Decentralization and Economic Growth in Europe: For Whom the Bell Tolls?

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Abstract

We aim to analyze the effects of fiscal decentralization on economic growth. We develop a theoretical framework, building on the relationships between government size and growth and between decentralization and government size. We empirically test our framework on a panel of 25 European countries observed from 1995 to 2015. Our econometric results show that the relationship between expenditure decentralization and growth is bell-shaped. We also focus on expenditure composition. In this respect, the relationship between investment decentralization and growth is an inverted bell-shaped curve: there is a critical mass of decentralized investments beyond which it is possible to enhance growth.

Keywords: Decentralization, Capital Expenditure, Economic Growth
JEL Codes: D11, H41, O40.

1 Introduction

The recent economic crisis has represented a huge challenge for the institutional structure of the EU countries, both at the European and at the national level.

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At the national level, the need to respect the financial measures "dictated by Europe" is leading many countries to substantially rethink to the financial relationships between levels of government (State and sub-central entities) concerning the division of tax and expenditure competencies. Specifically, all around Europe, there was a substantial re-centralization of decision-making on public resources (see Ahmad, Bordignon and Brosio, 2016). In the current context, the debate on whether to grant a greater or lower autonomy to sub-central entities is far from being solved. There is, on one hand, the need to protect some primary objectives, such as control of public finances, macro-economic stability and the rebalancing of unequal levels of development within a same country. And it is traditionally believed that these objectives are best pursued at a more centralized level of government. On the other hand, it is necessary to find new ways to make the territories more competitive and return to growth. In this respect, recently, in the literature on fiscal federalism, a new field of research, both theoretical and empirical, shows that decentralization could promote growth.

This paper aims to contribute to this literature in several important ways. First, we develop a theoretical framework that explains the relationship between expenditure decentralization and growth, building on the relationship between government size and growth (Barro-Armey curve) and on the relationship between decentralization and government size (Brennan and Buchanan hypothesis). Second, we empirically test these relationships on a panel of 25 European countries observed from 1995 to 2015. Third, we also focus on expenditure composition by considering the level of sub-national investments in Europe. Decentralization of public investments has received a very limited academic attention, despite the fact that public investments (both at the local and at the national level) may have in the long run effects on growth and regional disparities. Moreover, in the current political debate in Europe, it is not fully addressed the problem of the governance in the provision of public investments.[1] In this respect, information and knowledge provided by this paper could help to shed light on this issue.

Our results support the existence of a link between expenditure decentralization and growth in Europe. This relationship is bell-shaped, and we find an optimal degree of expenditure decentralization that maximizes growth, beyond which higher decentralization could reduce growth. When gross fixed investments are decentralized, we obtain an inverted bell-shaped meaning that there is a critical mass of decentralized investments, that has to be achieved in order to promote growth.

The paper is organized as follows. In Section 2 the theoretical framework is developed starting with a review of the three branches of literature we consider (namely government size and growth, decentralization and government size, and finally decentralization and growth). In Section 3, we test the model through a comparative econometric analysis carried out for 25 European countries. In Section 4 we analyze and test the effects of gross fixed investments on government size and growth. Section 5 concludes.

[1] See Cerniglia and Longaretti (2016).

2 Theoretical framework

In the following we contribute to the literature, that explains the relationship between decentralization and growth, building on a three-step rationale: *(i)* if government size affects non-monotonically growth (Section 2.1) and *(ii)* if decentralization affects government size (Section 2.2), then *(iii)* decentralization may affect non-monotonically growth (Section 2.3). To the best of our knowledge, this is the first paper that tries to establish the link between decentralization and growth through these two underlying channels.

2.1 How the government size may affect growth

Endogenous growth literature theoretically modelled and empirically verified the existence of a possible non-linear relationship between government spending and growth. Barro (1990) first plotted an inverted U-shaped curve showing the relationship between the growth rate and the ratio of government expenditure over GDP (government size hereafter). In fact he pointed out that different sizes of government have two effects on the growth rate. On one hand, higher expenditure implies higher taxes and an increase in taxes reduces the growth rate through disincentive effects; on the other hand, an increase in government spending raises marginal productivity of capital, which raises the growth rate. The second force dominates when the government size is small, whereas the first force dominates when the government size is large. This implies the possibility of an optimal size of government that has been further investigated by Armey (1995). He argues that, if government does not exist (government size equal to zero), there is a state of anarchy and low levels of output per capita, because there is no protection of property rights. Consequently, there is little incentive to save and invest and the growth rate is low. With a mix of private and public decisions on the allocation of resources, output should be larger. The growth enhancing features of government should dominate when government is very small, and expansions in governmental size should be associated with expansions in output. Nevertheless, as spending rises, the government finances less productive projects and the taxes and borrowing levied to finance government impose increasing tax burdens. At some point, the marginal benefits from increased government spending become zero. In other words, a non-monotonic relationship emerges as a result of excess burden of taxation as well as rent-seeking activities. A huge empirical literature confirms the validity of such parabolic hypothesis between public spending and output.[2] In particular in the literature, it is the so-called Barro-Armey curve, which is an inverted-U shaped curve according to which an efficient level of government size can be found. For instance, as reported by Facchini and Melki (2013), the efficient size of government can vary from around 17 percent to 43.5 percent of GDP. Focusing only on European countries, the percentage is around 40 percent (Forte and Magazzino, 2011)

[2] For a exhaustive survey on this theoretical and empirical literature see Bergh and Henrekson M. (2011).

Having recalled this literature, it is theoretically straightforward to assume an explicit second-order functional form of the relation between the per-capita rate of growth $\left(\frac{\Delta y}{y}\right)$ and the government size ($\left(\frac{G}{Y}\right)$, where G is total public expenditure and Y is aggregate GDP):

$$\frac{\Delta y}{y} = -a\left(\frac{G}{Y}\right)^2 + b\left(\frac{G}{Y}\right) + c \tag{1}$$

with the following restrictions[3] on parameters $0 < \frac{b}{2a} < 1$.

This equation is the first step of our theoretical framework and it is also the first relation that we will empirically test in Section 3.

2.2 How decentralization may affect the government size

In the literature the relationship between decentralization and government size is the well-known influential Leviathan hypothesis stated by Brennan and Buchanan (1980): "total government intrusions into the economy should be smaller, ceteris paribus, the greater the extent to which taxes and expenditures are decentralized". There has been an intense debate regarding this relationship and the state of research is seemingly contradictory, with some scholars asserting that decentralization decreases government size, and others denying this to be the case. Before presenting our algebraic formulation of this link, in the following lines we briefly recall the main arguments presented by this rich literature. The Leviathan hypothesis relies on the assumption that the government is a revenue-hungry beast. Since fiscal decentralization forces local governments to engage in tax competition to attract tax base and citizens, it puts a cap on the Leviathan's monopoly. Tax competition and citizens' mobility then bring government spending closer to the preferences of citizens and encourage more efficient production and supply of local public goods and services. In a nutshell, decentralization restrains the growth of the local governments and hence of the size of the public sector. This hypothesis has been the subject of several empirical analysis finding that fiscal decentralization has been linked to lower government spending (see Oates 1985). However, this literature, has given insufficient attention to the precise institutional design (and hence to the incentives created by different forms of decentralization). This topic has been investigated by other scholars in the political economy literature of fiscal federalism.[4] In this respect Prud'homme (1995) and Tanzi (1996) firstly recognized that poorly designed systems (for example, if subnational governments are allowed to borrow without controls with central government covering any defaults) lead to instability. And in these cases, fiscal decentralization could lead to less growth because there is some evidence that macroeconomic instability retards growth (Fischer, 1993). Furthermore, some researchers have suggested that corruption is more prevalent in federal systems because there is more opportunity and

[3] This restriction allows a positive maximum in the interval $\frac{G}{Y} \in (0,1)$, since obviously government size cannot be greater that 1 or lower than 0. See Appendix 1.

[4] For an exhaustive literature review see Lockwood (2006).

pressure by local interests. Local officials may have more discretion and fewer obstacles because of the often blurred distinction between politicians and bureaucrats. Especially in some developing countries there is a widespread belief (and empirical evidence) that corruption is deeply ingrained in local government institutions (see Shah 2006). Corrupt behavior on the part of local officials, of course, reduces the potential benefits of fiscal decentralization (Treisman, 1999 and 2000). Corrupt behavior would also reduce private incomes, as citizens must pay bribes to receive public services. Moreover, local officials (even if they are popularly elected) may be subservient to the needs of the local elites and lobbyism could increase (Bordignon et al. 2008). Obviously, if the preferences of the local elites differ significantly from those of the majority of voters, decentralization reduces local expenditure efficiency and eventually retards economic growth. Another issue recently investigated is how decentralization is funded. Specifically, in the literature on fiscal federalism there is a wide consensus that if expenditure decentralization is funded by "common pool resources" (such as grants and revenue-sharing) the positive (and efficient) link between local taxes and local benefits is weakened.[5] So, common pool resources give incentive to increase expenditure. For instance, Grossman (1989) emphasizes the role of intergovernmental grants, which encourage the expansion of the public sector, by concentrating taxing power in the national government and by weakening the fiscal discipline imposed on subnational governments for financing their own expenditures.

Finally, in a very influential paper, Rodden (2003) examines the effect of fiscal decentralization over time for a large group of countries. He explores the logic whereby decentralization should restrict government spending if subcentral entities have wide ranging authority to set the tax base and the rate; he finds that in countries where this is the case, decentralization is associated with smaller government. However, consistently with the theoretical arguments drawn from the positive political economy literature, he finds that public sector grows faster if local authorities are funded, for a greater portion of their spending, through intergovernmental transfers.

To conclude, indirect effects coming from decentralization design and expenditure funding affect the growth of the size of public sector. It is then plausible that, as the degree of expenditure decentralization increases, the negative effects of decentralization on government size prevails.

Therefore, this literature seems to suggest that decentralization places constraints on the size of the government up to a point. We can likely suppose therefore that the effects of decentralization on the size of government may be convex and non-monotonic. For theoretical purposes and algebraic simplicity, we can assume the following equation:

$$\left(\frac{G}{Y}\right) = d\left(\frac{G_{sn}}{G}\right)^2 - e\left(\frac{G_{sn}}{G}\right) + f \tag{2}$$

[5] There are many empirical papers finding that intergovernmental transfers increases local expenditure. For a survey see Oates (1993, 2005) and Ahmad and Searle (2006).

where $\left(\frac{G_{sn}}{G}\right)$ is our measure of expenditure decentralization, and G_{sn} is public expenditure decentralized at the sub-national level. Eq. (2) describes a convex relation between decentralization and government size. If $0 < \frac{e}{2d} < 1$ and $f > \frac{e^2}{4d}$, eq. (2) describes a non-monotonic function:[6] for low levels of decentralization, the aggregate government size diminishes, whereas, as decentralization increases, the positive effects on the size of government overcome the negative ones and the relationship between decentralization and the size of government becomes positive. Instead, if $\frac{e}{2d} > 1$, eq. (2) describes a convex decreasing relation between decentralization and government size.[7]

This equation is the second step of our theoretical framework and it is also the second relation that we will empirically test in section 3.

2.3 The resulting link between decentralization and growth

The literature briefly recalled in sections 2.1 and 2.2 is the reference background to develop our analysis regarding the relationship between decentralization and growth. This is a new field of research in the literature on fiscal federalism, recently surveyed by Martinez-Vazquez, Lago-Penas and Sacchi (2015). In the following lines, we summarize the theoretical back-stones of this literature and the empirical achievements as well as the unsolved theoretical and empirical issues.

First of all, theoretically these studies build on the results of static efficiency, shown in the literature on fiscal federalism, and try to consider its effects dynamically in terms of economic growth. In particular, these studies note that the effects of increased efficiency related to the local provision of certain types of expenditure (i.e. local public goods) could lead in the long run also to greater economic growth.

As surveyed in Cerniglia and Longaretti (2013b), the potential link between fiscal federalism and growth has been theoretically analyzed in the literature considering three potential mechanisms: 1) federalism can affect the savings rate; 2) federalism can generate technological progress; 3) federalism can generate increasing returns to scale.

The path-breaking study that considers the first mechanism is Brueckner (2006) in which the public good is financed by a uniform lump-sum tax and individuals have heterogeneous preferences about the public good. In a federal system individuals are sorted in two jurisdictions according to their preferences ("they vote with their feet"). In equilibrium it turns out that citizens of one jurisdiction pay a lower per-capita fee for funding the public good. This increases their incentive to save and this in turn promotes economic growth. Another

[6] In fact this restriction on parameters implies a positive minimum in the interval $\frac{G_{sn}}{G} \in (0,1)$. Notice in fact that the decentralization index cannot be greater that 1 or lower than 0. See Appendix 2 for a detailed algebraic and graphical analysis of this restriction on parameters.

[7] In this case, in fact, the function described by eq. (2) is monotonically decreasing in the interval $\frac{G_{sn}}{G} \in (0,1)$. See Appendix 1. In Section 2.3, we show the possible implications of these restrictions on parameters.

proposed mechanism that explains the link between federalism and the savings rate is tax competition. Under the assumption of perfect capital mobility between regions, tax competition on the tax base lowers the tax burden. And then it increases savings, capital accumulation, and growth (see Lejour and Verbon, 1997; Hatfield, 2015; Koethenbuerger - Lockwood, 2010; and Chu and Yang, 2012).

The second mechanism considers the fact that fiscal federalism brings technological progress. In fact technological progress can be also declined as a result of greater public sector efficiency that is achieved with decentralization. But also, it can be interpreted as a result of the attempts of the entrepreneurial "animal spirits" looking for new and more efficient technologies (Justman et al., 2002), that enhances efficiency of the private sector. In this perspective, the decentralization of certain powers to local governments can also have a greater impact on the agglomeration of economic activities and on the speed and the quality of accumulated capital. Hence, fiscal competition among local governments can encourage these effects of agglomeration and each different region can attract different types of private capital.[8] In conclusion, it is possible to say that this second theoretical explanation of the link between decentralization and growth has a sort of correspondence with the concept of "laboratory federalism", coined by Oates (1972). The idea is that politically decentralized countries may benefit from better policies than centralized countries, thanks to a greater efficiency in identifying the best policies. Multiple small scale experimentation may foster the identification and the implementation of the best policies in a region, generating an informational externality which allows the other regions to learn about the quality and/or adequacy of this policy.

The third mechanism deals with the possibility that increasing returns are generated by decentralizing the provision of local public goods. This possibility is modelled in Cerniglia and Longaretti (2013a) where the public good is "education-related". Education is indeed a competence of local governments in many federal and unitary countries, as documented in Sacchi and Salotti (2016). In Cerniglia and Longaretti (2013a), the local government provides a uniform level of the public good among all citizens of the territory. Education-related local public goods should be differentiated across regions on the basis of socioeconomic characteristics of territories and natural vocation of development. The authors show how this may generate increasing returns to scale. Their results show that, in a federal system, intra-jurisdictional heterogeneity may be a factor that stimulates the catching-up between regions and therefore a poor region, but with a very uneven distribution of income, can exhibit a higher growth rate compared to a richer but less heterogeneous region.

Recapping, these models offer three operating mechanisms that explain the positive link between decentralization and growth. However none of these mechanisms has been singularly empirically tested.

As a matter of fact, the wide empirical literature is inconclusive. As pointed

[8] Some local policies could produce catching-up phenomena in growth rates between the poorer regions and the richer ones (Brackman et al., 2002).

out by Martinez-Vazquez, Lago-Penas and Sacchi (2015), results are influenced by the variables used to measure the degree of decentralization; by the dataset and by the level of spatial aggregation; and finally, as already said, there is a lack of unambiguous hypotheses to be empirically tested.

The results of cross-countries studies, on the one hand, (for example Davoodi and Zou, 1998) find no significant evidence of the relationship between decentralization and growth in developed economies, while the link is negative, although not significant, for developing economies. On the other hand, other papers (Thiessen 2003) showed a significant positive relationship in the rich economies. Studies applied to single countries get more tangible results in favour of a positive relationship between decentralization and growth in emerging economies, such as China (Lin and Liu, 2000; Qiao, Martinez-Vazquez and Yu, 2002; Qian and Weingast, 2005; Feldenstein Iwata, 2005) and Russia (Desai, Freinkman and Goldberg, 2003). The evidence for developed economies (USA, Germany and Switzerland) is more ambiguous. For example, Xie, Zou and Davoodi (1999) find no statistically significant relationship between spending decentralization and growth for the USA in the period 1951-1992, while Stansel (2005) find a positive relationship for the USA in the period 1959-1989.

Summarizing, there is not an unanimous consensus about the sign of the effect of decentralization on growth.

We go one step further in this literature. Our attempt is to develop a framework that can be empirically tested. Based on what we have studied in the previous two sections (namely the link between government size and growth and the link between decentralization and government size), substituting eq. (2) into eq. (1), it is theoretically possible to derive a relationship between expenditure decentralization and growth.

We get:

$$\frac{\Delta y}{y} = -a\left(d\left(\frac{G_{sn}}{G}\right)^2 + e\left(\frac{G_{sn}}{G}\right) + f\right)^2 + b\left(d\left(\frac{G_{sn}}{G}\right)^2 + e\left(\frac{G_{sn}}{G}\right) + f\right) + c \tag{3}$$

Equation (3) is a 4-th order relation between expenditure decentralization and growth. Panel (d) of Figure 1 depicts eq. (3). This is graphically obtained as the result of panel (a), that sketches eq. (1) and of panel (c), that sketches eq. (2).

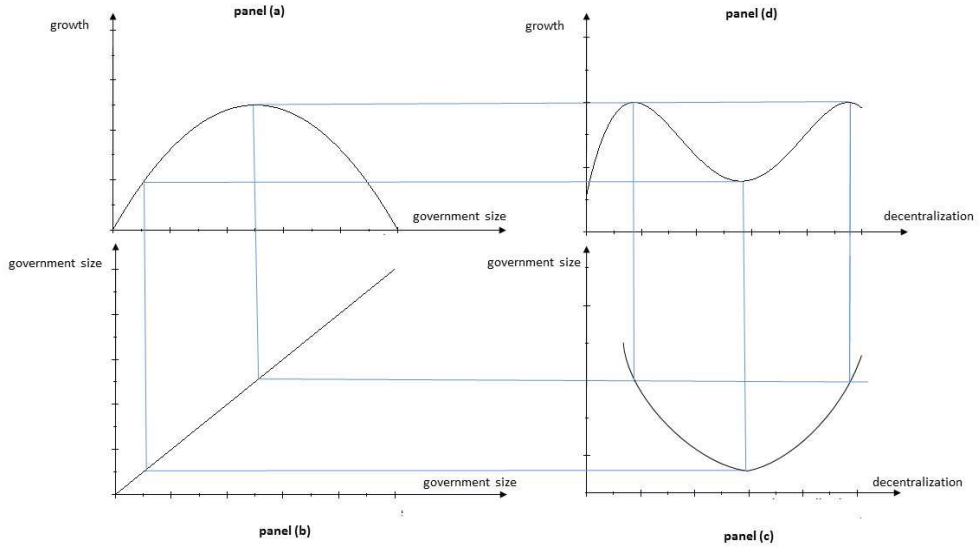

Figure 1: 4-th order relation between decentralization and growth

Equation (3) is our theoretical contribution on the relationship between expenditure decentralization and growth. Differently from previous theoretical models, this equation allows us to consider different scenarios that were only suggested by previous studies. In Figure 1, the relationship between expenditure decentralization and growth (eq. (3)) is depicted in panel (d). This relationship strongly depends on the shape of the relationship between decentralization and government size (panel (c)). Following a detailed algebraic explanations given in Appendix 1, we show that the shape of this latter relation may be decreasing or non-monotonic. The former case gives rise to a non-monotonic concave relation (a bell) between decentralization and growth (scenario 1, Figure 2, panel (d)), whereas the latter case gives rise to a non monotonic convex relation (inverted bell) between decentralization and growth (scenario 2, Figure 3, panel (d)),

To be more specific:[9]

- Scenario 1: $\frac{e-\sqrt{e^2-4\left(f-\frac{b}{2a}\right)d}}{2d} > 0$ and $\frac{e}{2d} > 1$ and $\frac{e^2}{4d} < f$

In this case the relationship between decentralization and government size is decreasing and convex (as depicted in bold in panel (c) in Figure 2) and the resulting relation between decentralization and growth described by eq. (3) is non-monotonic and concave (the bell), as depicted in bold in panel (d) of Figure 2.

[9] See Appendix 1 for a detailed algebraic and graphical analysis of the rstriction on parameters, that give rise to the two scenarios.

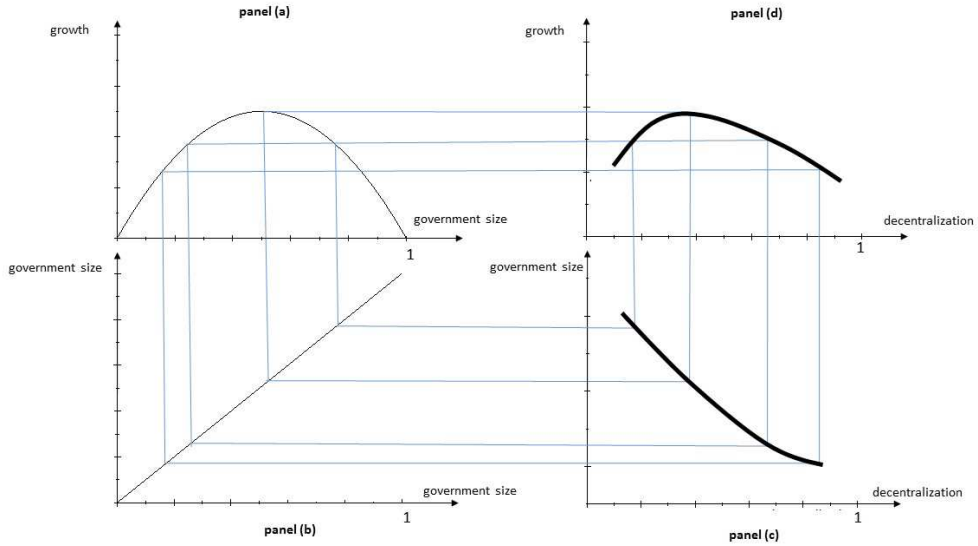

Figure 2: 2-nd order, non-monotonic and convex relation between decentralization and growth, resulting from a monotonically decreasing and convex relation between decentralization and government size (Scenario 1)

- Scenario 2: $\frac{e-\sqrt{e^2-4\left(f-\frac{b}{2a}\right)d}}{2d} < 0$ and $\frac{e+\sqrt{e^2-4\left(f-\frac{b}{2a}\right)d}}{2d} > 1$ and $0 < \frac{e}{2d} < 1$ and $\frac{e^2}{4d} < f$

In this case the relationship between decentralization and government size is non-monotonic and convex (as depicted in bold in panel (c) in Figure 3) and the resulting relation between decentralization and growth described by eq. (3) is non-monotonic and convex (the inverted bell), as depicted in bold in panel (d) of Figure 3.

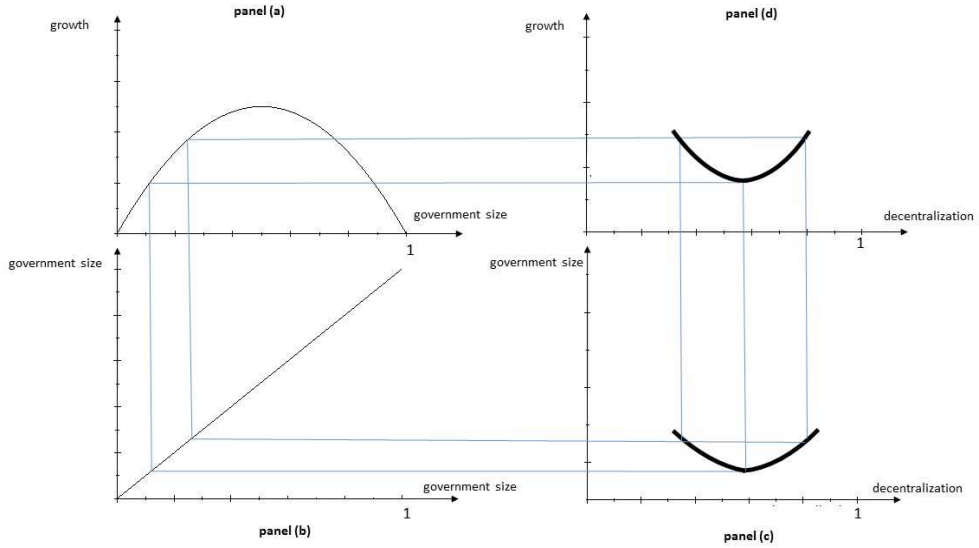

Figure 3: 2-nd order, non-monotonic and concave relation between decentralization and growth, resulting from a non-monotonic and convex relation between decentralization and government size (Scenario 2)

Summing-up, algebra and the theoretical underpinnings allowed us to depict the relationship between decentralization and growth as a bell or an inverted bell. For which category of decentralized expenditure does the bell toll? This is the aim of the next section.

3 Decentralization, Government Size, and Economic Growth in EU countries

In this section, we transpose on the empirical ground eqs. (1), (2) and (3). We use an unbalanced panel data on 25 European countries for the 1995-2015 period.[10] We proceed in this way: we first verify whether eq. (1) (Barro-Armey curve) is empirically supported by the data. Consistently with the literature, our results go in this direction. Secondly, we estimate whether and to what extent expenditure decentralization affects the government size, i.e. eq. (2) (Brennan and Buchanan hypothesis). Finally, we verify the existence of a bell-shaped

[10] The countries considered are the following: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom, Latvia, Lithuania. Switzerland is included even if it does not belong to the European Union, while we excluded Croatia, Romania, Malta and Cyprus because of the too many gaps in the data.

curve (or inverted bell-shaped curve) between expenditure decentralization and GDP growth, and between investment decentralization and GDP growth.

Section 3.1 describes data; Section 3.2 presents the empirical strategy to test the three relationships, while Section 3.3 presents the main results.

3.1 Data

The empirical analysis relies on different data sets on European Union countries covering a period between 1995 and 2015. Table A1 in Appendix 2 sets out the list of variables used in our analysis with their sources. The per capita GDP growth rate is obtained by the difference between natural log of real GDP in t and $t-1$. Data on per capita real GDP, denoted by y, and expressed in euros at constant 2010 prices, are from the International Monetary Found (IMF).

As mentioned in Section 2.1, government size, denoted by $\frac{G}{Y}$, is the ratio of government primary expenditure over GDP, while decentralization is measured by sub-national government expenditure on total general government expenditure $\left(\frac{G_{sn}}{G}\right)$. Both variables are from the OECD Fiscal Decentralization Database.

We also consider selected variables to control for heterogeneity in the three equations we focus on. In investigating the empirical pattern of the Barro-Armey curve (eq. (*1*)), we add: *(i)* the degree of economic openness of a country measured by the sum of export and import on the GDP, and denoted by $\frac{O}{Y}$ (in logs; source: IMF, 2016), as in Facchini and Melki (2013); *(ii)* the unemployment rate, u (in logs; source: IMF, 2016), supposed to control for economic cycles (Vedder and Gallaway, 1998); *(iii)* the ratio of taxes on GDP, $\frac{T}{Y}$ (in logs; source: OECD database), which allows to assess the effect on the growth rate of a change in primary expenditure holding taxes constant, as in Facchini and Melki (2013); *(iv)* population, P (in logs; source: Eurostat). In the relationship between decentralization and government size (eq. (*2*)), we also include, as control variables: *(i)* the GDP per-capita growth rate, g; *(ii)* the current GDP lagged one year; *(iii)* population; *(iv)* economic openness. In the relationship between decentralization and growth (eq. (*3*)), we also add: *(i)* economic openness; *(ii)* government size (both in logs); and *(iii)* the years of school expectancy of students, S (in logs; source: Eurostat) as a measure of the human capital accumulation. Table 1 shows summary statistics of variables by decomposing the standard deviation into between and within component, reflecting the variation across countries and over time. Most of the variation in all variables is due to cross-sectional differences, being the variation in time much smaller. This further justify the choice of using panel data for controlling unobservable time-invariant heterogeneity across countries. We have a preference for the fixed model since it admits that country specific effects may be correlated to covariates. As we will see in Section 3.2, the choice of a fixed effect specification for the three relationship is supported by the results of the Hausman test.

Variable		Mean	Std. Dev.	Min	Max	Observations
y	overall	$27,328$	$17,048$	$3,814$	$83,714$	$N = 523$
	between		$17,762$	$7,429$	$76,747$	$n = 25$
	within		$2,980$	$13,813$	$34,971$	$T = 20.92$
$\frac{G}{Y}$	overall	0.4291	0.0605	0.2893	0.6268	$N = 524$
	between		0.0517	0.3242	0.5172	$n = 25$
	within		0.0333	0.3466	0.6980	$T = 20.96$
$\frac{G_{sn}}{G}$	overall	0.3034	0.1336	0.0485	0.6290	$N = 432$
	between		0.1302	0.0672	0.5917	$n = 22$
	within		0.0363	0.1362	0.4685	$T = 19.63$
$\frac{O}{Y}$	overall	0.9790	0.5547	0.3213	3.914	$N = 548$
	between		0.5153	0.4833	2.9172	$n = 25$
	within		0.2267	0.1377	1.9757	$T = 21.92$
u	overall	.0857	0.0451	0	0.2747	$N = 550$
	between		0.0343	.0336	0.1708	$n = 25$
	within		0.0300	$-.0058$	0.2263	$T = 22$
$\frac{T}{Y}$	overall	0.3686	0.0560	0.2490	0.5088	$N = 478$
	between		0.0549	0.2651	0.4658	$n = 23$
	within		0.0151	0.3203	0.4429	$T = 20.78$
S	overall	17.42	1.409	13.8	20.55	$N = 441$
	between		1.165	14.22	19.78	$n = 25$
	within		0.8359	14.17	19.79	$T = 17.64$
P	overall	$1.89e+07$	$2.31e+07$	$400,200$	$8.25e+07$	$N = 550$
	between		$2.35e+07$	$467,084$	$8.20e+07$	$n = 25$
	within		$946,076$	$1.51e+07$	$2.32e+07$	$T = 22$
g	overall	0.0212	0.0341	-0.1573	0.1229	$N = 518$
	between		0.0141	0.0026	0.0525	$n = 25$
	within		0.0312	-0.1806	0.0996	$T = 20.72$
FI_{sn}	overall	0.4840	0.1629	0.1225	0.9635	$N = 522$
	between		0.1499	0.1913	0.8568	$n = 25$
	within		0.0702	0.0223	0.8502	$T = 20.88$
FI	overall	0.0364	0.0103	0.0060	0.0730	$N = 522$
	between		0.0076	0.0222	0.0524	$n = 25$
	within		0.0071	0.0042	0.0652	$T = 20.88$

N is number of observations; n the number of countries; T the number of years.

Table 1: descriptive statistics

3.2 Econometric specification

Following the three-step procedure of the theoretical framework (eqs. (1), (2), (3)), we now describe the econometric specification that enable us to test the validity of our theoretical approach.

As for the Barro-Armey relationship, we estimate the following equation:

$$\begin{aligned}\ln y_{it} &= \alpha_0 + \alpha_1 \ln\left(\frac{G}{Y}\right)_{it} + \alpha_2 \ln\left(\frac{G}{Y}\right)^2_{it} + \alpha_3 \ln\left(\frac{O}{Y}\right)_{it} + \\ &+\alpha_4 \ln u_{it} + \alpha_5 \ln\left(\frac{T}{Y}\right)_{it} + \alpha_6 \ln P_{it} + \rho_i + \varepsilon_{it} \end{aligned} \tag{4}$$

where ρ_i represents a vector of country-specific effects; ε_{it} is the usual error term.

The per capita growth rate is calculated from estimation results of (4), as follows:

$$\begin{aligned}\widehat{\ln y_{it}} - \widehat{\ln y_{it-1}} &= \hat{\alpha}_1 \left(\ln\left(\frac{G}{Y}\right)_{it} - \ln\left(\frac{G}{Y}\right)_{it-1}\right) + \\ &+\hat{\alpha}_2 \left(\ln\left(\frac{G}{Y}\right)^2_{it} - \ln\left(\frac{G}{Y}\right)^2_{it-1}\right) \end{aligned} \tag{5}$$

Eq. (5) empirically captures eq. (1).

Next, transposing on the empirical ground eq. (2), the specification of the relationship between decentralization and government size is the following:

$$\begin{aligned}\left(\frac{G}{Y}\right)_{it} &= \beta_0 + \beta_1 \left(\frac{G_{sn}}{G}\right)_{it} + \beta_2 \left(\frac{G_{sn}}{G}\right)^2_{it} + \beta_3 \left(\frac{O}{Y}\right)_{it} + \\ &+\beta_4 P_{it} + \beta_5 y_{it-1} + \beta_6 g_{it} + \theta_i + \eta_{it} \end{aligned} \tag{6}$$

where θ_i represents a vector of country-specific effects; η_{it} is the usual error term.

Finally, we estimate the following equation:

$$\begin{aligned}\ln y_{it} &= \gamma_0 + \gamma_1 \ln\left(\frac{G_{sn}}{G}\right)_{it} + \gamma_2 \ln\left(\frac{G_{sn}}{G}\right)^2_{it} + \beta_3 \ln\left(\frac{G}{Y}\right)_{it} + \\ &+\beta_4 \ln S_{it} + \xi_i + \nu_{it} \end{aligned} \tag{7}$$

where ξ_i represents a vector of country-specific effects; ν_{it} is the usual error term.

The effect of decentralization of total expenditure on the per-capita growth rate is calculated from estimation results of eq.(7), as follows

$$\begin{aligned}\widehat{\ln y_{it}} - \widehat{\ln y_{it-1}} &= \hat{\alpha}_1 \left(\ln\left(\frac{G_{sn}}{G}\right)_{it} - \ln\left(\frac{G_{sn}}{G}\right)_{it-1}\right) + \\ &+\hat{\alpha}_2 \left(\ln\left(\frac{G^{sn}}{G}\right)^2_{it} - \ln\left(\frac{G^{sn}}{G}\right)^2_{it-1}\right). \end{aligned} \tag{8}$$

Eq. (8) empirically captures eq. (3).

We have tested the stationarity of macroeconomic variables, by implementing the unitary root test developed by Levin, Lin and Chu (2002).[11] For most of variables we can exclude the presence of a unit root in the series. We are not able to refuse the null hypothesis of presence of unit root only for unemployment and population (in logs). Hence, we take into account the presence of a deterministic component by considering for both variables the difference between variables' values and the average values calculated across countries. We denote by $d\_\ln u$ the difference between the rate of unemployment and its average calculated across countries in each period; by d_P the difference between population and its average, and by $d\_\ln P$ the difference between the log of population and its average.

Moreover, we have tested Granger causality between per capita growth rate and the ratio of government primary expenditure over GDP. By applying the Pairwise Dumitrescu Hurlin Panel Causality Tests provided by E-views, we find evidence of Granger causality from $\ln\left(\frac{G}{Y}\right)_{it}$ to $\ln y_{it}$. The null hypothesis "Government size does not Granger cause economic growth" is rejected with a p-value = 0.0159 (test with lags=2) and with a p-value = 0.0463 (test with lag=1). At the same time, we cannot reject the opposite, that is "growth does not Granger cause government size" in both cases.

3.3 Empirical results

As said above, the transposition on the empirical ground of our theoretical framework consists in eqs. (5), (6) and (8). We get these equations by firstly estimating eqs. (4), (6) and (7). Table 2 reports the estimation results, as well as the results of Hausman tests which lead us to run a fixed effects panel regression for these models. According the F-test results, all the coefficients in the models are different than zero and all the covariates are individually statistically significant.

[11] Stationarity tests results are available upon request.

Eq. (4) Dep. Var.:$\ln y$		Eq. (6) Dep.Var.: $\left(\frac{G}{Y}\right)$		Eq. (7) Dep. Var.: $\ln y$	
Variable	Coeff.	Variable	Coeff.	Variable	Coeff.
$\ln\left(\frac{G}{Y}\right)$	-0.7538*	$\frac{G_{sn}}{G}$	-0.0057**	$\frac{G_{sn}}{G}$	0.9125*
	(0.3094)		(0.0011)		(0.3732)
$\left(\ln\left(\frac{G}{Y}\right)\right)^2$	-0.4211*	$\left(\frac{G_{sn}}{G}\right)^2$	0.00005**	$\left(\frac{G_{sn}}{G}\right)^2$	-1.2435*
	(0.1850)		(0.000019)		(0.6201)
$\ln\left(\frac{O}{Y}\right)$	0.5433**	d_P	0.00001**	$\frac{G}{Y}$	-0.3076*
	(0.0163)		(0.0000001)		(0.1208)
$d\_\ln u$	-0.1157**	$\left(\frac{O}{Y}\right)$	0.0504**	$\frac{O}{Y}$	0.3447**
	(0.0132)		(0.0091)		(0.0299)
$d\_\ln P$	0.1468	g	-0.5895**	S	0.0488**
	(0.1155)		(0.0499)		(0.0063)
$\ln\left(\frac{T}{Y}\right)$	-0.8225**	y_{-1}	-4.0000**		
	(0.0795)		(-1.0000)		
$Intercept$	12.7911**	$Intercept$	0.5940**	$Intercept$	8.9094**
	(0.3209)		(0.0235)		(0.1171)
$F(6, 422)$	256.32	$F(6, 380)$	48.74	$F(5, 324)$	99.38
$\Pr ob > F$	0.0000	$\Pr ob > F$	0.0000		0.0000
Hausman test	30.01	Hausman test	42.01	Hausman test	13.81
$\Pr ob > chi2$	0.0000	$\Pr ob > chi2$	0.0000		0.0169
N. of obs.	451	N. of obs.	408	N. of obs.	354

Table 2: Econometric Results

By the estimation of equation (4), we get the Barrro-Armey curve (eq. (5)), that is plotted in Figure 4 panel (a). The estimation we obtain for European countries perfectly fulfills the Barro-Armey prediction[12] and also the first step of our theoretical framework (eq. (1) and panel (a) of Figure 1).

The estimated effect of decentralization on government size (the Brennan and Buchanan hypothesis) is given by eq. (6) and the shape of this estimated relationship is plotted in Figure 4 panel (c). Our empirical evidence shows a negative and convex effect of decentralization on government size in Europe confirming the theoretical predictions of Scenario 1. A one per cent increase in the sub-national expenditure on total government expenditure decreases on average the ratio of government primary expenditure over GDP of about 0.59 per cent.[13]

[12] According to our results, the government size that maximizes the growth rate of GDP per capita is given by $\exp(-\frac{\hat{\alpha}_1}{2\hat{\alpha}_2}) = 0.4832$.

[13] This is obtained the first derivative of eq. (6) with respect to $\frac{G_{sn}}{G}$ calculated at the overall average.

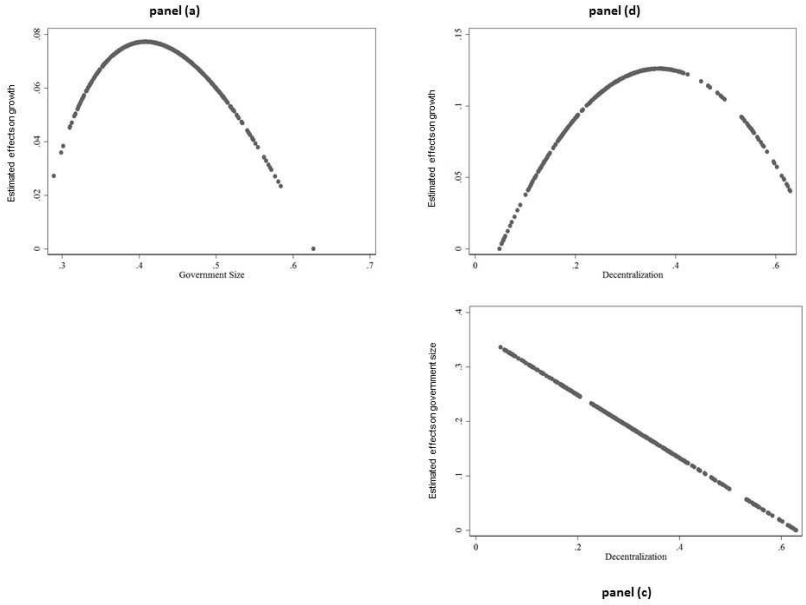

Figure 4: panel (a) Barro-Armey curve; panel (c) relationship between expenditure decentralization and government size; pane (d) relationship between expenditure decentralization and economic growth

We now turn to the main focus of the paper, that is the relationship between expenditure decentralization and growth. Panel (d) shows that the bell tolls in Europe. The theoretical underpinnings that allowed us to establish the relationship between expenditure decentralization and growth in Scenario 1 are all confirmed by the data. The bell shape implies that the link between expenditure decentralization and growth is neither only positive, nor only negative, differently from previous empirical studies, in which the link was either positive or negative. We find that an increase in the share of expenditure decentralization increases economic growth up to a point, and the share of decentralized expenditure maximizing economic growth is 0.3669.

4 Decentralization of gross fixed investments and growth

The vast majority of the empirical literature has been concentrated to consider decentralization of total general government expenditure. Very few exceptions are Sacchi and Salotti (2016), Cantarero and Lago-Penas (2012) and Habibi et al. (2003), that focus on health or education. None of these studies has explicitly considered the role of decentralized investments, despite the fact that it is one

of the driving forces of growth. In this section we focus on this sub-category of capital expenditure, namely gross fixed investments. Building on the same theoretical framework developed in Section 2, in the following we empirically test the relationship between decentralization and growth, considering only the degree of decentralization in gross fixed investments across countries and over time. The sample is the same as before.

Transposing on the empirical ground eq. (2), the specification of the relationship between investment decentralization and government size is the following:[14]

$$\ln\left(\frac{G}{Y}\right)_{it} = \delta_0 + \delta_1 \ln\left(\frac{FI_{sn}}{FI}\right)_{it} + \delta_2 \left(\ln\frac{FI_{sn}}{FI}\right)^2_{it} + \delta_3 \ln P_{it} + \delta_4 \ln\left(\frac{O}{Y}\right)_{it} + \pi_i + \varkappa_{it}, \tag{9}$$

Moreover we estimate the following equation:

$$\begin{aligned} \ln y_{it} \quad = \quad & \lambda_0 + \lambda_1 \ln\left(\frac{FI_{sn}}{FI}\right)_{it} + \lambda_2 \left(\ln\frac{FI_{sn}}{FI}\right)^2_{it} + \lambda_3 \left(\frac{FI}{Y}\right)_{it} + \\ & + \lambda_4 \ln\left(\frac{O}{Y}\right)_{it} + \lambda_5 \ln S_{it} + \psi_i + \varrho_{it} \end{aligned} \tag{10}$$

where $\frac{FI_{sn}}{FI}$ is the sub-national on total government gross fixed investment (in logs; source: OECD Fiscal Decentralization Database); $\frac{FI}{Y}$ is the total government gross fixed investment over GDP (source: OECD Fiscal Decentralization Database); π_i and ψ_i are vectors of country-specific effects; $\varkappa_{it}$ and ϱ_{it} are usual error terms.

The effects of decentralization of gross fixed investments on the per-capita growth rate is calculated from estimation results of eq.(10), as follows:

$$\begin{aligned} \widehat{\ln y_{it}} - \widehat{\ln y_{it-1}} \quad = \quad & \hat{\lambda}_1 \left(\ln\left(\frac{FI_{sn}}{FI}\right)_{it} - \ln\left(\frac{FI_{sn}}{FI}\right)_{it-1} \right) + \\ & + \hat{\lambda}_2 \left(\ln\left(\frac{FI_{sn}}{FI}\right)^2_{it} - \ln\left(\frac{FI_{sn}}{FI}\right)^2_{it-1} \right) \end{aligned} \tag{11}$$

We applied the same test used in Section 3.2 to verify variable stationarity and Granger causality between sub-national on total government gross fixed investment and economic growth. The results show strong evidence of Granger causality from sub-national gross fixed investment to growth (the p-value is close to 0.002-0.003 in all the tests with different lags).

Table 3 shows the results for eqs. (9) and (10). The estimated coefficients are all statistically significant and it comes out a non-monotonic relationship between decentralized gross fixed investments and both government size and economic growth .

[14] Notice that the Barro-Armey curve, both theoretically and empirically, still remains valid, since eq. (1) and eq. (5) do not consider any decentralization ratios.

Eq. (9) Dep. Var.: $\ln\frac{G}{Y}$		Eq. (10) Dep. Var.: $\ln y$	
Variable	Coeff.	Variable	Coeff.
$\ln\left(\frac{FI_{sn}}{FI}\right)$	0.1188*	$\ln\left(\frac{FI_{sn}}{FI}\right)$	0.1582*
	(0.0564)		(0.067372)
$\left(\ln\left(\frac{FI_{sn}}{FI}\right)\right)^2$	0.0577**	$\left(\ln\left(\frac{FI_{sn}}{FI}\right)\right)^2$	0.1118**
	(0.0257)		(0.036738)
$\ln P$	0.2910**	$\ln\frac{FI}{Y}$	0.2060**
	(0.0845)		(0.015453)
$\ln(\frac{O}{Y})$	-0.0741**	$\ln(\frac{O}{Y})$	0.1960**
	(0.0370)		(0.038046)
		$\ln(S)$	0.7201**
			(0.091847)
		$Intercept$	7.9046**
			(0.266634)
Time trend	yes	Time trend	yes
$F(6, 380)$	48.74	$F(22, 344)$	61.15
$\Pr ob > F$	0.0000	$\Pr ob > F$	0.0000
Hausman test	19.86	Hausman test	13.94
$\Pr ob > chi2$	0.0029	$\Pr ob > chi2$	0.0833
N. of obs.	522	N. of obs.	388

Table 3: Estimating decentralization of gross fixed investment

As before, we plot eq. (9) and eq. (11) in panel (c) and panel (d) of Figure 5. Notice that this is a mirror of Scenario 2 (Figure 3). As for the Brennan and Buchanan hypothesis (panel (c)), it does not work for a high degree of investment decentralization. After a turning point of decentralized investments, that we evaluate at 0.3571, the size of the public sector tends to increase as decentralized investments increase. However this result is not totally in contradiction with what we said in Section 2.2. In fact consistently with the political economy suggestions, since local investments are mainly funded by central transfers (or are co-funded by central and local governments), it may follows an "excessive" public investment and then a larger size of the public sector.

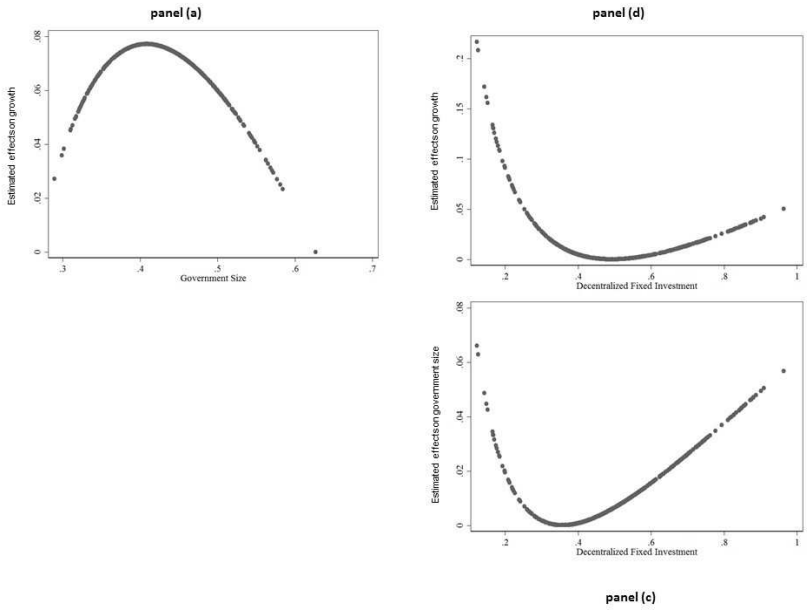

Figure 5: panel (a) Barro-Armey curve; panel (c) relationship between decentralization of investments and government size; pane (d) relationship between decentralization of investments and economic growth

The other interesting resulting relationship is the inverted bell-shaped curve that represents the link between decentralization of gross fixed investments and growth. This reveals that growth is boosted by investment decentralization only after a critical mass, that we estimate to be equal to 0.4928. Since most of sub-national governments are key actors in Europe in the provision of investment[15], our results support the importance of this decentralized category of expenditure to enhance and enforce growth.

5 Conclusions

The aim of this paper has been to develop a theoretical framework on the relationship between expenditure decentralization and growth, that could be empirically tested. To do that we have built on two established economic mechanisms, namely the Barro-Armey curve, and the Brennan and Buchanan hypothesis. These two branches of literature allowed us to build a coherent paradigm that has also been confirmed by the empirical investigation.

Our results have shown that in Europe a bell tolls for expenditure decentralization. Differently from previous studies expenditure decentralization and

[15] The share of sub-national investment is in most countries around 60% (see Kappeler and Valila 2008, and Kappeler at al. 2013)

growth do not go always in the same direction. After a turning point, an increase in expenditure decentralization may be detrimental for growth. On the other hand, an inverted bell tolls for investment decentralization, meaning that economies of scale are at work, and therefore, at the local level, a critical mass of investments is necessary to enforce growth.

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Appendix 1: Algebraic and graphical analysis of the restrictions on parameters that allow to different Scenarios

In order eq. (1) shows a positive maximum in the interval $\frac{G}{Y} \in (0,1)$, the following restrictions on parameters must old:

$$0 < \frac{b}{2a} < 1$$

and

$$\frac{b^2}{4a} > -c$$

this second condition is always satisfied for $a > 0$.

In order eq. (2) shows a positive maximum in the interval $\frac{G_{sn}}{G} \in (0,1)$, the following restrictions on parameters must old:

$$0 < \frac{e}{2d} < 1$$

and

$$\frac{e^2}{4d} < f$$

Passing to study the function described by eq. (3), it has two points of maximum: $A \equiv \left(\frac{e-\sqrt{e^2-4\left(f-\frac{b}{2a}\right)d}}{2d}, \frac{b^2}{4a} + c \right)$ and $B \equiv \left(\frac{e+\sqrt{e^2-4\left(f-\frac{b}{2a}\right)d}}{2d}, \frac{b^2}{4a} + c \right)$.

In order the function described by eq. (3) may be approximated by a 2nd-order function in the interval $\frac{G_{sn}}{G} \in (0,1)$, the following restrictions on parameters must hold:

- $\frac{e-\sqrt{e^2-4\left(f-\frac{b}{2a}\right)d}}{2d} > 0$ and $\frac{e}{2d} > 1$ and $\frac{e^2}{4d} < f$

In this case, that we label scenario 1, eq. (2) is monotonically decreasing and eq. (3) depicts a bell shaped (non-monotonic concave) curve in the interval $\frac{G_{sn}}{G} \in (0,1)$.

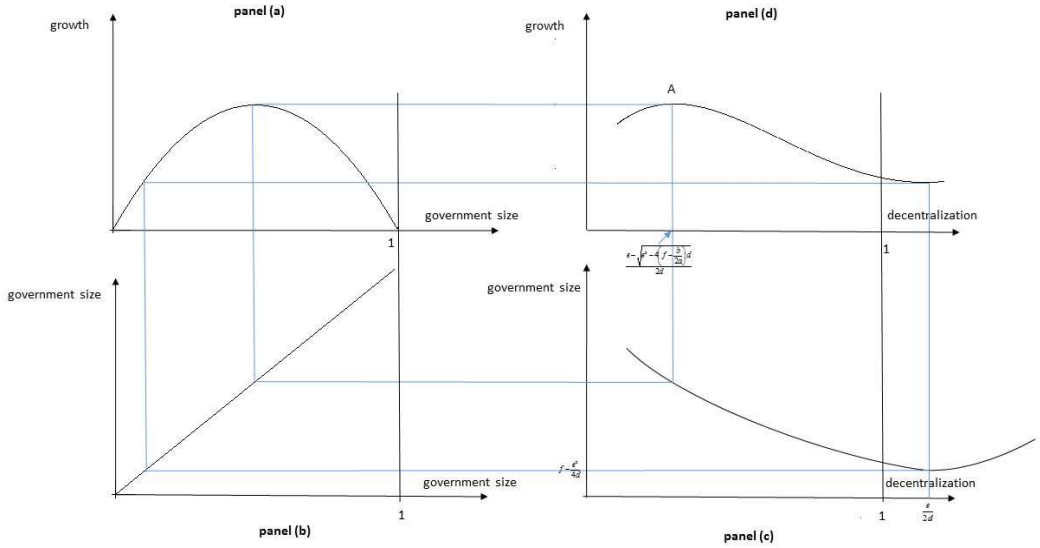

Figure A1: graphical analysis of the restrictions on parameters in order to have Scenario 1

- $\frac{e-\sqrt{e^2-4\left(f-\frac{b}{2a}\right)d}}{2d} < 0$ and $\frac{e+\sqrt{e^2-4\left(f-\frac{b}{2a}\right)d}}{2d} > 1$ and $0 < \frac{e}{2d} < 1$ and $\frac{e^2}{4d} < f$

In this case, that we label scenario 2, eq. (2) is non-monotonic and eq. (3) depicts an inverted-bell shaped (non-monotonic convex) curve in the interval $\frac{G_{sn}}{G} \in (0,1)$.

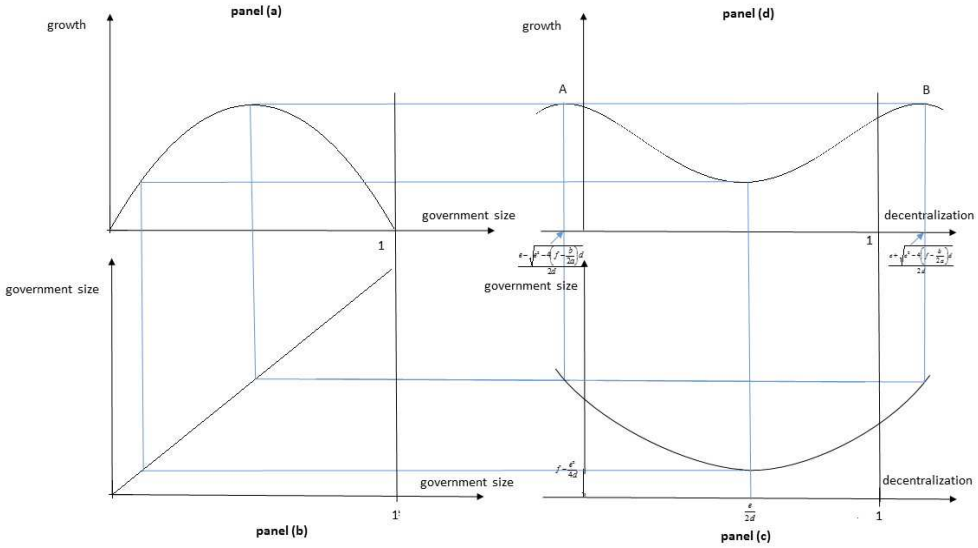

Figure A2: graphical analysis of the restrictions on parameters in order to have Scenario 2

Appendix 2

Variable	Definition	Source
y	Per capita real GDP (€ at constant 2010 prices)	IMF, 2016
$\frac{G}{Y}$	Ratio of government primary expenditure over GDP	OECD
$\frac{G_{sn}}{G}$	Ratio of sub-central expenditure on total government expenditure	OECD
$\frac{O}{Y}$	Sum of export and import on the GDP	IMF, 2016
$\frac{T}{Y}$	Ratio of taxes on GDP	OECD
u	Unemployment rate	IMF, 2016
g	GDP per capita growth rate	IMF, 2016
P	Population	Eurostat
S	Years of school expectancy of students	Eurostat
$\frac{FI_{sn}}{FI}$	Ratio of sub-central on total government gross fixed investment	OECD
$\frac{FI}{Y}$	Ratio of the total government gross fixed investment over GDP	OECD

Table A1: Description and sources of variables