OPTIMAL SIZE OF GOVERNMENT AND ECONOMIC GROWTH IN EU COUNTRIES

FRANCESCO FORTE - COSIMO MAGAZZINO

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ABSTRACT: Using time-series and panel data methodologies, the paper analyzes the existence and shape of the "BARS curve" (Barro, Armey, Rahn, and Scully) for EU countries in the period 1970-2009, connecting the size of Government (measured by the share of public expenditure on GDP) to the rate of economic growth. Individual countries research has been conducted for twelve EU countries for which enough data were available, while panel analysis has been performed both for EU-27 and for some sub-groups, distinguished by their different socio-economic and monetary structures, and per capita GDP. BARS curves were generally found, and the shares of actual public expenditures generally exceed substantially those related to the maximization of GDP growth. However, great differences emerge. For the 12 countries examined by time-series techniques, the difference between the actual level and the peak of the BARS curve ranges from 5.7 points for Germany and 18.1 points for Belgium. Similar situations were found in the panel analysis, with a smaller gap for the Anglo-Saxon countries in comparison to the Western Continental countries. For low per capita GDP countries the peak is higher than for the mature economies. Moreover, we found a long-run relationship between real GDP and public expenditure for six countries, while Granger-causality tests suggest different flows of direction for each country. So, further research may prove useful to shed light on the disparities emerging in the empirical analysis of individual countries, as well as within panel sub-groups.

SUMMARY: 1. Introduction; 2. Optimal size of Government and "BARS curve" in literature; 3. Econometric methodology and data; 4. The estimates; 5. Concluding remarks and policy implications.

KEYWORDS: Government size; economic growth; BARS curve; public expenditure; EU-27.

JEL Codes: C22; E62; H60; O40.

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1. – Introduction

Growth theory has a central role in modern macroeconomics. However for a long time studies on growth haven been based on Solow's (1956) neoclassical approach, which focuses on the importance of two factors related to long-run growth, i.e. exogenous technological changes and convergence of per capita income. If one assumes that all the determinants of growth are exogenous, it is clear how economic policies are not susceptible of influencing the growth process – unless temporarily during the transitional phase of an economy towards its stationary state. As a consequence, the role of Government in the growth process in this approach has been neglected.

The models on growth developed by Romer (1986), Lucas (1988), Barro (1989; 1990) and Rebelo (1991) devise a new (endogenous) theory of growth, with a role of Government in the growth process. Indeed according to this new approach, both the growth rates in the transitional phase and those associated to the stationary condition are endogenous, thus implying that the growth rates of long-run economic activities are endogenous. And in the endogenous approach to growth the positive and negative influence of Government on the growth process, cannot be overlooked. These factors as Bros, de Groot and Nijkamp (1999) showed are both direct and indirect. In this perspective long-run growth rates can differ among various countries, and the convergence of per capita income is not necessary. Thus, for instance, Dar and AmirKhalkhali (2002) pointed out how the three main instruments of budgetary policy (taxation, public expenditure and overall balance) can influence the long-run growth process through the efficient use of resources, factorial accumulation rate and dynamics of technological process.

Obviously Governments, at various levels, provide both intermediate public goods (that can be considered as factors of production and as factors for the private consumption) and goods for final consumption or/and redistribution purposes. While public expenditure, in a general meaning, is necessary to have a functioning market economy and to promote GDP growth, its expansion cannot necessarily be consistent with the maximization of the long-run GDP growth rate. Indeed, if Government size grows then free market economy goes down. So, equilibrium among them has to be found. This does not mean that the equilibrium should be that where the GDP growth rate is maximized. A high growth with an unbalanced society may not be consistent with the welfare maximization in any of the various meaning of this complex concept. It helps in choosing among the different objectives of the public policy and in looking to the possibility of reconciling them, as far as possible, by improving the quality of the public sector and that of the growth process. A recent approach to the effects of Government size on economic growth is centred on the "BARS curve"[1], which relates the rate of economic activity to public expenditure, considered as a peculiar proxy of Government size (Armey, 1995; Rahn and Fox, 1996; Chao and Grubel, 1998; Vedder and Gallaway, 1998; Tanzi and Schuknecht, 1998a, 1998b, 2007; Scully, 1998, 2000, 2002, 2004; Pevcin, 2003, 2004, 2008). As stated in Osband and van Rijckeghem (2000), a low value of public deficit/GDP ratio and public expenditure/GDP ratio are two key-factors ("fundamentals") to prevent a financial crisis, as well as to guarantee a safety environment

[1] Acronym of Barro, Armey, Rahn and Scully.

for net capital inflows. Moreover, some recent studies tend to shed light on themes very close to the BARS curve, such as the relationship between budget deficit and GDP growth (Alesina and Ardagna, 2009), or the effects of public debt on economic activity (Reinhart and Rogoff, 2010). While, Fedeli and Forte (2010) show that high public deficit/GDP ratio in the long run causes high unemployment rates.

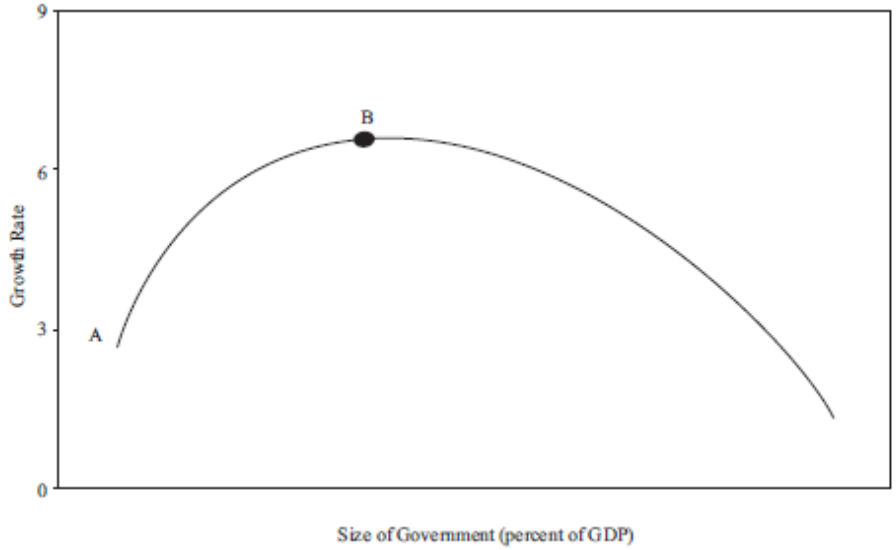
However, in a more coherent approach this methodology needs to be completed by cointegration to ascertain the existence of a long-run relationship between the economic variables.

The paper is divided into five sections. Section 2 provides a survey of economic literature on this issue. Section 3 presents an overview of the applied empirical methodology and a brief discussion of the data used. Section 4 discusses the empirical results, either for time-series analysis or panel-data models. Section 5 contains our concluding remarks and policy implications.

2. – The Optimal Size of Government and the "BARS curve" in literature

Armey (1995) proposed a curve with a bell's shape, showing the relationship between the ratio of public expenditure to GDP and the variation of GDP, as a measure of the general welfare of the country. The idea beneath that shape is that a too low level of public expenditure would not allow the State to guarantee the functioning of the market economy, and therefore a positive GDP growth rate. On the other hand, very high rates of public expenditure on GDP would discourage citizens from investing and producing because of the high fiscal burden. And GDP growth would suffer. Moreover, if the productivity of public expenditure is lower than that of market economy, with given input of factors of production, a high public expenditure bottles up the GDP growth. Thus, there is an optimal level in the relationship between public expenditure and GDP that maximizes the GDP growth.

Figure 1 – BARS curve.



Source: Gwartney, Lawson and Holcombe (1998).

In the field of endogenous growth models, Barro (1989; 1990) pointed out that a raise in taxation reduces the growth rate through triggering discouraging effects. At the same time, however, the increase in public expenditure causes the rise of marginal productivity of capital, – and thus – it has a positive effect on growth. The second measure prevails when the dimensions of the public sector are smaller, while the first one when the public sector is very wide. Thus, the effect of Government expenditure on economic growth is non-monotonic. In this way the "Barro Rule" is formulated, and according to it public services are provided at an optimal level when their marginal product is unitary. Graphically, then, the relation between the growth rate of economy and the variation rate of public expenditure follows a bell's shape curve.

Analyzing the relation among tax rates, public revenue and economic growth in 103 countries, Scully (1994; 1998; 2000; 2002; 2003) found out that economic growth rates are maximized when public expenditure is approximately equal to the fifth part of the aggregate income, as excessive increases in the expenditure have a substantially depressive effect on economic growth.

Rahn and Fox (1996) carried out an empirical analysis reaffirming the existence of an optimal size of Government, graphically represented through an upside-down U-shaped curve. These first studies on the topic suggested to some scholars to name such curve differently, i.e. BARS (due to Barro, Armey, Rahn, and Scully contributions).

Grier and Tullock (1989) completed an empirical work on OCSE countries between 1951 and 1980, demonstrating that growth in the dimension of the Governments in countries with an interventionist regime has a significantly negative effect on GDP growth[2].

Feldtsein (1997), considering the US experience, showed that the appropriate size of Governments depends on the burden of the fiscal transfers from the private sector, which cause increasing welfare losses per unit of revenue, whit the increase of the ratio of taxes on GDP. Moreover, he maintained that at the margin financing a public expenditure of one dollar would require an increase in taxation of more than two dollars.

Gwartney, Lawson and Holcombe (1998), considering a sample of 23 OECD member countries from 1960 to 1996, argued that the expansion of Government beyond its core functions has a negative influence on economic growth for three reasons: a) the discouraging effects of high taxation and the crowding effect of public investments if compared to private ones; b) the diminution in profits coming from governmental intrusion in activities not appropriate to the public sector; c) the interference in the wealth-generating process.

Yavas (1998) showed that an increase in the size of public sector rises the output level if the economy is characterized by a low level of per capita GDP, while reduces it when the economy has a high level of per capita GDP. The reason would be that in developing countries a significant share of public expenditure is usually destined to the construction of infrastructures, while in mature economies the main share of the

[2] On the other hand, Tanzi and Schuknecht (1997a; 1997b; 1998a; 1998b; 2007) analyzing the long-term dynamics of public expenditure in industrialized countries, came to the conclusion that countries with "small Governments" do not usually show worse socio-economic and welfare indicators than those having "big Governments". They found that when public expenditure absorbs half GDP social progresses is not more significant than when it is lower.

budget is destined to social services.

Ghali (1998) and Anaman (2004) showed, by empirical research, that public expenditures may have positive effects on economic activity due to the development of a favourable economic, administrative and legal framework and the interventions for market failures.

Bajo-Rubio (2000) pinpointed that the Government size has negative effects on economic growth, mainly because of bureaucratic inefficiency, excessive fiscal burden, distortion in the incentives system and interventions on the market.

Heitger (2001) pointed out, with an empirical analysis for OECD countries in 1960-2000, that public expenditures for "central" public goods (rule of law, security from external aggression, internal order) have a positive impact on economic growth[3]; while production and public supply of private goods have negative outcomes.

Folster and Henrekson (2001) examined the effects of expenditure on growth rate in rich countries between 1970 and 1995, finding a strong negative relation between public expenditure and economic growth.

Illarionov and Pivarova (2002) studied the optimal size of Government in OECD countries in the period 1960-2000, concluding that the rise of one percentage point in the share of public expenditure on GDP caused a 0.1% reduction of the average growth rates[4].

Afonso, Schuknecht, and Tanzi (2003), on the basis of Armey's contribution, suggested that a General Government expenditure exceeding the ratio of 30% of GDP reduces economic growth and does not trigger any improvement in social welfare.

Pevcin (2003; 2004; 2008) analyzed the presence of a "BARS curve" in twelve European countries for the period 1950-1996, evidencing a decreasing marginal productivity of public expenditure.

Kustepeli (2005) analyzed the size of Government in the twelve new EU countries and two candidates[5], for the period 1994-2001[6]. The results of the panel-type econometric analysis show that a smaller size of Government positively influences the GDP growth rates.

Magazzino (2008; 2010b) estimated the BARS curve for Italy for the period 1862-1998, finding the peak at a level of 23.06%. Yet, limiting the analysis to the period

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[3] See also: Brumm H.J., (1997), Military Spending, Government Disarray, and Economic Growth: A Cross-Country Empirical Analysis, *Journal of Macroeconomics*, 19(4), 827-838; Kennedy P., (1987), *The Rise and Fall of the Great Powers*, New York: Random House.

[4] The two scholars subdivided their sample in several sub-samples in order to take into account individual heterogeneity (due to the presence of very different countries in the initial sample). The results showed that for both the dependent variables, the only relevant regressors were the GDP per capita (carrying a positive sign, thus confirming the "Wagner's Law") and the annual average of population (carrying a negative sign). Finally, they calculated a "necessary level of public size" equal to 20.9% of the public expenditure share on GDP for less developed and highly populated countries (more than one million inhabitants). When such indicator reached ratios between 21% and 36%, the fiscal burden was described as "irrational", while over 36% it was described as "excessive".

[5] They are Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia, and Turkey.

[6] The sample was initially subdivided into three groups, according to the average expenditure share on the GDP: "low" (26-33%): Lithuania, Latvia, Estonia, Czech Republic, Turkey and Romania; "medium" (34-40%): Slovakia, Cyprus, Poland, Bulgaria and Slovenia; "high" (41-47%): Malta, Hungary and Croatia.

1950-1998, the peak is at a level of 32.83%.

Chobanov and Mladenova (2009) examined the optimal size of public expenditure for 28 OECD countries for the 1970-2007 period, finding the peak at a ratio of public expenditure to GDP of 25%.

Alesina *et al.* (2002) found that an increase in public expenditure causes an increase in labour costs in the private sector and that the related increase in taxation reduces profits and investments. Thus fiscal stabilizations able to promote economic growth should consist in reduction of public expenditures and related tax burdens.

Alesina and Ardagna (2009) examined the relationship between public deficit and economic growth, for OECD countries from 1970 to 2007. Fiscal stimuli based upon tax cuts are more likely to increase growth than those based upon spending increases. Adjustments on the spending side rather than on the tax side are less likely to create recessions.

These studies, with their difference in focus, show the risk of an oversimplification of the meaning of the curve. Indeed, it does not merely represents the optimal size of the government for a given size, but shows this optimum level inclusive of the interaction of the growth rate on the level of public spending, caused both by the different effects of the composition of the Government finances and of the different structures of the market system.

3. – Econometric methodology and data

In this research we use both time-series and panel type econometric analysis.

As for the time-series analyses, the ARIMAX (*AutoRegressive Integrated Moving Average with Exogenous Variables*)[7] models were used, together with Newey and West's correction regarding heteroscedasticity and autocorrelation[8] and Kalman's filter for data filtering[9].

Panel-type analysis, instead, were conducted through FEMAR (*Fixed Effect Models with an AR(1) Disturbances*), PFGLS (*Panel Feasible Generalized Least Squares*) and GMM (*Generalized Method of Moments*) models[10].

We studied some developed countries, and the data used in this work were pro-

[7] For a detailed analysis of the time-series modelling used see, among others: Lütkepohl H., (2005), *New Introduction to Multiple Time Series Analysis*, Milan: Springer-Verlag; Franses P.H., (1998), *Time series models for business and economic forecasting*, Cambridge: Cambridge University Press; Engle R.F., (ed., 1995), *ARCH. Selected Readings*, Oxford: Oxford University Press; Hamilton J.D., (1994), *Time Series Analysis*, Princeton: Princeton University Press.

[8] Newey W.K., West K.D., (1987), A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix, *Econometrica*, 55, 703-708; White H., (1980), A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity, *Econometrica*, 48, 817-838.

[9] Kalman R.E., (1960), A new approach to linear filtering and prediction problems, *Journal of Basic Engineering*, Transactions of the ASME, D, 82, 35-45.

[10] For a detailed analysis of the panel modelling used see, among others: Baltagi B.H., (2005), *Econometric Analysis of Panel Data*, New York: Wiley; Hsiao C., (2003), *Analysis of Panel Data*, New York: Cambridge University Press; Wooldridge J.M., (2002), *Econometric Analysis of Cross Section and Panel Data*, Cambridge: MIT Press; Baltagi B.H., Wu P. X., (1999), Unequally spaced panel data regressions with AR(1) disturbances, *Econometric Theory*, 15, 814-823.

vided by AMECO[11] database and *Total Economy Database*[12], freely consultable on the internet.

In Table 1 variables of the model are summed up.

Table 1 – List of variables.

Variable	***Explanation***
TGDPGK	Total GDP, in millions of 1990 US$ (converted at Geary-Khamis PPPs)
CATEGG	Cyclically adjusted total expenditure of general government, % GDP

Sources: AMECO and TED database.

In Table 2 some preliminary descriptive statistics are shown.

Table 2 – Exploratory data analysis.

Variable	***Mean***	***Median***	***Standard Deviation***	***Skewness***	***Kurtosis***	***Range***
TGDPGK	258006.5	96097	369505.5	1.9304	5.7864	1716872.9
CATEGG	46.1405	45.6866	6.9494	0.1881	2.7092	41.5205

Sources: our calculations on AMECO and TED data.

Results of stationarity tests reveal, in general, that both variables are non-stationary at levels, but they become stationary at first differences; so we can conclude that real GDP and public expenditure are *I(1)* processes.

4. – The estimates

First we examine the relation between economic growth and public expenditure[13] estimating three relationships. The first is the relation between the rate of change of GDP and the ratio of public expenditure on GDP. The estimated equation belongs to the type:

$$d(TGDPGK)_{i,t} = \alpha + \beta_1 CATEGG_{i,t} + u_{i,t} \qquad [1]$$

The dependent variable (*TGDPGK*) represents the GDP growth rate at constant prices (converted in Geary-Khamis P.P.P.), while the explanatory (*CATEGG*) consists in the total public expenditure of the general Government, corrected according to the trend of the economic cycle. We expect that an excessive size of the Government trigger negative effects on economic growth.

The second relationship that we studied concerns the link between the growth rate of the aggregate product, the expenditure share as regards the GDP and the variation of public expenditure. The estimated equation belongs to the type:

$$d(TGDPGK)_{i,t} = \alpha + \beta_1 CATEGG_{i,t} + \beta_2 d(CATEGG_{i,t}) + u_{i,t} \qquad [2]$$

[11] See the website: http://ec.europa.eu/economy_finance/ameco/user/serie/.
[12] See the website: http://www.conference-board.org/economics/database.cfm.
[13] Following the methodology used by Illarionov and Pivarova (2002), Scully (2004), Pevcin (2004), and Chobanov and Mladenova (2005).

In this case we test whether an increase of the rate of public expenditure has a negative effect on GDP growth.

The third relationship analyzes the link between the variation rate of economic growth and the growth rate of the expenditure share as regards the GDP. The estimated equation is:

$$d2(CATEGG)_{i,t} = \alpha + \beta_1 d(CATEGG_{i,t}) + u_{i,t} \quad [3]$$

In this case, too, an increase in public expenditure can trigger a check to the economic growth dynamics.

We then estimate the relationships between economic growth rate and public expenditure[14]. It assumes that the growth rate of aggregate income is the positive function of the public expenditure share on domestic product and the negative function of the square of the public expenditure share; initially we estimate the following model:

$$d(TGDPGK)_{i,t} = \alpha + \beta_1 CATEGG_t + \beta_2 CATEGG^2_{i,t} + u_{i,t} \quad [4]$$

with the *i* index standing for the country (*i*=Austria, …), while the *t* one referring to the period (*t*=1970,…, 2009). The dependent variable is the real GDP growth rate corrected according to the impact of the factors of commerce (measured at constant prices), *TGDPGK*, while the independent variables are the public expenditure share corrected according to the economic cycle trend on real GDP, *CATEGG*, and its square value, $CATEGG^2$. For every series the logarithmic transformed counts were calculated.

We expect that the linear term, *CATEGG* carry a positive sign and show the positive effects of public expenditure on economic growth; on the contrary, the square term $CATEGG^2$ should take a negative sign, as it measures the negative effects associated to the enlargement of public sector. In other words, this second degree term should stand for the decreasing marginal productivity of public expenditure.

The government expenditure as a share of GDP that maximizes economic growth from the quadratic function above is found to be the following after differentiating the *TGDPGK* with respect to *CATEGG*:

$$CATEGG^* = -b/2c \quad [5]$$

Finally, Baltagi[15] lists several benefits from using panel data. These include the following.

4.1 – Time-series analysis of the relationship between economic growth and size of Government

In order to study the relationship between public expenditure and economic growth,

[14] As suggested by Vedder and Gallaway (1998), Pevcin (2004), Chobanov and Mladenova (2005), and Davies (2008).

[15] See: Baltagi B.H. (2005).

we used a dataset for 27 countries members of the European Union (Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and UK) from 1970 to 2009. First we conducted an econometric analysis for time-series data of the countries with enough yearly data.

The negative relationship between economic growth rate and public expenditure is clearly evident from Table 3. The coefficient of the explanatory variable is statistically relevant for every country but Denmark, and it has a negative sign. Regarding the determination coefficient, public expenditure alone explains from 19% (United Kingdom) to 86% (Greece) of the ratio of growth rate variability. Residuals are never correlated, and for each country they are White Noise (W.N.).

Granger causality tests between real GDP (at levels) and public expenditure share show that we have a bi-directional causality for three countries (Belgium, France and Ireland). Instead, GDP Granger-causes public expenditure for Germany and Italy. On the contrary, Denmark empirical results support the opposite hypothesis, since the direction of causality moves from public expenditure to aggregate income. The inverse causality found for Italy may have an explanation in the fact that social public expenditures were planned structurally assuming a rate of GDP growth that actually did not came out. On the other hand, the reason for the lack of econometric evidence for a causal relation between the expansion of public spending and the reduction of the growth rate might be that expansion was largely financed through public debt, and that a share of it, for a period, was absorbed by the central bank. Only later, when the burden of the high debt did appear in the budget via high expenditures for interest and high tax burden became necessary, the negative effect of big Government on the rate of GDP growth emerged.

Long-run relationship between real GDP (*TGDPGK*) and public expenditure share (*CATEGG*) has been studied through cointegration analysis. For each country, the Johansen and Juselius (1990) approach has been performed. As shown in Table 3, our empirical findings suggest the presence of a long-run relationship in six countries.

Regarding Table 4, the growth rate is estimated as a function of the public expenditure share on GDP and its series in first differences. The results previously shown are roughly confirmed; in fact, public expenditure still has a negative sign in almost all countries (just Greece is the exception). The series to first differences carry a negative sign and a strong statistical significance (everywhere). The R^2 fluctuates between 40% (Germany) and 89% (France). Just in the case of Germany residuals do not follow a Gaussian trend, while for every country they are serially uncorrelated, thus being a W.N.

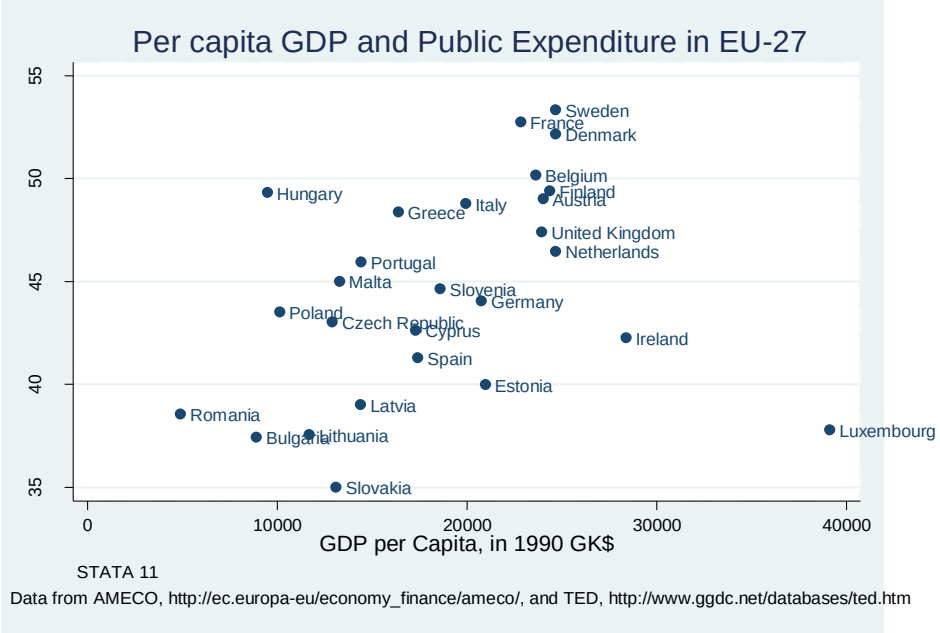
In Table 5, conversely, we regress the variation in the GDP growth rate, i.e. the acceleration or deceleration of aggregate growth (*d2TGDPGK*) on the difference of the public expenditure share on GDP. Again, there is a negative relationship between economic growth and public expenditure growth. The independent variable has the expected negative sign and it is statistically relevant in eleven out of twelve countries (the only exception being Denmark, as before). The coefficient of determination fluctuates from a minimum of 19% (UK) to a maximum of 80% (Italy) of the growth rate variability. Regressions' residuals seem to be normally distributed. Finally, in eve-

ry case the residuals appear serially uncorrelated.

The time-series analysis show that the optimal size of public expenditure in relation to the GDP growth rate maximization (G^*) differs from country to country: from 35.4% for Belgium to 44.5% for Ireland (Table 6).

As shown in Table 7, all the countries here considered are situated in the right-side of the BARS curve. The peak of the curve varies among these countries with a difference of 9.08 p.p. between the lowest level (35.39) and the highest level (44.47). In the lowest range we find Belgium and The Netherlands; in the highest range there are Ireland and UK. Ireland is the country with the minimum deviation from its ratio of public expenditure on GDP that maximizes GDP growth: only 2.27%. Ireland is also the country with the highest ratio of public expenditure consistent with its growth maximization. The difference between the actual level of public expenditure and the level consistent with the maximization of GDP growth rate, if we put aside these case, ranges between 5.7 p.p. for Germany and 18.1 p.p. for Belgium.

Figure 2 – Relation between per capita GDP and public expenditure (EU-27, 2009).



Source: our elaborations on AMECO and TED data.

Table 3 – Relation between economic growth rate and public expenditure in twelve EU countries (1970-2009).

Indipendent Variables	Dependent Variable: d(TGDPGK)											
	AUT	**BEL**	**DNK**	**FIN**	**FRA**	**GER**	**GRE**	**IRL**	**ITA**	**PBS**	**POR**	**UK**
Constant	.0749 **	.0772 ***	.0163	.1563 ***	.0487 *	.1296 ***	.1695 **	.0994 ***	.1269 ***	.0634 ***	.0790 ***	.0655 **
	(.0332)	(.0171)	(.0265)	(.0424)	(.0262)	(.0450)	(.0703)	(.0165)	(.0336)	(.0218)	(.0237)	(.0266)
CATEGG	-.0230 **	-.0239 ***	-.0040	-.0501 ***	-.0150 *	-.0426 ***	-.0557 **	-.0302 ***	-.0422 ***	-.0193 ***	-.0259 ***	-.0215 **
	(.0108)	(.0056)	(.0086)	(.0136)	(.0086)	(.0151)	(.0238)	(.0054)	(.0120)	(.0072)	(.0083)	(.0093)
Log-likelihood	151.199	158.552	161.501	124.988	157.182	164.638	81.160	96.957	144.037	184.960	139.740	161.911
Wald χ^2	4.54	18.23	31.64	59.53	8.61	117.18	9.85	546.49	58.65	13.20	56.44	6.89
R^2	0.5082	0.4594	0.3757	0.5215	0.7578	0.3170	0.8590	0.4168	-	0.5658	0.7633	0.1880
ARIMA/ARCH Corrections	-	MA(1)	AR(1) MA(1)	AR(1)	MA(1)	AR(1) MA(1)	AR(1)	AR(1) MA(1)	AR(1) ARCH(1)	MA(1)	MA(1)	AR(1)
BIC	291.908	302.450	304.813	235.870	300.629	310.959	150.143	280.400	271.238	355.164	265.617	309.167
SW W Test	(0.5241)	(0.3828)	(0.5034)	(0.5884)	(0.7445)	(0.0500)	(0.4487)	(0.0286)	(0.8900)	(0.9593)	(0.4804)	(0.0931)
LB Q Test	(0.9252)	(0.5923)	(0.4508)	(0.4075)	(0.3360)	(0.8710)	(0.4963)	(0.3402)	(0.0973)	(0.8884)	(0.5494)	(0.2946)
Granger-causality	-	→ ←	←	-	→ ←	→	-	→ ←	→	-	-	-
Cointegration	No	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes	No	No

N.B.: Newey-West HAC estimator and Kalman filter applied. Significance levels: * 10%, ** 5%, *** 1%. Robust Standard Errors in brackets. → Granger causality exists only from the dependent towards the independent variable. ← Granger causality exists only from the independent towards the dependent variable. Cointegration refers to the Johansen's procedure.

Source: our calculations on AMECO and TED data.

Table 4 – Relationships among economic growth rate, public expenditure and first differences in expenditure in twelve EU countries (1970-2009).

Indipendent Variables	Dependent Variable: d(TGDPGK)											
	AUT	**BEL**	**DNK**	**FIN**	**FRA**	**GER**	**GRE**	**IRL**	**ITA**	**PBS**	**POR**	**UK**
Constant	.0321	.0904 ***	.0198	.0446 ***	.0646 ***	.1405 ***	-.0755	.0663 ***	.0262	.0676 **	.0442	.0314 **
	(.0348)	(.0183)	(.0242)	(.0094)	(.0145)	(.0526)	(.0886)	(.0129)	(.0268)	(.0289)	(.0349)	(.0152)
CATEGG	-.0090	-.0275 ***	-.0051	-.0126 ***	-.0200 ***	-.0462 ***	.0277	-.0197 ***	-.0078	-.0207 **	-.0137	-.0095 *
	(.0113)	(.0061)	(.0078)	(.0031)	(.0047)	(.0176)	(.0303)	(.0045)	(.0089)	(.0095)	(.0121)	(.0052)
d(CATEGG)	-.0535 ***	-.0582 ***	-.0799 ***	-.1261 ***	-.0883 ***	-.0735 ***	-.0459 **	-.0902 ***	-.0341 ***	-.0476 **	-.0252 *	-.0482 ***
	(.0215)	(.0201)	(.0155)	(.0091)	(.0111)	(.0279)	(.0188)	(.0177)	(.0085)	(.0185)	(.0143)	(.0146)
Log-likelihood	150.028	178.984	162.571	21298.80	164.370	163.023	73.218	80.275	143.433	184.224	136.637	181.939
R^2	0.6027	0.6658	0.5310	-	0.8930	0.4037	0.8000	0.5420	0.8749	0.6443	0.7819	0.4879
ARIMA/ARCH Corrections	-	AR(1) MA(1)	-	AR(1) MA(1) ARCH(1)	-	AR(1) MA(1)	MA(1)	AR(1)	MA(1)	AR(1)	MA(1)	AR(1) MA(1)
BIC	286.194	336.142	310.698	283.945	315.135	304.221	131.457	144.872	270.205	350.129	256.104	342.052
SW W Test	(0.7536)	(0.8233)	(0.0428)	(0.5881)	(0.3107)	(0.0000)	(0.4201)	(0.3406)	(0.7518)	(0.7971)	(0.9645)	(0.0157)
LB Q Test	(0.9958)	(0.7022)	(0.9232)	(0.7091)	(0.7835)	(0.9336)	(0.2604)	(0.8864)	(0.6059)	(0.9929)	(0.3579)	(0.8614)

N.B.: Newey-West HAC estimator and Kalman filter applied. Significance levels: * 10%, ** 5%, *** 1%. Robust Standard Errors in brackets.

Source: our calculations on AMECO and TED data.

Table 5 – Relationship between variation of economic growth rate and first differences in public expenditure in twelve EU countries (1970-2009).

Indipendent Variables	Dependent Variable: d2(TGDPGK)											
	AUT	**BEL**	**DNK**	**FIN**	**FRA**	**GER**	**GRE**	**IRL**	**ITA**	**PBS**	**POR**	**UK**
Constant	-.0001	.0000	-.0001	.0003	.0001	.0001	.0003	-.0008	.0000	-.0001	.0002	.0000
	(.0002)	(.0003)	(.0005)	(.0008)	(.0003)	(.0005)	(.0003)	(.0006)	(.0004)	(.0003)	(.0007)	(.0005)
d(CATEGG)	-.0452 *	-.0638 **	-.0293	-.0642 ***	-.0510 ***	-.0889 ***	-.0544 ***	-.0633 ***	-.0605 ***	-.0592 ***	-.0476 *	-.0430 *
	(.0257)	(.0322)	(.0259)	(.0250)	(.0188)	(.0265)	(.0179)	(.0174)	(.0156)	(.0160)	(.0271)	(.0228)
Log-likelihood	142.823	148.475	133.114	135.37	132.688	153.183	94.942	91.220	138.806	180.063	131.327	167.596
Wald χ^2	24.31	96.29	49.29	42.48	12.45	23.90	32.02	28.23	40.41	33.99	46.49	25.11
R^2	0.5380	0.4536	0.3692	0.4713	0.5257	0.3230	0.8874	0.4354	0.8023	0.5912	0.7177	0.1861
ARIMA/ARCH Corrections	AR(2)	AR(1) MA(1)	AR(1) MA(1)	AR(1) MA(1)	AR(1)	AR(1)	AR(2)	AR(1)	AR(1) MA(1)	AR(1)	AR(1) MA(1)	AR(1) MA(1)
BIC	268.318	278.763	248.174	253.251	251.770	291.815	174.906	169.899	260.952	345.471	245.485	317.003
SW W Test	(0.2714)	(0.0733)	(0.0214)	(0.5664)	(0.5192)	(0.0600)	(0.5711)	(0.2207)	(0.2219)	(0.0145)	(0.0105)	(0.0439)
LB Q Test	(0.9150)	(0.3805)	(0.2225)	(0.5966)	(0.3641)	(0.7068)	(0.8033)	(0.4613)	(0.3749)	(0.9375)	(0.4108)	(0.5501)

N.B.: Newey-West HAC estimator and Kalman filter applied. Significance levels: * 10%, ** 5%, *** 1%. Robust Standard Errors in brackets.

Source: our calculations on AMECO and TED data.

Table 6 – "BARS curve" in twelve EU countries (1970-2009).

Indipendent Variables	Dependent Variable: d(TGDPGK)											
	AUT	**BEL**	**DNK**	**FIN**	**FRA**	**GER**	**GRE**	**IRL**	**ITA**	**PBS**	**POR**	**UK**
Constant	5.0870 ***	.6598 ***	2.2004 ***	-.9094 ***	-3.1221 ***	-1.8816 ***	4.3571 ***	-.7677 **	.9400 **	1.0941	-2.0833 ***	-.3547 ***
	(.0554)	(.0000)	(.1971)	(.0000)	(.0000)	(.0000)	(.0000)	(.3208)	(.3896)	(.0009)	(.3797)	(.0000)
CATEGG	1.8006 ***	.1951 ***	.7993 ***	.3718 ***	1.2007 ***	.8490 ***	1.6564 ***	.4118 ***	.3215 **	.3272 ***	-.9568 ***	.1857 ***
	(.0184)	(.0085)	(.0755)	(.0255)	(.0165)	(.0299)	(.0322)	(.1363)	(.1502)	(.0152)	(.1527)	(.0177)
CATEGG²	-2.3563 ***	-.2756 ***	-1.0346 ***	-.4604 ***	-1.5202 ***	1.0109 ***	-2.1060 ***	-.4630 ***	-.4266 **	-.4605 ***	-1.1315 ***	-.2134 ***
	(.0216)	(.0065)	(.0954)	(.0193)	(.0125)	(.0226)	(.0238)	(.1652)	(.1896)	(.0114)	(.1892)	(.0134)
N	34	40	39	35	32	39	22	25	30	41	33	40
Log-likelihood	152.365	176.540	163.332	142.685	158.389	164.918	98.645	100.176	143.544	189.399	110.492	179.847
R^2	0.5418	0.5180	-	0.5803	0.7756	0.3278	0.8787	0.5522	0.8231	-	0.8029	0.2710
ARIMA/ARCH Corrections	AR(1) MA(1)	AR(1) MA(1)	AR(1) MA(1) ARCH(1)	MA(1)	MA(1)	AR(1) MA(1)	AR(1) MA(1)	MA(1)	MA(1)	AR(1) MA(1) ARCH(1)	MA(1)	MA(1)
BIC	283.750	334.762	301.201	271.264	303.042	311.517	182.066	178.106	270.252	356.664	203.6543	345.040
SW W Test	(0.5241)	(0.382)	(0.9875)	(0.4829)	(0.7445)	(0.0000)	(0.4541)	(0.2431)	(0.9057)	(0.8938)	(0.2504)	(0.0225)
LB Q Test	(0.9252)	(0.5923)	(0.5198)	(0.4255)	(0.3360)	(0.9277)	(0.1653)	(0.9507)	(0.5805)	(0.7964)	(0.0692)	(0.7114)
Curve peak	38.21%	35.39%	38.63%	40.38%	39.49%	41.99%	39.33%	44.47%	37.68%	35.52%	42.28%	43.50%

N.B.: Newey-West HAC estimator and Kalman filter applied. Significance levels: * 10%, ** 5%, *** 1%. Robust Standard Errors in brackets.

Source: our calculations on AMECO and TED data.

Table 7 – Margins for public expenditure reduction in twelve EU countries.

Country	*Size of government (% of GDP, 2009)*	*"BARS curve" optimum (% of GDP)*	*Percentage change in spending as a share of GDP*
Austria	52.24	38.21	-14.03
Belgium	53.48	35.39	-18.09
Denmark	55.41	38.63	-16.78
Finland	54.07	40.38	-13.69
France	55.15	39.49	-15.66
Germany	46.02	41.99	-5.65
Greece	49.97	39.33	-10.64
Ireland	46.74	44.47	-2.27
Italy	51.52	37.68	-13.84
The Netherlands	49.01	35.52	-13.49
Portugal	51.54	42.28	-9.26
UK	51.17	43.50	-7.67

Source: our calculations on AMECO and TED data.

The marked differences in the peaks of the BARS curves of these countries may depend from several factors, ranging from the different composition of the public expenditures; to the different degrees of efficiency of the public spending process; and from the way of financing them to the different degrees of tax evasion which increases the burden of those who do not evade. Different economic structures and institutions and different levels of per capita GDP might affect the capability of growth. A panel analysis may help the goal more in detail, while broadening the number of the states under consideration.

4.2 – Panel Analysis of the relationship between economic growth and Government size

The estimates of regression models for panel data essentially depend on hypotheses regarding the intercept, coefficients and error terms. Panel data methodology allows us to control for individual countries heterogeneity and to obtain more information, through more variability, less collinearity among variables, greater degrees of freedom. Panel data are better able to study the dynamics of adjustment and to identify and measure effects not detectable in pure cross-section and time-series data[16].

The first and simpler approach consists in analyzing the relationship between economic growth rate and public expenditure (measured as aggregate income share) and its first differences. As it is pointed out in Table 8, the coefficient of the explanatory variable *CATEGG* in the first column indicates that a country having a 10% higher public expenditure records a decrease in its GDP growth equal to 2.1%. Public expenditure alone can explain more than 22% of the differences in growth rate among the 27 countries here analyzed, during the reference period[17]. In Table 8, the coefficient of the explanatory variable *CATEGG* in the first column indicates that a country with a ratio of public expenditure on GDP 10% higher than that coinciding with the optimal ratio of GDP growth has a decrease of 2.1% in its GDP growth.

[16] On this topic see: Baltagi B.H. (2005), *Econometric Analysis of Panel Data*, New York: Wiley.

[17] Following the works of Vedder and Gallaway (1998), Illarionov and Pivavora (2002), Pevcin (2004), Davies (2008), and Chobanov and Mladenova (2009) the GLS-RE approach was used, with AR(1) type disturbances.

The third column of Table 8 shows that an increase of one percentage point in the variation of public expenditure ratio on GDP corresponds approximately to a reduction of 0.04% in the rate of GDP growth.

Moreover, economic growth is negatively correlated with the variation in public expenditure, thus reinforcing the negative effect that the increase in Government size can trigger on economic growth. The empirical evidence found suggests that big Governments impose big penalties upon their people, in the form of more limited GDP growth rates. Thus, reductions in the growth rate of economic activity are more accentuated in countries showing a strong public intervention in their economies. In fact, the results in the third column of Table 8 show that an increase of one percentage point in the public expenditure variation corresponds approximately to a reduction of 0.04% in the acceleration rate of economic growth.

Table 8 – Relationships between public expenditure and GDP growth, GLS-RE approach (EU-27, 1970-2009).

Indipendent variable	**Dependent variable**		
	d(TGDPGK)		**d2(TGDPGK)**
Constant	.0677***	.0589***	-.0003
	(.0069)	(.0069)	(.0003)
CATEGG	-.0208***	-.0178***	-
	(.0023)	(.0024)	
d(CATEGG)	-	-.0335***	-.0402***
		(.0044)	(.0056)
Number of obs.	593	569	566
Number of groups	27	27	27
$R^2_{overall}$	0.2259	0.3071	0.0839
Wald χ^2	78.8103	138.3321	51.0725
	(0.0000)	(0.0000)	(0.0000)
ARIMA Correction	AR(1)	AR(1)	AR(1)
Baltagi-Wu LBI test	1.4561	1.4904	2.3594
Bhargava *et al.* DW M test	1.2352	1.2642	2.1412

N.B.: White correction for heteroscedasticity and Kalman filter applied. Significance levels: * 10%, ** 5%, *** 1%. Robust Standard Errors in brackets.

Since EU-27 is not a homogeneous panel, in order to test the presence of a BARS curve, we break up the panel in homogeneous sub-groups of countries[18], constructed considering the characters of their welfare and labour institutions, their per capita GDP, and whether they have a common currency that determines their monetary policy. From the point of view of the welfare model we distinguish: Anglo-Saxon countries[19], Eastern European[20], Western Continental European[21], and Mediterranean[22] countries; after that, we consider the Euroarea members [23]. We didn't consider a

[18] As in Kustepeli (2005) and Hakro (2009).

[19] Ireland, Malta and UK.

[20] Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

[21] Austria, Belgium, France, Germany, Italy, Luxembourg and The Netherlands.

[22] Cyprus, Greece, Portugal and Spain.

[23] Austria, Belgium, Cyprus, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, The Netherlands, Portugal, Slovakia, Slovenia and Spain.

Scandinavian group, because Norway and Iceland are not EU members, while for Sweden we have short time-series.

Table 9 – BARS curve peak, Cross-Section Time-Series FGLS approach (1970-2009).

Panel	*Median G/Y [(a)]*	*Mean G/Y [(a)]*	*Curve peak*
EU-27	47.64%	47.90%	37.29%
Euroarea	49.01%	48.19%	35.45%
Anglo-Saxon	46.74%	47.88%	41.96%
Eastern European	44.43%	44.11%	39.74%
Western Continental European	48.79%	47.00%	36.84%
Mediterranean	47.59%	47.79%	43.30%

N.B.: (a) in 2009.
Source: our calculations on AMECO and TED data.

As is shown in Table 9, for the sub-groups of countries classified by welfare structures, the optimal size of Government – measured by curve peak – lies in the interval 35-43%. It is quite interesting to note that for the Western Continental European countries – that have a common tradition of welfare state and complex labour institutions – the peak of the BARS curve is at a much lower level than for the Anglo-Saxon countries, which, at least from Thatcher's reforms (Magazzino, 2010d), have a much more flexible labour market. On the other hand, Mediterranean countries have an optimal estimated public expenditure share of 43%, only 4 p.p. less than the current value, likely because they are generally at a lower rate of per capita GDP, but also because the structural differences in the welfare state and the labour market. Also Eastern European countries show a wedge of about 4% between the actual level of their public expenditure and the level coinciding with the BARS curve. However their actual level of public expenditure on GDP is lower than that on any other group of countries, likely because their public economy structures are weak, due to the transition from the collectivist top then market economy system. These differences resulting from the panel data analysis entice further research on the relation between the composition of the public spending and of the tax systems, and the BARS curve.

Finally, in order to take into account the problem of endogeneity in panel estimates, we applied the GMM model. The results are summarized in Table 10. We divided our sample into three groups: Group 1, which includes low per capita income countries[24]; Group 2, with medium per capita income countries[25]; and Group 3, which includes high per capita income countries[26].

[24] Bulgaria, Czech Republic, Hungary, Latvia, Lithuania, Malta, Poland, Romania and Slovakia.
[25] Cyprus, Germany, Greece, Italy, Portugal, Slovenia and Spain.
[26] Austria, Belgium, Denmark, Estonia, Finland, France, Ireland, The Netherlands, Sweden and UK.

Table 10 – BARS curve peak, GMM approach (1970-2009).

Panel	*G/Y*	*(G/Y)²*	*Curve peak*	*Endogeneity*
EU-27	Significant	Significant	37.79	Yes (26.8283)
Euroarea	Not Significant	Not Significant	-	-
Anglo-Saxon	Significant	Significant	40.77	No (5.2510)
Eastern European	Significant	Significant	39.85	No (2.7439)
Western Continental European	Significant	Significant	38.32	No (2.7865)
Mediterranean	Significant	Significant	42.06	No (5.8548)
Group 1	Significant	Significant	39.66	No (0.8126)
Group 2	Significant	Significant	42.47	No (9.6046)
Group 3	Significant	Significant	38.44	No (4.1051)

N.B.: foe endogeneity, the χ^2 values are given in parenthesis.
Source: our calculations on AMECO and TED data.

We instrumented the explanatory variables with their own lags and a country dummy variable. Endogeneity exists for EU-27 which we do not consider meaningful, because too heterogeneous. The subdivision based on welfare system produced robust estimates (the null hypothesis of exogeneity is not rejected). Here, the four peaks are very close to each other: the lowest value is for Western Continental European countries (38.32%), while the highest value is for the Mediterranean countries (42.06%). In general, GMM estimates produce results roughly similar to previous FGLS estimates. In fact, for each of these four different groups, the peaks calculated with the two different estimation methods differ only for few decimal points.

As regards the subdivision by per capita income, the first group roughly corresponds to the Eastern European countries, so that the two estimated curve peaks converge to a very similar value. In the second group we find the Mediterranean area (but also Germany and Slovenia), and again the curve peak for these group is nearby to that of found for the Mediterranean group, as well as for Germany and Portugal with time-series estimates. For the high income countries, the optimal size of Government is equal to 38.44, about the value found for Austria and Denmark. Yet, the three estimated curve peaks show little difference (they ranges from 38.4 to 42.5%).

5. – Concluding remarks and policy implications

In the second half of the 20th century there has been a general growth in the size and aims of Government, due to the institution of modern Welfare State systems and to the intervention of the public economy in the economic process. The rates of economic growth in the EU countries have undergone a systematic reduction trough time. Several factors, including the aging of the population, the preference for leisure and low risk, the excesses of regulations of real economy together with lack of regulation in the monetary and financial sector may have been among the causes of the reduction of growth rates. However, there are reason to believe that an "excessive" increase of the ratio of public expenditure to GDP reduces the rate of its growth, because the costs for the market economy of its financing may exceed its marginal productivity, and because the productivity of the market economy which is exposed to the competitive pressure tends to grow more than that of the public sector, which

is not exposed to these pressures.

As for the 27 EU member countries we considered, a country having a public expenditure/GDP ratio above 10% the peak, on average, suffers a diminution in the GDP growth rate of 2.1%. Moreover, an increase of 1 percentage point in the variation of public expenditure approximately corresponds to a 0.04% reduction in the acceleration rate of economic activity.

Moreover, we found statistically significant inverse relationships between the growth of the ratios of public expenditure to GDP and the GDP growth rate, and their variations. Thus we were able to construct statistically significant BARS curves, for the 12 countries for which we have homogeneous data for the entire period and, by panel data methodology, for the 27 EU countries as a whole, and for some subgroups of "homogenous" countries. In all these cases, the considered EU countries are on the right-side of the "BARS curve". For the EU-27 panel, the peak of the BARS curve is attained for an expenditure of 37.29% of GDP, while the average ratio is 47.90%: i.e. 10 p.p. more. For the twelve EU countries for whom an individual time-series analysis was meaningful (because of the availability of data), we found that the peak of the BARS curve ranges from 35.39 for Belgium and 35.52 for The Netherlands to 43.50 for UK and 44.47 for Ireland. The minimum deviation from the level of the public expenditure that coincides with the peak of the BARS curve is that of Ireland with only 2.27%, followed by UK with 7.67 p.p. in excess. The maximum deviation is that of Belgium (of about 18%), followed by Denmark (with a percentage of about 17%).

Considering the four groups of EU countries homogeneous from the point of view of their welfare and labour market institutions, it emerged that for the Mediterranean countries (whose welfare state is relatively young and the labour market not extensively regulated) the peak of the BARS curve is reached by a public expenditure at a share of 42.06% of GDP: almost the same value found for Portugal. Also for the Anglo-Saxon countries the peak of the BARS curve coincides with a share of public expenditures higher than 40% of GDP (40.77%). In this case, too, the labour market (after the Thatcher's reforms) is flexible, but the welfare state is relatively big. Likely an important factor that allows to a size of the public expenditure greater than 40% of GDP, to be consistent with GDP growth maximization it is its efficiency. For Eastern European countries, whose welfare state features and labour market institutions are small, the share of public expenditure consistent with the peak of the BARS curve is close to 40%, too. On the other hand, for the Western Continental EU countries, that have an old tradition of welfare state and of labour market regulations, but also a mature economy, the level of public expenditure coinciding with the peak of the BARS curve is equal to 38.32%. For these countries the excess of the share of public expenditure on that coinciding with GDP growth maximization it is of about 9 p.p. For the Mediterranean countries, 6%; for the Eastern European countries, it is of about 4 and a half p.p., and for the Anglo-Saxon countries of about 7 p.p.

We do not argue that one should reduce the Government sizes by percentage that allows to having a maximum GDP growth rate. Obviously, distributive factors do matter. However, the cost of equity in terms of GDP growth has to be considered, together with the question of present versus future welfare. On the other hand, macroeconomics may be elusive: one cannot argue that any percentage reduction in the share of public expenditure on GDP would have the same effect as for the increase

of GDP. The efficiency of public expenditure varies from country to country. The composition of the public expenditure and of its financing should be considered. Indeed, as we have seen, the different groups of countries have their peak at a different point. And this outcome suggests that one should consider not only the size but also the quality of the two sides of the public finances of the various countries. Further research may prove useful to show light on the disparities emerging in the empirical analysis of individual countries and of the sub groups of the panel. However, the present research provides enough evidence that high GDP countries of EU have overcome the level of government size compatible with GDP growth rate maximization.

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