneficial at least because of two main reasons: i) it allows to assess the evidence in favor of more than one competing measure of the same theoretical concept, i.e. in the last section I defined five different measures of FD, so BMA will help to compare them; and ii) when there is

uncertainty over a considerable number of explanatory variables (twenty three hypothesized determinants of growth in my case), BMA helps test the robustness of their estimates. Of course BMA is not without its critiques, particularly concerning the impact of the specification of the prior distribution, which is indeed one of the main reasons for Bayesian inference remaining relatively unpopular among researchers (Sala-i-Martin et al 2004).

Following an intuitive brief discussion of my adopted analytical framework, the next sub-section aims to present a more formal and somewhat technical discussion of my econometric specification.

4.2. Bayesian Model Averaging

In section 3 I have derived a panel dataset from 1975 to 2001 for 23 OECD with three measures of FD and eleven control variables. I start with the cross-country case, which is then easily extended to the case of panel data analysis.[9]

With k possible explanatory variables, I will have 2^k possible combinations of regressors, i.e. 2^k different models, each model denoted by M_j for j = 1, 2, …,2^k. A generic representation of the linear growth regression model M_j is:

$y = \alpha\tau_n + X_j\beta_j + \sigma\varepsilon$ (2)

where the dependent variable y is the vector of per capita real GDP growth rates of *j = 1,…,n* countries, α is the intercept multiplied by τ_n an *n*-dimensional vector of 1's, matrix X_j of dimension *n x k* contains a number of explanatory variables chosen from a set of *k* = 23 variables (six measures of FD and seventeen economic control variables) with β as the *k*-dimensional vector of regression coefficients, ε is a vector of the error terms following an n-dimensional Normal distribution with σ as a scale parameter.

The starting point of the Bayesian Model Averaging approach is that for each of the large number of models M_j some probability of being the 'true' model is assigned, i.e. the researcher has to subjectively choose prior distributions for the three parameters α, β_j and σ of model M_j. The appropriate choice of these distributions is currently a widely debated topic in applied statistics, as it can potentially impact the posterior model probabilities. Fernandez et al (2001) tackle this issue by proposing a 'benchmark' prior distribution which, they claim, has modest influence on posterior model probabilities. They make an additional conjecture, by assuming that the variance parameter has a common prior across different models, i.e. the residual standard deviation of y given the full set of regressors X is constant across models. In particular, for the intercept α and the variance parameter σ, Fernandez et al (2001) propose a common, improper and non-informative prior:

$p(\alpha, \sigma) \propto \sigma^{-1}$ (3)

For prior of the slope parameters β_j, namely ($p(\beta_j|\alpha, \sigma, M_j)$), Fernandez et al (2001) use Zellner's (1986) g-prior structure which is equal to the density function of a Normal distribution of β_j with zero mean and covariance matrix: $\sigma^2(gX'_jX_j)^{-1}$, where $g = 1/\max\{n, k^2\}$.

[9] See Hoeting et al (1999) for an excellent review of the statistics of the Bayesian Model Averaging techniques and its applications.

Once I have specified the sampling and prior setting, I only need to define the prior distribution for each of the models M_j. In particular, Fernandez et al (2001) assume that every model has the same uniform distribution over the whole model space, i.e. apriori each model has equal probability of being the true one:

$$P(M_j) = p_j = 2^{-k}, \quad \sum_{j=1}^{2^k} p_j = 1 \qquad (4)$$

The posterior distribution of any randomly chosen subset of regressors, of quantity Δ, is the weighted average of the posterior distributions of that quantity in each model, with weights given by the posterior model probabilities, $P(M_j|y)$. Thus:

$$P_{\Delta|y} = \sum_{j=1}^{2^k} P_{\Delta|y,M_j} P(M_j|y) \qquad (5)$$

Equation (5) is the central BMA argument. For a given choice of regressors, Δ, this formula gives the posterior distribution of parameters. Hence, it is straightforward to say that the marginal posterior probability of a certain variable to belong to the 'true' model is simply the sum of the posterior probabilities of all 2^{k-1} models that hold this regressor.

Now I turn to the point of computing the posterior model probabilities, namely $P(M_j|y)$, which, to put intuitively, is the probability of model M_j being the true model conditional on my information set, i.e. given my data. The logic of Bayesian inference suggests that given the prior model probability $P(M_j)$, I can derive the posterior model probability using the famous Bayes' Rule:

$$P(M_j|y) = \frac{f(y|M_j)P(M_j)}{f(y)} \qquad (6)$$

where $f(y|M_j)$ is the marginal (or integrated) likelihood of model M_j and $f(y)$ is the average of the marginal likelihoods over all possible models weighted by the prior model probability:

$$f(y|M_j) = l_y(M_j) = \int p(y|\alpha, \beta_j, \sigma, M_j) p(\alpha, \sigma)\, p(\beta_j|\alpha, \sigma, M_j) d\alpha\, d\beta_j\, d\sigma \qquad (7)$$

$$f(y) = \sum_{i=1}^{2^k} l_y(M_{hhhi}) p_{hhhhi} \quad (8)$$

This ratio of integrated likelihoods, also in statistical literature commonly referred as Bayes factor, will serve as the weighting scheme as it gives more weight to the models that are more likely to be close to the 'true' model (Sala-i-Martin 1997). Also note, that the derived Bayes factor is closely related to the likelihood ratio statistic in classical econometrics.

Fernandez et al (2001, b) show that the derived marginal likelihoods can be analytically computed, and, therefore, posterior model probabilities in equation (6) are known. However, I have considered a very large set of models by allowing every possible subset of k=23 independent variables to enter the model. Hence, the number of different possible linear models is 2^{23} = 8.389 x 10^6; that is over eight million regressions. Evaluation of all these regressions is computationally prohibitive and, thus, I, similar to most authors, adopt Markov chain Monte Carlo (MCMC) techniques of Model Composition (MC^3) to solve this numerical problem[10].

As already noted above, I have derived two datasets in section 3: one for cross-country and one for panel data. Moral-Benito (2009) shows that the presented BMA methodology can be easily extended

[10] See Madigan and York (1995) for the MC^3 methodology or the computational appendix of Moral-Benito (2009) for its application to Fernandez et al (2001).

to the case of panel data analysis with *i = 1,…,n* countries and *t = 1,…,T* years, if we rewrite equation (2) as:

$$y_{it} = \alpha + \beta^j x_{it}^j + \sigma\varepsilon_{it} \qquad (9)$$

I will also be interested in studying country fixed effects (between estimator) and time fixed effects (within estimator) models, therefore I define the following two-way error component model:

$$\varepsilon_{it} = \mu_i + \rho_t + \epsilon_{it}$$

where μ_i denotes the unobservable individual effects, ρ_t denotes the unobservable time effects and ϵ_{it} is the remainder stochastic disturbance term.

To get the within estimator (10) time constant unobserved heterogeneity has to be removed, so I average the equation over time for each *i* (between transformation) and then subtract for each t (within transformation):

$$\bar{y}_{i.} = \alpha + \beta^j \bar{x}_{i.}^j + \sigma(\mu_i + \bar{\rho}_. + \bar{\epsilon}_{i.})$$

$$y_{it} - \bar{y}_{i.} = \beta^j\left(x_{it}^j - \bar{x}_{i.}^j\right) + \sigma(\rho_t - \bar{\rho}_.) + \sigma(\epsilon_{it} - \bar{\epsilon}_{i.}) \qquad (10)$$

Similarly, I 'country-demean' the data to get the between estimator:

$$y_{it} - \bar{y}_{.t} = \beta^j\left(x_{it}^j - \bar{x}_{.t}^j\right) + \sigma(\mu_i - \bar{\mu}_.) + \sigma(\epsilon_{it} - \bar{\epsilon}_{.t}) \qquad (11)$$

To sum up, in the section above I first intuitively, then in a more formal manner, discussed the analytical framework of the empirical analysis to follow. In short, I depart from the traditional methodology of the empirical decentralization literature, i.e. rather than almost arbitrarily selecting a few variables from a very large pool of growth determinants and conditioning on this specific model as if it is the 'true' one (this requires a strong assumption that the specified model has generated the data), I don't restrict my analysis by conditioning on any model. In fact, to explain the relation between GDP growth rate and FD I construct six measures of FD and seventeen economic control variables. Then, I use Bayesian inference to obtain results for every model or regression under consideration (any combination of these 23 explanatory variables, that is over eight million regressions) and average them using appropriate weights. Based on these weights I, next, estimate the posterior probability of a particular regressor to be included in the regression (Moral-Benito 2009). Posterior probability of a variable reflects its probability of belonging to the 'true' model, therefore regressors with high posterior probability are considered to be robust determinants of economic growth.

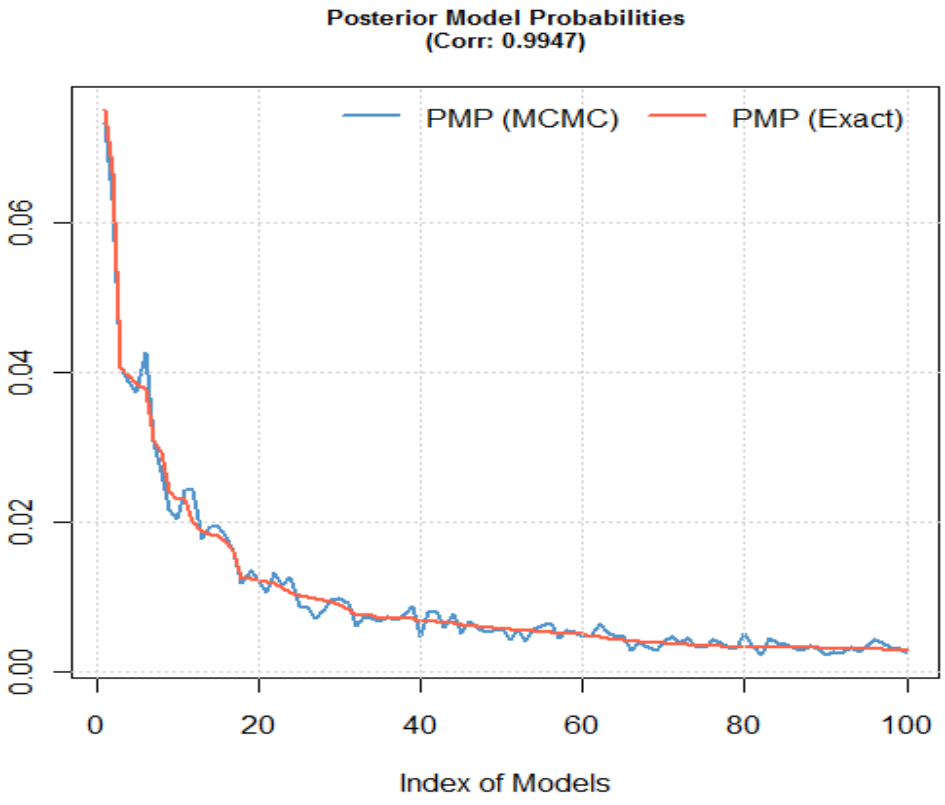
5. Analysis and Results

Since I will be interested in FD's long-term structural effects on economic performance (rather than short-run fluctuations), from the annual panel data I derive two datasets: first with three-year averages (i.e. nine time points, hence 207 observations) and the second with six-year averages (actually it is 4 six-year and 1 three-year periods, hence 115 observations).I estimate three Bayesian models of linear regressions for each of the three- and six-year averages datasets: estimation with country fixed effects (CFE) to encounter for between unobserved heterogeneity (equation 11); estimation with time

fixed effects (TFE) to get rid of time constant unobserved heterogeneity (equation 10) and pooled OLS estimation as a base case (equation 9).

Zellner's g-prior was defined as: $g = 1/\max\{n, k^2\}$, hence I take $g = 1/n$ for the three-year averages case (since $n > k^2$) and $g = 1/k^2$ for the six-year averaged data ($n < k^2$).[11] Analogous to the cross-country case, I run the BMA with one hundred thousand recorded drawings after a burn-in of fifty thousand discarded drawings of the Markov Chain Monte Carlo Model Composition (MC^3) sampler. In case of the country fixed effects, out of the $j=2^{14}$ models the chain visits 241 regressions, of which 68 have posterior probabilities over 0.1%. Figure (9) plots the differences between Posterior Model Probabilities (PMP) based on MCMC frequencies and the marginal likelihoods for the best 100 models. The correlation coefficient between visit frequencies and exact posterior probabilities is close to perfect for all three models: it is 0.9947 for CFE, 0.9991 for TFE and 0.9963 for the pooled-OLS (only CFE is reported)[12].

Figure 9: Correlation between PMP based on MCMC frequencies and exact PMP for the country fixed effects estimation of three-year averaged data.

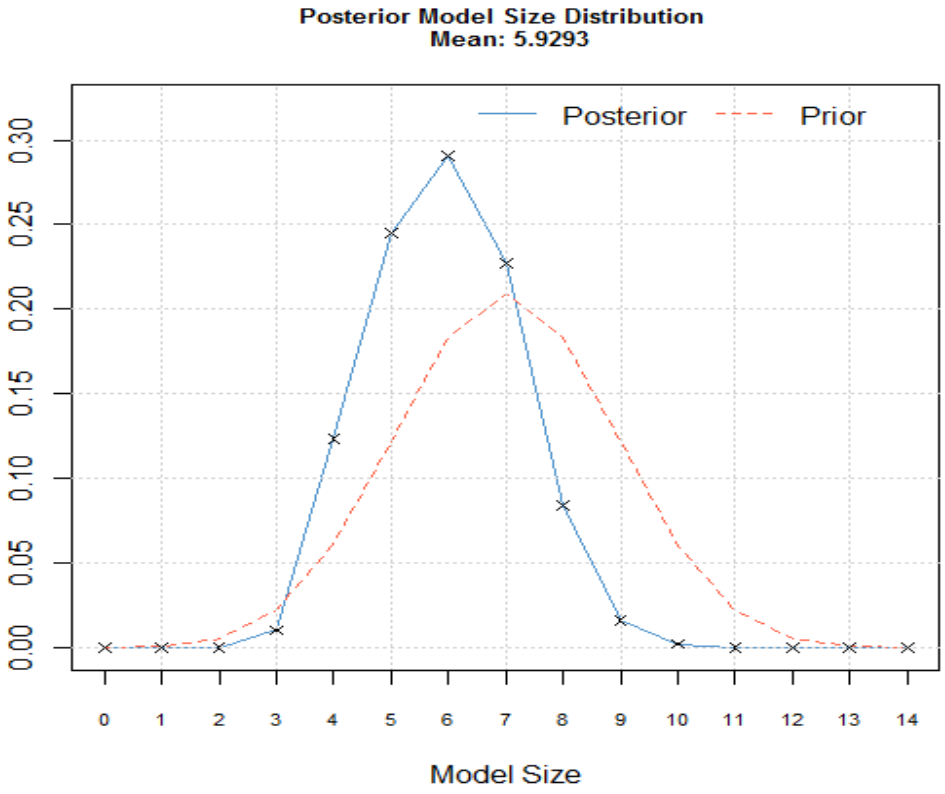


Source: Own calculations.

[11] Prior assumptions are identical for all the three models: country FE, time FE and pooled-OLS.
[12] Unless otherwise noted, I report results for the three-year averages dataset, as the basic descriptive statistics are very similar to the six-year case.

With the loss of several explanatory variables, the posterior expected model size also decreases. This is one of the limitations of BMA, because the posterior expected model size greatly depends on the assumption of a uniform prior distribution. Hence, the expected model size will always increase with inclusion of an extra (even unrelated) variable, just like it would increase the model fit in classical econometrics. Nevertheless, this measure helps to compare the model fits of my three estimations (given apriori identical expected number of regressors, 7 in this case). CFE model has the largest posterior expected model size with nearly 6 explanatory variables (the best 68 models with posterior probabilities over 0.1% have between 2 and 10 covariates (a rather large variance) and on average the number of regressors is 5.93, see figure 10), followed by pooled-OLS (4.21) and the TFE model (3.51).

Figure 10: Prior and posterior model size distribution of the CFE estimation of three-year averaged data.



Source: Own calculations.

Tables (6) and (7) report BMA estimation results for country fixed effects, time fixed effects and pooled-OLS models for three- and six-year averaged datasets accordingly.

Table 6: BMA estimation of Country FE, Time FE and Pooled-OLS models for a balanced panel of 23 OECD countries for 3-year averages over 1975 to 2001.

	Country FE		Time FE		Pooled-OLS	
	PIP	Ratio Pos.	PIP	Ratio Pos.	PIP	Ratio Pos.
Capital formation (% GDP)	1.0000	1.0000	0.9854	1.0000	0.9429	1.0000
Country Openness	1.0000	1.0000	0.9969	1.0000	0.9642	1.0000
Inflation	0.9419	0.0000	0.0541	0.0379	0.1989	0.0000
Secondary school enrollm.	0.5633	1.0000	0.0659	1.0000	0.4519	1.0000
RAut1	0.5136	0.0000	0.1505	0.3142	0.1510	0.1678
Log _ Life Expectancy	0.4968	0.0000	0.1297	0.0000	0.0576	0.9170
RAut2	0.2714	0.0000	0.1406	0.3865	0.1457	0.1408
RAut1sq	0.2286	0.0000	0.3915	0.0000	0.4165	0.0000
FDI (% GDP)	0.2200	0.0000	0.0434	0.0000	0.0264	1.0000
Labor participation	0.1254	0.0000	0.0582	0.2754	0.0417	0.7488
Fertility rate	0.1188	0.0000	0.0422	0.8728	0.0247	0.1131
Population growth	0.1108	0.0000	0.0426	0.0429	0.0321	0.0000
Lending interest rate	0.0458	0.3303	0.0919	0.0000	0.3711	0.0000
Log_ Initial p. c. GDP	0.0126	1.0000	0.0648	0.2632	0.0599	0.0000
Posterior Model Size	5.9293		3.5139		4.2100	
Corr. PMP (MCMC) & PMP (Exact)	0.9947		0.9991		0.9963	

Source: Own calculations.

Table 7: BMA estimation of Country FE, Time FE and Pooled-OLS models for a balanced panel of 23 OECD countries for 6-year averages over 1975 to 2001.

	Country FE		Time FE		Pooled-OLS	
	PIP	Ratio Pos.	PIP	Ratio Pos.	PIP	Ratio Pos.
Capital formation (% GDP)	1.0000	1.0000	0.5467	1.0000	0.2373	1.0000
Country Openness	1.0000	1.0000	0.9413	1.0000	0.9475	1.0000
Inflation	0.9893	0.0000	0.0361	0.4372	0.0602	0.1232
Labor participation .	0.9821	0.0000	0.0477	0.1357	0.0274	0.3056
RAut1	0.8311	0.0000	0.1498	0.0734	0.1368	0.0663
Secondary school enrollm	0.3873	1.0000	0.0366	0.8043	0.1255	1.0000

FDI (% GDP)	0.2733	0.0000	0.0488	0.0000	0.0265	1.0000
Fertility rate	0.1983	0.0000	0.0366	1.0000	0.0233	0.2356
RAut2	0.1854	0.1926	0.1297	0.1070	0.1287	0.0994
RAut1sq	0.0768	0.5652	0.2511	0.0000	0.2782	0.0000
Log _ Life Expectancy	0.0556	0.5871	0.1250	0.0000	0.0684	1.0000
Population growth	0.0537	0.1331	0.0414	1.0000	0.0480	1.0000
Lending interest rate	0.0536	0.2963	0.0465	0.0000	0.2598	0.0000
Log_ Initial p. c. GDP	0.0453	0.8525	0.0621	0.0000	0.0941	0.0000
Posterior Model Size	6.2623		2.8202		3.0474	
Corr. PMP (MCMC) & PMP (Exact)	0.9992		0.9989		0.9972	

Source: Own calculations

I start from the interpretation of the economic control variables (Table 8). The two strongest determinants of per capita GDP growth rate in my sample are the proxy of the rate of accumulation of physical capital and the country openness indicator. Gross capital formation (% in GDP) is significantly positively related to growth in almost all models. Concerning country openness, higher level of economic integration translates to higher growth.

Inflation is negatively correlated to growth with PIPs close to 100% in between estimations, whereas my earlier cross-country analysis showed a positive impact. The reason behind these opposing results is that in the cross-country case the mean of inflation over 1995 to 2001 was just 2.29%, while in the early years of the panel data inflation often passed its controllable threshold level, often reaching to 15-20%. The combined results of the cross-country and panel models prove my earlier hypothesis that inflation has significantly negative impact on growth for higher levels of inflation, but none for low or moderate levels. The other proxy of macroeconomic policy, rate of lending interest rate, has weaker correlation with growth, but the direction of its impact is consistent with the theory, i.e. high interest rates on lending imply lower growth rates.

Secondary school enrollment, as expected, has a significantly positive effect on growth rates. Not surprisingly, it has lower than 0.1 PIP in both time fixed effects models, because the within variation of this variables is low (in fact, some authors take only the initial level of school enrollment rate). The other proxy of human capital, life expectancy, behaves contrary to my initial hypothesis for already the second time, i.e. life expectancy is negative correlated with growth in both cross-country and panel cases. Nevertheless, its impact is weak (less than 0.5 PIP in all models) and this estimation error is due to the low variation of the variable within my homogenous OECD sample.

Two similar and common determinants of growth, average fertility rate per woman and population growth rate, are consistent with the hypothesis that they negatively affects growth, as increased resources are devoted to child rearing rather than to production and investment.

The labor participation rate is negatively correlated with growth, implying that people work less in countries with higher growth rates. Finally, unlike the convergence hypothesis of neoclassical growth

theory that growth is substantially negatively related to the level of initial income, initial per capita GDP was not a significant determinant of growth in my sample. The latter implies that the convergence hypothesis is possibly more relevant when analyzing a large heterogeneous sample, but is less or not essential when the sample consists of high income countries only.

Table 8: Summary of the panel data estimations[13].

	3 year averages			6 year averages		
	Country FE	Time FE	Pooled OLS	Country FE	Time FE	Pooled OLS
Capital formation (% GDP)	+	+	+	+	+	+
Country Openness	+	+	+	+	+	+
Inflation	-		-	-		
Secondary school enrollm.	+		+	+		+
RAut1	-	-	-	-	-	-
Log _ Life Expectancy	-	-			-	
RAut2	-	-	-	-	-	-
Raut1sq	-	-	-		-	-
FDI (% GDP)	-			-		
Labor participation	-			-		
Fertility rate	-			-		
Population growth	-					
Lending interest rate			-			-
Log_ Initial p. c. GDP						

Source: Own calculations

Now I turn to the FD variables. As in the cross-country case, here likewise, RAut1 reports to have a significantly negative effect on economic growth. Except a few countries, e.g. Spain, Italy, France and UK to some extent, the within country variation of FD is low, therefore RAut1 shows particularly strong results in the country fixed effects model, i.e. between estimation. In the three-year averaged model RAut1 has a 51% posterior probability of inclusion, whereas when estimating longer term effects RAut1's significance raises to 0.83 PIP, in both cases having a strictly negative coefficient. Although within and pooled models report a low PIP (0.14 to 0.15), the ratio of how often the coefficients' expected values were positive (Ration pos.) is close to 0, implying a negative relationship. So the central finding is clear-cut; both 1995 to 2001 cross-sectional comparison and 1975 to 2001 panel data between estimation show that FD negatively affects per capita GDP growth rates in 23 OECD economies, when the measure of fiscal autonomy is limited to own source tax revenues, which was defined as the share of

[13] I take hypothetically 'high' and 'low' threshold values of 0.5 and 0.1 of PIP to make the general picture more visible (variables with PIP higher than 0.5 are noted with black and those between 0.1 and 0.5 with red). Positive and negative signs reflect the sign of the expected posterior coefficient, whereas an empty cell means that the PIP of the given variable is less than the low threshold value of 0.1.

tax revenues over which sub-national governments' posses the authority to set the tax rate and/or the tax base.

RAut2 is a weaker measure of revenue autonomy, while, in addition to RAut1, it also includes tax revenues that are shared between the central and lower level of governments. The empirical evidence here is not straightforward; while cross-country data showed a significantly positive relation, panel data analysis illustrates negative, but modest significance (it has the highest PIP in three-year averages between estimation, 0.27). It is most likely that the cross-country estimation with just 19 observations is not very reliable, because of its contradicting outcome on significantly positive RAut1 versus significantly negative RAut2; the latter two should not vary so much[14]. Given this inconsistency of the cross-country estimation, the results of panel data analysis (RAut2 has insignificantly negative effects) at least do not reject my central finding that RAut1 negatively affects growth.

The squared value of RAut1 partially confirms the hypothesis of non-linear relation between FD and growth. RAut1 squared has the higher PIPs in the three-year averages time fixed effects (0.39) and pooled-OLS (0.42) models. The absolute significance is of course weak, but it is 3rd and 4th growth determinant by order of PIP accordingly, implying a higher 'relative' significance. While the evidence on its significance only partially supports the non-linearity hypothesis, expected posterior coefficient of the squared term is always negative (with the exception of 3-year CFE, which, however, is highly unlikely to be included, PIP=0.07). Combining the two mentioned facts (RAut1 squared is more significant in within estimation and has negative coefficient) implies interesting results: FD is particularly harmful for countries planning big shifts of fiscal autonomy towards lower levels of authority, e.g. large scale federalism reforms generate negative economic shocks.

6. Conclusion

In this paper I have examined the empirical relationship between FD and economic growth in a Bayesian framework. While theoreticians identify several channels through which FD can have significantly both positive and negative impacts on economic performance, empirical studies do not grant a clear-cut evidence whether there is such a relation and whether the gross effect is good or bad for enhancing growth. I have identified two major limitations of the previous studies that possibly lead to such inconclusiveness. Whereas the first limitation, namely issues concerning quantifying FD, is widely recognized, my second concern, the robustness of estimates, is not properly addressed in the decentralization literature.

The relative absence of guidance from economic theory on channels through which FD should affect growth left most researchers to choose their explanatory variables on an arbitrary basis.

[14] A second option is that in the 1995-2001 cross-sectional data shared revenues between central and sub-central governments played a major role. However, a close examination of the data implies that this is a highly unlikely event.

Moreover, these studies do not sufficiently involve new results of the empirical growth theory (Breuss and Eller 2004). The vast amount of literature on the determinants of economic growth has identified over 60 or more variables to have explanatory power and has accordingly developed new methodological approaches to deal with them. Ironically, FD has never had its place among these determinants of economic growth. Furthermore, what is surprising is that the empirical FD, by definition closely being linked to growth empiricism, did not follow these newest trends.

Therefore, I have first adopted a new panel dataset for 23 OECD countries from 1975 to 2001, with seventeen hypothetical determinants of economic growth and, in addition to the traditional expenditure and revenue GFS variables of FD, also measures of sub-national governments' real fiscal autonomy, defined as the share of tax revenues over which local governments posses the authority to set the tax rate and the tax base. Then, I have applied this innovative methodology, Bayesian Model Averaging, to tackle the common problem of the arbitrary choice of determinants of growth and associated errors of conditioning on 'blindly' specified models leading to non-robust estimates.

Overall, my analysis shows, that in the selected 23 OECD countries in the course from 1975 to 2001, FD seems to be negatively affecting economic growth and this detrimental impact becomes most prominent when analyzing FD's long –term effects on growth. Both measures of revenue autonomy, RAut1 and RAut2, appear to support this hypothesis. The interpretation of the non-linear nature of decentralization – growth relation is less clear. My results show that FD negatively impacts growth and this decline in growth is marginally increasing as OECD countries intensify the process of FD. Some care should be taken when comparing the results of this project to the empirical evidence reviewed in section 3.2; it is not straightforward to say that my findings are opposite to the more common view of a positive decentralization-growth correlation. It may well be the case of comparing apples and oranges. First, among the reviewed empirical analysis, Thiessen (2003) was the main paper to test for a non-linear relationship and he found that the decentralization-growth function is 'hump-shaped'. Secondly, the GFS data allows distinguishing between OECD and non-OECD countries and it turns out that the average expenditure decentralization measure is almost twice higher for OECD countries than the rest (non-OECD data is not reported here). The two latter arguments imply that it is highly probable that my analysis only reflects data from the right-hand of the inverse U-shaped function, i.e. the declining part. If this is the case, then future research should concentrate on proving the existence of this moderate growth maximizing level of FD.

Finally, the theoretical implication of my results is that the potential economic benefits from shifting fiscal authority towards sub-national governments are counterbalanced by the possible economic pitfalls of FD in terms of economic growth. Thus, the possibility of enhancing the efficiency of public good provision by better preference matching, increased competition among governments and higher government accountability may simply be wishful thinking. Instead, it seems that sub-national governments' scarce resources to better address local preferences ('decentralization theorem'), its insufficient capacities to lever the argument of economies of scale, and its comparative lack of power and authority to overcome issues concerning lower quality of governance are likely to counterweight the pro-decentralization phenomena.

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Appendix 1: Summary of the review of main empirical literature on fiscal decentralization - economic growth relationship.

Study	Countries	Period	Method	DCT. Measure	Control Variables	Main Results
Davoodi and Zou (1998)	46 Developing and Developed Countries	1970-1989 five and ten year averages	Country and time fixed effects	GFS expenditure decentralization	Average tax rate Investment/GDP Population growth Initial Human Capital Initial GDP	Negative, but weak (10% significance) effect in developing countries and none in developed world.
Thornton (2007)	19 OECD countries	1980-2000 Cross-country averages	OLS	FD classified by Revenue Autonomy (OECD 1999)	Primary school enrollment rate	Statistically insignificant effect when the FD measure is limited to tax revenues over which SCG have full autonomy i.e. can set the tax rate and the tax base.
Baskaran and Feld (2009)	23 OECD countries	1975-2001 Annual panel and cross-country averages	FE & RE, Hsiao (2003) method for low within variation	FD classified by Rev. Autonomy for a panel data OECD (1999) Stegarescu (2005)	Lag GDP per worker Country openness Inflation Dummy for Federal vs. Unitary states	Negative but non-robust relation. Similar to Thornton (2007), but with longitudinal measure of revenue autonomy.
Thiessen (2003)	21 high income OECD Countries	1973-1998 Cross-country averages	OLS	GFS expenditure and revenue decentralization, their unweighted average	Quadratic of the expenditure decentralization	Significant nonlinear effect: positive when FD is increasing from low levels, but then reaches a peak and turns negative.

Study	Countries	Period	Method	DCT. Measure	Control Variables	Main Results
Rodriguez-Pose and Ezcurra	21 OECD Countries	1990-2005 five year averages	OLS	GFS expenditure and revenue dct, Political and administrative decentralization	Public sector size	Significantly negative impact of FD, robust to different specifications. Political and administrative decentralization show mixed effects.
Enikolopov and Zhuravskaya (2003)	21 Developed and 70 Developing Countries	1975-2000 Cross-country averages	OLS, IV	GFS expenditure and revenue decentralization	Institutional aspects, e.g. strength of party systems, administrative subordination of SCG	Significantly positive effect for developing countries only, institutions matter: strength of political parties improves outcomes of FD, whereas administrative subordination has a contrary influence.
Woller and Philipps	23 Developing Countries	1974-1991 Annual, three and five year averages	FE, OLS	GFS expenditure and revenue decentralization	Time trend	No robust significant effect.
Yilmaz (2000)	46 Newly Industrialized and Developed Countries	1971-1990 annual data	Country and time fixed effects, GLS	GFS expenditure decentralization	Dummy for Federal vs. Unitary states	FD at the local level increases growth in unitary states (17) more than in federations (13). FD at the regional level is not significant.
Iimi (2005)	51 developed and developing countries	Annual panel of 1997–2001	OLS, IV	GFS expenditure decentralization	Degree of political rights	Significantly positive impact.

Source: Own assortment. First row includes the basic control variables, afterwards only additional regressors are reported.

Appendix 2: Summary statistics of used variables.

	Abbreviation	Observ.	Mean	St. Dev.	Min	Max	Source
Fiscal Decentralization Variables							
Revenue Autonomy of first degree	RAut1	607	0,189	0,166	0	0,615	Stegarescu (2005)
Revenue Autonomy of second degree	RAut2	438	0,247	0,156	0,041	0,647	Stegarescu (2005), OECD Rev Stat.[15]
Economic Control Variables							
GDP per capita growth (annual %)	GDPgrowth	621	2,12	2,34	-7,91	10,38	WDI
Initial GDP per capita (constant 2000 US$)	InitialGDP	23	14456	4720	5277	25950	WDI
Population growth (annual %)	Pop_growth	621	0,57	0,5	-0,93	3,8	WDI
Fertility rate, total (births per woman)	Fertility	612	1,74	0,33	1,15	3,4	WDI
Life expectancy at birth, total (years)	LifeEXP	561	75,97	2	69,31	81,42	WDI
School enrollment, secondary (% gross)	School2_enroll	212	99,89	19,89	42,15	161,7	WDI, National Stat. Service
Inflation, consumer prices (annual %)	Inflation	604	7,09	8,07	13,85	84,22	WDI
Foreign direct investment, net inflows (% of GDP)	FDI.GDP	581	1,98	5,28	-0,86	92,67	WDI
Gross capital formation (% of GDP)	Capital.GDP	616	22,82	5,03	-3,67	65,01	WDI
Labor participation rate(% of total pop. ages 15+)	Labor_part	506	60,11	7,26	46,9	80,6	WDI
Merchandise trade (% of GDP)	Openness	597	50,38	25,4	13,22	159,3	WDI, World Penn Tables
Lending interest rate (%)	Lending_interest	545	11,65	5,95	1,97	45,95	WDI, National Stat. Service

Source: Own calculations.

[15] Stegarescu (2005) does not report RAut2 for Greece and Japan, therefore I calculate them from OECD's Revenue Statistics based on the tax revenue categorization of OECD (1999), assuming there have been no significant structural changes over time.