Sizing the Government

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Abstract

Is there such a thing as an optimal government size? We investigate by the non-parametric Data Envelopment Analysis (DEA) the so-called 'Armey curve' which claims an inverted U-shaped relationship between government size and economic performance. The DEA scores are linked to control variables as initial per capita income, openness, population density, urbanization, country size and family size. For 23 OECD-countries we estimate the country specific efficiency scores, which reveal the extent to which a country uses excess public resources to achieve the observed growth rate of GDP.

JEL Classification: H10, H21, H31

Keywords: Data Envelopment Analysis, Government size, Public sector performance, Armey-curve.

Introduction

During the second half of the last century, government involvement in OECD-countries expanded rapidly. Whereas the size of the tax burden (i.e., the ratio of tax revenue to GDP) was 24.7% in 1960, the tax burden reached an average of 36.3% in 2003. Many theories for the growth of government have been offered. Wagner's law (1877) states that the demand for governmental services has an income elasticity in excess of one. Baumol (1967) blames the unbalanced growth between the private and public sectors, Niskanen (1971) bureaucratic expansionism. Other theories mention interest-group lobbying, fiscal illusion or public-employee bloc voting (for an overview see, e.g., Lybeck and Henrekson 1988; Meltzer and Richard 1983;).

These theories have in common that government expansion is inherent and continuous. Although it has been argued by Higgs (1987) that due to the ratchet effect the size of goverment increases permanently, we observe for a sample of 23 OECD countries that from the end of the 1990s on, government involvement measured by the general tax burden, slowed down and even decreased. We illustrate this in Figure 1 where we measure the tax burden for OECD and EU-15 countries by taking two-year intervals. Focusing on the last 16 years, we present the tax burden for the 23 0ECD countries in Figure 2.

This paper follows the stream of economists which insists on downsizing government, although this is an intricate issue as the civil servants themselves have many political powers (Buchanan and Tullock, 1977). In Section 1, we explain the arguments for downsizing the goverment by the so-called 'Armey curve' (Armey 1995). The conceptual starting point is a society without a government. The absence of government allows lawlessness, insecurity and instability. Even a small government could advance welfare by introducing the protection of property rights and the rule of law. But the richer society gets, the more government gets involved (Slemrod *et al.* 1995). The median voter prefers state-of-the-art health care, education and pension systems. As the scope of the government grows, so do the tax burden and public expenditures. Public choice theory predicts that governments will expand in size beyond its efficient level: higher public expenditures result in a lower GDP growth. Advocates of the Armey curve try to estimate the efficient level of government involvement. They obtain optimal values which are lower than the current observations.

The parametric regressions applied to estimate the optimal government size face some drawbacks which are circumvented by the non-parametric estimation in Section 2. Using Data Envelopment Analysis (DEA), we develop an alternative approach to determining the optimal size of the government. By applying an input-oriented model (i.e., minimization of the inputs for a given output level) on a sample of 23 OECD countries, we benchmark governments by comparing GDP growth relative to their tax burdens. In a first stage analysis, we investigate the variables as proposed by Armey (1995). We measure the size of the government by overall government spending (general government outlays). These expenditures include the spendings from the central, state and local government as well as spendings by the social security system (cfr. Gupta *et al.* 2001). Other measures of government size are also popular. Meltzer and Richard (1981) use the share of income redistributed by government as a measure of relative size. Katsimi (1998) defines the size of the public sector as the ratio of public to total employment. Others use the total tax level or the share of government consumption in total consumption. As these measures of government size are strongly correlated (e.g., correlation of 0.88 between public spending and overall taxation level), our results remain robust for related measures.

In a second stage, we correct the first stage gross efficiency measures. As a first correction variable, we develop the idea of *the anorexia family*. Countries with lean family sizes prefer larger government involvement, since the public sector takes over several concerns which used to be handled within the family. Family size is considered as an implicit revelation of the preference for the extent of government involvement. Other correction factors are openness of the economy (Roderik 1996), initial GDP per capita to capture the catching up effect (Wagner 1877) and the income of the median voter, urbanization, country size (proxied by the total population), population density and the capital stock (proxy of physical capital stock).

In methodological terms, this paper develops a simple procedure to correct the DEA efficiency scores for environmental characteristics by using the residuals of the Tobit regressions. We extend the procedure as suggested by Gasparani and Ramos (2003) to a more generous correction mechanism. The optimal size of the public sector is computed as the actual size

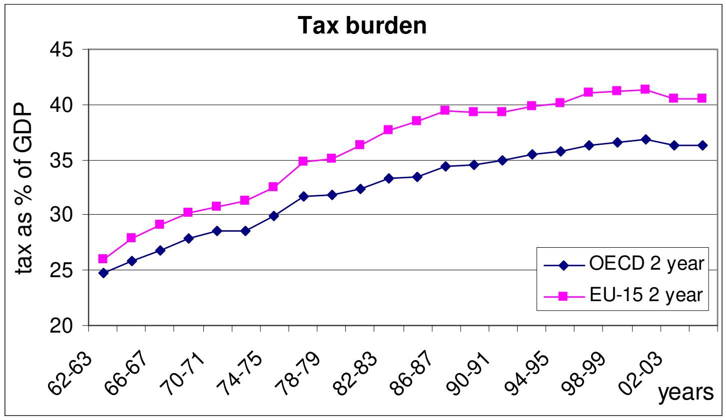

Figure 1: Tax burden 1962-2003

times the adjusted net efficiency score. We do not consider the influences of outliers nor measurement errors. From the outset, it should be emphasized that our approach offers only a partial analysis. As such, we do not investigate the crucial issue of equity, i.e., the interpersonal redistribution of opportunities, income and wealth. Furthermore, in the context of political economy, the many dimensions of 'eudemonia' (good life and happiness) are not covered except for the contribution from real growth.

Our results show that, on average, the public sector of the 23 OECD countries which constitute our sample should decrease by 3.74 percentage points to reach an overall tax burden of 41.22% of GDP. The Italian public sector, followed by the Swedish, would be prone to the largest decrease with, respectively, 10.24 and 7.88 percentage points. Public spending in New Zealand appears to be too low and could thus increase.

1 Is there an optimal government size?

1.1 The Armey curve

The search for an optimal size of government has been popularized by Armey (1995). The so-called 'Armey curve', which is represented in Figure 3, describes the relationship between the growth of the economy and the size of the public sector (where tax burden is a proxy).

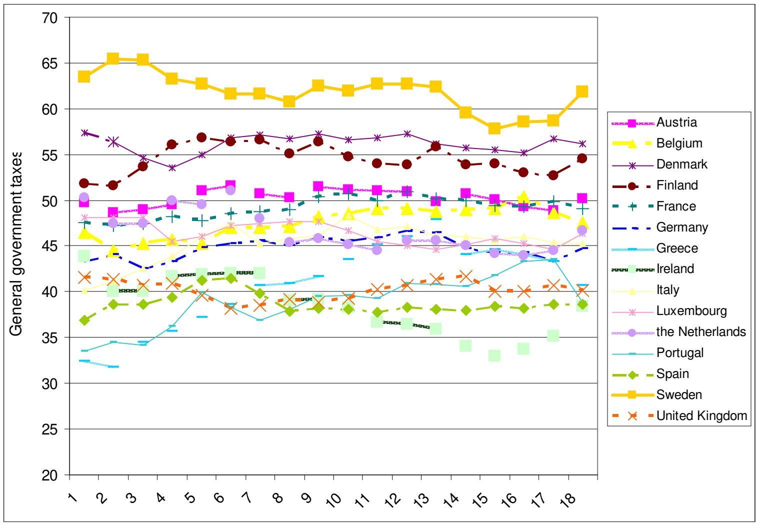

Figure 2: Tax burden for some OECD countries

If the government has no resources (i.e., zero taxation level), the growth rate of the economy corresponds to G_0. In a world without rule of law, private agents have to protect their own property rights. The establishment of a government skims some income, but creates a higher growth rate by introducing the provision of public goods and services which increases overall economic efficiency. At low levels of government spending, an increase in the tax rate raises the growth rate since the outlays (e.g., for infrastructure, education, public health, protection of property) are considered to be productive (Scully 2003). However, whereas the first euros spent have huge marginal effects, the next euros have smaller effects. For example, once a country possesses primary roads, the positive effects of secondary roads are smaller. In addition, as higher taxes are needed to finance government, distortions usually become more prevalent. Agents change their behavior in order to escape taxes. Public choice theory also predicts that the government officials become increasingly self-interested and not benevolent (see Mueller (2003) for an overview). Therefore, the curve has a concave shape due to decreasing marginal returns: a proportional increase in spending and taxation yields a less than proportional increase in economic growth. But thanks to positive externalities, an additional percentage of tax burden still creates higher economic efficiency (i.e., a positive

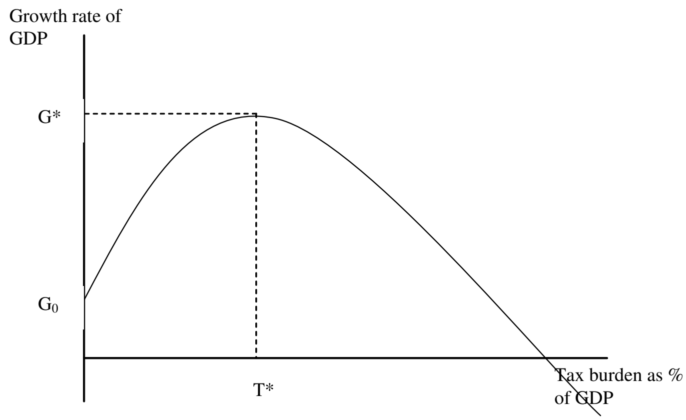

Figure 3: Armey curve

slope).

At some point, the marginal benefits from increased government spending become zero. With a tax burden of T^*, the government induces the highest possible rate of economic growth. Beyond T^*, government spending is more oriented towards non-productive spending (e.g., transfers and subsidies). An increase in the tax rate then lowers the growth rate of the economy. In contrast with what has come before, the additional resources claimed by the government come at the cost of private projects with higher returns.

1.2 Estimation of the optimal government size

The empirical literature provides several attempts to estimate the optimal level of the public sector. We mention some studies. Based on a model of endogenous growth, Barro (1990) finds the growth maximizing tax rate to be 25.1%. However, the standard error of the coefficient is so large that confidence in the estimate is quite small. Chao and Grubel (1998) place the maximum of the Armey curve for Canada at 34% of GDP. Pevcin (2004) suggests that the Armey curve for 12 European countries peaks when government spending is between 36.6% and 42.1% of GDP. Scully (1994) estimated a curve similar to the Armey curve. His model yields an optimal tax burden of 19.3% of GDP for the United States and 23% for New Zealand. According to Branson and Lovell (2001), the growth maximizing tax burden is 22.5%, far below the observed tax burden of 28%. Afonso *et al.* (2006) calculate that countries with lean public sectors and with public expenditure ratios of about 30% of GDP tend to be the most efficient countries in terms of public performance. As we show below, our results are somewhat similar, in that we estimate the average optimal size for the OECD countries to be around 40% of GDP with a standard deviation of 5%.

1.3 Drawbacks of a parametric estimation

Although the Armey curve represents an attractive conceptual framework, it suffers from a few drawbacks which make an empirical estimation of the curve rather inadequate. Some authors (e.g., Pevcin 2004) estimate the Armey curve by using a panel dataset in which the space and time dimension are disregarded. Measuring the optimum in this way assumes that all countries have the same G_0, as well as the same preferences and the same rate of decreasing marginal returns (Slemrod *et al.* 1995). These assumptions seem unrealistic. Moreover, the social cost of raising revenues, as well as their social benefits, can be expected to vary among countries due to differences in the effectiveness of budgetary institutions and political economy factors. In some countries, for example, citizens favor redistributive policies, while in others, they do not (Gupta *et al.* 2001).

If the Armey curve is estimated by country specific time series as in, e.g., Scully (2001), correlation is confused with causation. During periods of more robust economic growth, as in the 1950s and 1960s, government involvement was rather modest. Governments enlarged their outlays in the 1970s and 1990s when economic growth slowed down. However, this negative correlation does not necessarily mean causation. On the one hand, economic growth is subject to many exogenous factors (see, e.g., Crafts and Toniolo (1996)); on the other hand, government involvement is the result of the aggregation of social preferences in society, which varies with the voting rules in place. Estimations such as those by Scully (2001) do not take these effects into account.

In addition, parametric models assume *a priori* a particular functional form on the dataset, which is difficult to justify. We suggest an alternative exploration by estimating the optimal tax burden by use of the non-parametric 'Data Envelopment Analysis' (DEA). This procedure allows us to compare governments and to benchmark their long term achievements. We are able to correct for control variables, such as the openness of a country or preferences about government involvement in the economy (see *infra*). In this paper, we follow a top-down approach as explained in Slemrod *et al.* (1995). Top-down studies investigate the overall association between government involvement and economic growth. They contrast with bottom-up studies which estimate costs country by country, program by program and tax by tax.

2 Measuring government size with DEA

2.1 Measuring with DEA

Data envelopment analysis (DEA) assesses the relative efficiency of decision making units (DMUs). The original model with constant returns to scale was proposed by Charnes, Cooper and Rhodes (CCR) (1978) and later extended by Banker, Charnes and Cooper (BCC) (1984) to variable returns to scale. The DEA approach defines a non-parametric frontier which serves as a benchmark for efficiency measures. The frontier is constructed as the piecewise linear combination of the efficient DMUs in the sample.

We consider the input-oriented model which searches for the minimal inputs needed to produce given outputs. The efficiency of a DMU is obtained as the maximum of the ratio of the weighted sum of its outputs to the weighted sum of its inputs, subject to the condition that this ratio for any DMU does not exceed 1. This condition means that no DMU can operate beyond the efficiency frontier. We further assume non-negative weights. If there are m inputs x_i, s outputs y_r and n DMUs (indexed by $j \varepsilon \{1, 2, \ldots, n\}$), we state the BCC-problem as a simple linear programming formulation:

$$\theta_k(x, y) = \left\{ \theta \mid \theta x_o \geq \sum_{i=1}^{n} \gamma_i x_i ; y_o \leq \sum_{i=1}^{n} \gamma_i y_i ; \gamma_i \geq 0; \sum_{i=1}^{n} \gamma_i = 1; i = 1, ..., n \right\} \tag{1}$$

The inputs and outputs, labelled with a i subscript, are the inputs and outputs of DMU_i whose efficiency is being evaluated. The problem needs to be solved for every DMU. The technical efficiency score of DMU_i is defined as the value of θ_i. If θ_i equals 1, the DMU is relatively efficient. If θ_i is less than 1, it could produce, given its inputs, $(1 - \theta_i)$ percent more outputs. We consider θ_i as a gross efficiency measure which we will further correct for control variables in order to obtain an adjusted net efficiency measure.

Consider the case where there is only one input variable in an input-oriented model. Multiplying the efficiency score θ_i by the only input value, we obtain the *targeted* input value. This targeted input value indicates the optimal input for the DMU, given its output. We compute the optimal size of the government by the use of this optimal target value.

2.2 Advantages of DEA

To our best knowledge, the optimum of the Armey curve has been estimated only by the use of parametric methods. In this contribution, we apply an input-oriented DEA model to the problem (i.e., minimization of the inputs for a given amount of outputs). Although one of the advantages of DEA is the use of multiple inputs and outputs, we compute the model only for one input and one output variable. The tax burden is used as the input variable, and GDP growth as the output variable. This is consistent with the idea behind the Armey curve: for a given GDP growth rate, what is the optimal level of tax burden? By the use of DEA, we calculate for every country an optimal government size relative to the observed performances of the other countries in the dataset. In other words, we benchmark the governments by relating a country's economic growth to the size of its government. Since DEA is a non-parametric estimation procedure, we do not need any *a priori* assumption about the shape of the production function, as is required in the literature estimating an inverted U-shape. Moreover, in a second step, we will take into account control variables (e.g., openness of the country) and preferences (e.g., redistribution towards families).

The analysis covers OECD economies. Studying only OECD countries offers several advantages (see, e.g., Alesina and Furceri 2008). Firstly, data quality and comparability are of higher standards. Comparability is the more important due to the relative nature of the DEA technique. Secondly, data from OECD and non-OECD countries do not share a common set of coefficients in growth regressions (Grier and Tullock 1989). As such, it is difficult to pool these data. Finally, and related to the previous point, the economic structures in emerging OECD countries differ from those in mature economies. Therefore, we considere a sample of 23 reasonably comparable OECD countries. We borrow the data from the OECD statistical databases and evaluate the year 1999 (due to data constraints for family size, see *infra*). Nevertheless, we experimented with other years as well. As mentioned earlier, the output variable is GDP growth.[1] Gross Domestic Product (GDP) is preferred above Gross National Product (GNP) as GDP yields a better correlation with the economic activity within a country. The degree of government involvement is measured by the level of general government spending (total outlays). General government spending is the sum of the spendings by the central, state and local government, as well as social security spendings.

The input-oriented efficiency scores are presented in the first column of Table 1. We learn from this exercise that Ireland and the United States allocate the levied taxes most efficiently. For a given GDP growth, their governments need the smallest tax absorption. The Swedish and Danish governments spend according to the gross efficiency scores the collected taxes in the least efficient way in order to push GDP. The average gross efficiency score is 0.75. This means that, if governments would perform efficiently (i.e., as the US and Irish governments), they would only need 75% of the current taxation level.

3 Correction for exogenous influences

To improve the comperability of the sample, we make corrections for preferences and some other control variables. By the use of a specially designed econometric procedure, we correct the gross efficiency scores to obtain net efficiency values. We first introduce and explore the concept of the anorexia family.

Table 1: Optimal government size with GDP growth

	Gross efficiency score ($\theta_i^{adj^0}$)	Residu Tobit ϵ_i	Net efficiency score ($\theta_i^{adj^3}$)	Size public sector	long run optimal size	change in long run size
	(1)	(2)	(3)	(4)	(5)=(4)*(3)	(5)-(4)
Australia	0.921	0.052	0.972	37.947	36.883	-1.063
Austria	0.606	-0.008	0.912	50.893	46.418	-4.475
Belgium	0.642	-0.007	0.913	49.114	44.852	-4.262
Canada	0.795	-0.004	0.917	44.298	40.611	-3.687
Denmark	0.577	-0.001	0.919	57.233	52.596	-4.637
Finland	0.643	0.017	0.938	53.899	50.555	-3.344
France	0.612	-0.036	0.884	50.885	44.997	-5.888
Germany	0.657	0.000	0.920	46.723	42.993	-3.730
Greece	0.701	-0.078	0.842	46.035	38.778	-7.257
Iceland	0.771	-0.045	0.876	45.474	39.819	-5.656
Ireland	1.000	0.000	0.920	36.465	33.565	-2.900
Italy	0.649	-0.138	0.783	47.140	36.898	-10.242
Japan	0.839	0.035	0.955	30.569	29.205	-1.364
Luxembourg	0.785	0.000	0.920	45.055	41.472	-3.583
Netherlands	0.705	0.008	0.929	45.638	42.385	-3.253
New Zealand	0.804	0.137	1.057	40.075	42.376	2.301
Norway	0.678	0.022	0.943	54.311	51.194	-3.117
Portugal	0.741	0.036	0.957	40.933	39.157	-1.776
Spain	0.798	-0.003	0.918	38.267	35.125	-3.141
Sweden	0.557	-0.046	0.874	62.665	54.784	-7.881
Switzerland	0.876	0.000	0.920	34.656	31.900	-2.756
United Kingdom	0.821	0.050	0.971	40.734	39.537	-1.198
United States	1.000	-0.010	0.911	35.162	32.017	-3.145
average	0.747		0.920	44.964	41.222	-3.741
St. Deviation	0.126		0.051	7.870	6.826	2.563

3.1 The anorexia family

Family size in OECD countries steadily decreased during the last few decades. Whereas an average family consisted of 2.8 members in 1988, eleven years later a typical family has only 2.5 members (see Figure 4). One could say that the anorexia family emerges. The question remains as what extent this decline in family size reflects government involvement. Empirically, we find a strong negative correlation (-0.80) between family size and overall government taxes measured as a percentage of GDP and between family size and government spending (-0.55) (see Figure 5 for 1999 data).

On the one hand, the anorexia family invites the government to take up more tasks. Whereas before, for instance, families themselves looked after their younger and older members, crèches and resthomes supported by the government often fulfil that requirement nowadays. Several tasks which formerly were family responsibilities are nowadays assigned to the welfare state. On the other hand, thanks to extended government involvement, families could emaciate. Governments provide, for instance, pension allowances such that children are no longer the only safeguards for retired parents.[2]

Although we find a strong correlation, we do not know the direction of the causality. In further research, this causality should be carefully examined by Instrumental Variables (IV) techniques.[3] To present a flavor of the correlation between the family size and the government size, by use of an ordinary least squares estimation, we test the hypothesis that, for 23 OECD-countries, a smaller family size yields a larger government involvement. The results are presented in Table 2. Family size alone can explain 30.5% of the variation in taxation levels. We also checked whether the results remain robust if we add per capita GDP as an explanatory variable.

There exists a large and growing public finance literature on the relationship between government involvement and family size. A large part of the literature focuses on the link between fertility, growth and government size. This branch is based on the inspiring paper of Galor and Weil (1996). Another branch of the literature discusses the role of family size in the design of optimal income taxation (e.g., Cremer *et al.* 2003). However, to our best

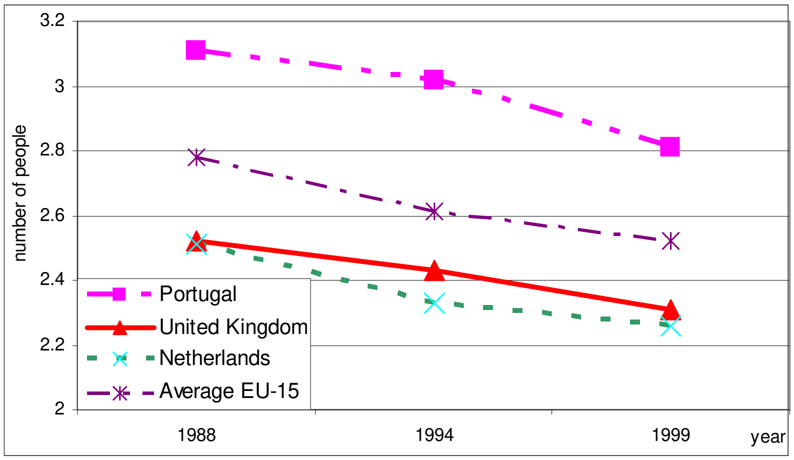

Figure 4: Family size 1988-1999

knowledge the literature does not provide a model which specifies the relationship between family size and the size of the government.

In the remainder of this section, we consider family size to represent an implicit preference for the extent of government involvement. Societies which prefer a larger government involvement (e.g., Denmark with general government spending equal to 52.5% of GDP in 1999), have on average smaller families (i.e., Denmark counts only 2.14 members in 1999). Due to the unknown causality is the reverse also true: societies with lean public sectors (e.g., Spain with 38.3% of GDP), have on average bigger families (i.e., Spain counts 3.24 family members). If we consider total 'social' expenditures, which are measured as the sum of resources spend for families, disabled persons, the unemployed, elderly people and sick persons, as an explicit measure for government involvement, we find a significant negative correlation (-0.65) between explicit and implicit preferences. Family size can explain 38.5% of the variation in total social expenditures (see Table 3 and Figure 6).

3.2 Other control variables

The countries in the sample differ in several aspects. First of all, different countries have different tastes and preferences about the optimal size of government. We capture preferences

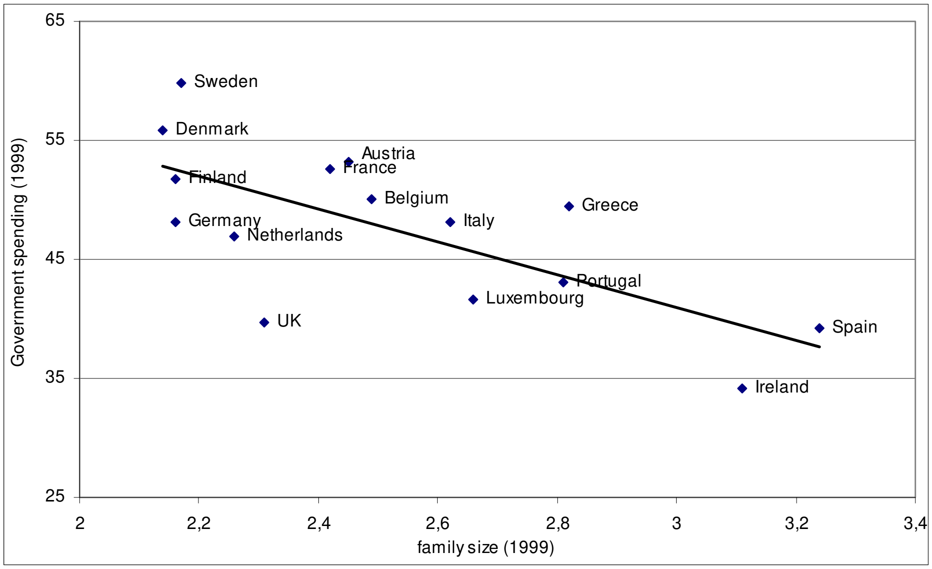

Figure 5: The anorexia family and government spending

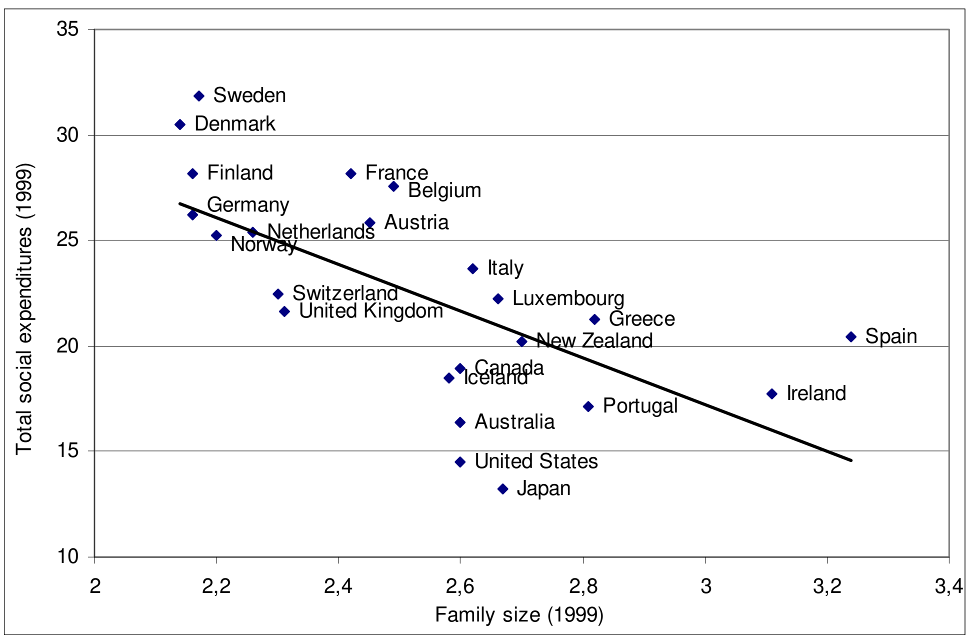

Figure 6: The anorexia family and total social expenditures

Table 2: Relationship government size - family size

Variable	Coefficient	Std. Error
Constant	4.6027 ***	0.2744
Family size	-0.3277 ***	0.1080
R-squared	0.3049	

Dependent variable: logarithm of average taxes levied by general government

where *** denotes significance at 1% level.

Table 3: Relationship social expenditures - family size

Variable	Coefficient	Std.Error
Constant	4.3218	0.3424
Familysize	-0.4889	0.1347
R-squared	0.3854	

Dependent variable: logarithm of total social expenditures

where *** denotes significance at 1% level.

for the extent of government involvement by the average family size. Countries with lean families prefer larger government involvement as argued in the previous section.

Secondly, we correct for the degree of countries' openness to trade. Open countries are more subject to external shocks and therefore need a larger public sector to accomplish a stabilizing role (Roderik 1996). We measure the degree of openness by computing the sum of exports and imports as a percentage of GDP. Afonso *et al.* (2006) remark that exports also can act as a proxy for the degree of international competition in labor and capital markets, and that greater competitiveness would penalize public inefficiency disproportionately. If the penalizing effect of Afonso *et al.* (2006) dominates, we expect a positive sign in the correction, if Roderik's stabilizing requirement dominates, we expect a negative sign.

A third correction measure is GDP per capita. It captures the large income elasticity (exceeding one) with respect to governmental services as suggested by Wagner (1877). He stated that richer economies prefer larger public sectors. In addition, GDP per capita is also a measure for the income of the median voter[4] (although median income is more usual), who is an important actor in the public choice literature (starting from Tullock 1972; Borcherding and Deacon, 1972).

Fourthly, we include the capital stock of a country. This variable aims to proxy the physical capital stock which stimulates an efficient production of (public) goods and services (Afonso *et al.* 2006).

Finally, we include some traditional variables to explain government involvement: country size (expressed as total population), population density and urbanization (proxied by the share of national population in the 10% of regions with the largest populations).

In order to compute the adjusted net efficiency score for each DMU, we econometrically explore these factors which are likely to influence productive efficiency. The left-hand variable is the gross efficiency score, while the right-hand variables are the correction factors. Since the gross efficiency scores are right-censored (no values above 1), we have to estimate by a Tobit model. The regression residuals from the Tobit model indicate the portion of the efficiency that remains unexplained after correcting for the control variables (Tupper and Resende 2004). Since the residuals alternate in sign, whereas a proper efficiency measure should possess a one-sided distribution, we use the procedure of Gasparini and Ramos (2003), which allows us to generate adjusted DEA scores that are confined within the $[0,1]$ interval:

$$\theta_i^{adj} = \epsilon_i + (1 - \max_{j=1,\ldots,n} \epsilon_j) \tag{2}$$

where θ_i^{adj} denotes the adjusted efficiency score for DMU_i, ϵ_i stands for the residual for each DMU_i obtained from the Tobit estimation.

However, we consider this procedure as 'too severe'. Some governments could be 'inefficient' simply because they are too small. Those governments could, by increasing the tax burden, obtain a larger GDP growth. The adjusted efficiency score as obtained by equation (2) fails to detect those inefficient governments. Therefore, we extend the procedure of Gasparini and Ramos (2003) to a more general correction mechanism. Our suggestion is to consider not only the largest residual, but an average of the w largest residuals. Hence, we sort the residuals ϵ_i in order of magnitude and compute:

$$\theta_i^{adj^w} = \epsilon_i + (1 - \frac{1}{w}\sum_{j=1}^{w} \epsilon_j). \tag{3}$$

Obviously, the relative rigour of the correction depends on the number w by which the residuals are corrected. The larger is w, the less severe is the correction and, hence, the larger is the average optimal public sector. As we do not know the proper value of w, we further perform a sensitivity analysis.

3.3 Sizing the government

The results of the estimation are given in Table 1. The left column in the Table represents the uncorrected gross efficiency scores. By estimating a Tobit regression, we correct the gross efficiency scores. The Tobit estimation is presented in Table 4. Family size, openness of the economy, country size, population density and urbanization have a statistically significant effect on the efficiency of the DEA model. As capital stock has a very insignificant effect, we removed it from the results. Family size has the expected positive effect on gross efficiency. The larger the average family, the higher the gross efficiency. Hence, countries with larger average family size (and thus preferences for less government involvement), can create a given GDP growth with fewer government spendings. Since larger exports decrease efficiency, Roderik's stabilizing effect emerges. GDP per capita shows a positive but insignificant effect on the efficiency: the richer the country, the higher the gross efficiency. Both country size, population density and urbanization influence the gross efficiency scores positively.

As also the size of the effect is of importance, we present in Figure 7 the effect on the mean of each of the significant variables. We observe that the effect of the household size has the largest influence on efficiency. Urbanization, population density and population have clearly a lower effect on the mean.

Since we are primarily interested in the residuals which we obtain from the Tobit regression, the finding whether a certain variable has a significant impact on the efficiency score does not matter so much for our purpose. The residuals are reproduced in the second column of Table 1. From the residuals, we compute the net efficiency scores by use of equation (3) with w arbitrarily set to, e.g., 3 (later on, we perform a sensitivity analysis). The optimal size is computed as the government size times the adjusted net efficiency score.

From comparing the gross and the net efficiency scores, we learn that all countries, except for Ireland and the United States, gain from the correction for control variables. The efficiency scores of Denmark, Sweden and Austria increase the most, thanks to the correction for redistributive preferences. If we take control factors into account, the optimal average tax burden of the 23 OECD countries should amount to 41.22% of GDP. The public sector thus should on average decrease by 3.74 percentage points. Note that our results compare well with those in related literature (e.g., Chao and Grubel 1998 or Pevcin 2004). But the optimal government size differs considerably between the countries. The largest decrease in tax burden should occur in Italy, with a fall of 10.24 percentage points. Also Sweden, Greece, Iceland and France should decrease the tax burden by more than 5 percentage points. In contrast, the tax burden in New Zealand should optimally increase by 2.30 percentage points to 42.37% of GDP.

Table 4: Tobit estimation with GDP growth

		Coefficient	Std. Error
efficiency =	Constant	-3.551E-02	0.157
	Size household	2.179E-01 ***	0.053
	Openess	-9.100E-04 *	0.001
	GDP/cap.	9.520E-06 *	0.000
	Population	6.920E-10 ***	0.000
	Population density	6.290E-04 ***	0.000
	Urbanization	4.536E-03 ***	0.002
	R-squared	0.844	

where *** denotes efficiency at 1% level, ** at 5% and * at 10%.

In order to test the robustness of w in determining the size of the optimal government involvement, we perform a sensitivity analysis. We compute for several values of w the optimal tax burden. The results are presented in Table 5. Notice that, as w increases, the optimal size of government rises as well. The difference between $\theta_i^{adj^1}$ and $\theta_i^{adj^7}$ amounts on average to 3.92 percentage points. However, some countries benefit more from generous weighting. The difference between $\theta_i^{adj^1}$ and $\theta_i^{adj^7}$ is largest in Sweden with 5.45 percentage

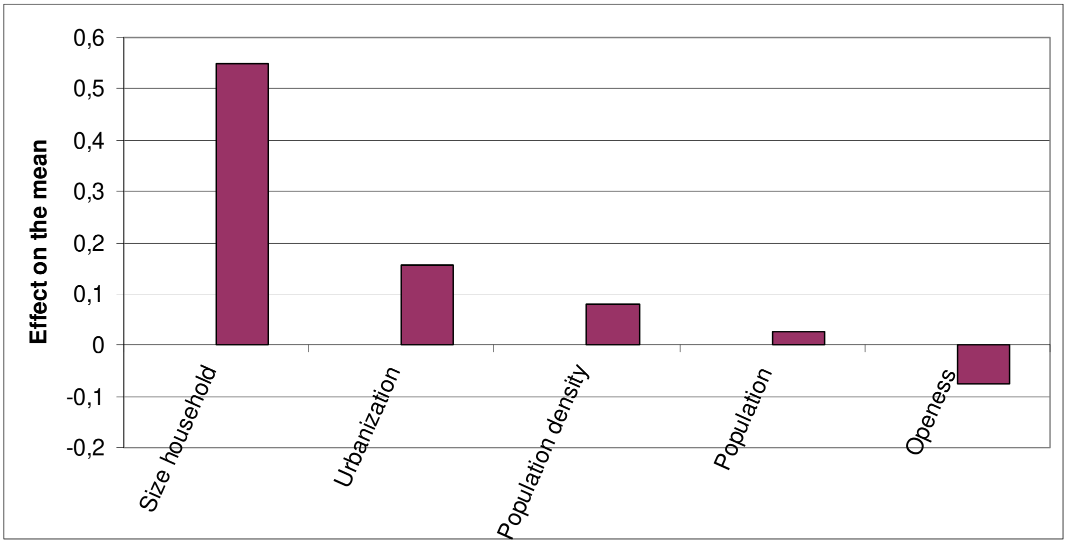

Figure 7: Effect on the mean of the exploratory variables

points. Sweden is followed by Denmark (a difference of 4.98), Norway (4.72) and Finland (4.69). These Scandinavian countries take most advantage of a more generous weighting of w. Japan (with 2.66) obtains the least gain from the weighting system.

However, even in a very generous model (i.e., w equal to 7), most governments would have to decrease spending by 2.41 percentage points in order to obtain higher GDP growth. Only New Zealand should decrease its tax burden in none of the models. Australia and United Kingdom should optimally increase the government size from the moment we correct by taking w as 7.

3.4 Public sector performance

Economic growth is not the only objective that a benevolent government can pursue. Musgrave (1959) defined three major tasks for the government: (1) allocative efficiency, (2) economic stability and (3) redistribution. Afonso *et al.* (2005) added to these main tasks four opportunity indicators: the quality of administration, education, health and public infrastructure. The last four indicators describe the rule of law and the promotion of equality and opportunity in the market place. Afonso *et al.* (2005) constructed the composite indi-

Table 5: Sensitivity analysis

	Actual size	$\theta_i^{adj^1}$	$\theta_i^{adj^2}$	$\theta_i^{adj^3}$	$\theta_i^{adj^4}$	$\theta_i^{adj^5}$	$\theta_i^{adj^6}$	$\theta_i^{adj^7}$
Australia	37.947	34.704	36.326	36.883	37.295	37.551	37.803	38.008
Austria	50.893	43.496	45.670	46.418	46.970	47.314	47.652	47.927
Belgium	49.114	42.031	44.130	44.852	45.384	45.716	46.042	46.307
Canada	44.298	38.067	39.960	40.611	41.092	41.391	41.685	41.924
Denmark	57.233	49.310	51.755	52.596	53.217	53.604	53.983	54.293
Finland	53.899	47.460	49.763	50.555	51.140	51.504	51.861	52.152
France	50.885	42.075	44.249	44.997	45.549	45.893	46.230	46.505
Germany	46.723	40.309	42.306	42.993	43.499	43.815	44.125	44.377
Greece	46.035	36.135	38.102	38.778	39.278	39.589	39.894	40.143
Iceland	45.474	37.207	39.150	39.819	40.312	40.619	40.921	41.166
Ireland	36.465	31.471	33.029	33.565	33.961	34.207	34.449	34.646
Italy	47.140	34.191	36.205	36.898	37.409	37.728	38.040	38.295
Japan	30.569	27.449	28.755	29.205	29.536	29.743	29.946	30.111
Luxembourg	45.055	38.884	40.809	41.472	41.960	42.265	42.564	42.807
Netherlands	45.638	39.764	41.714	42.385	42.880	43.189	43.491	43.738
New Zealand	40.075	40.075	41.787	42.376	42.811	43.081	43.347	43.564
Norway	54.311	48.075	50.395	51.194	51.783	52.150	52.510	52.803
Portugal	40.933	36.807	38.556	39.157	39.601	39.878	40.149	40.370
Spain	38.267	32.928	34.563	35.125	35.540	35.799	36.053	36.259
Sweden	62.665	51.185	53.863	54.784	55.464	55.887	56.303	56.641
Switzerland	34.656	29.909	31.390	31.900	32.275	32.510	32.739	32.927
United Kingdom	40.734	37.197	38.938	39.537	39.979	40.254	40.524	40.744
United States	35.162	29.997	31.500	32.017	32.398	32.636	32.869	33.059
average	44.964	38.640	40.561	41.222	41.710	42.014	42.312	42.555
maximum	62.665	51.185	53.863	54.784	55.464	55.887	56.303	56.641
minimum	30.569	27.449	28.755	29.205	29.536	29.743	29.946	30.111
St. Deviation	7.870	6.398	6.716	6.826	6.907	6.957	7.007	7.047

cator 'Public Sector Performance' (PSP) by equal weighting of these seven sub-indicators.

We investigate whether the optimal size of the government changes if we use the PSP-indicator in the first step of the DEA-model. In this setting, the government has to minimise spending, while fulfilling a whole set of public activities. In the DEA input-model, government spending remains the input, while PSP becomes the output variable. Once more we correct for implicit preferences (family size as proxy), openness, GDP per capita, country size, population density and urbanization. The results are given in Table 6.

Table 6 with PSP as output in the first step, slightly differs from Table 1 with GDP growth as output in the initial DEA-model. The correlation is 0.93. Whereas the average size of the government was 41.22%, an extension to broader government tasks yields an optimal tax burden of 42.18%. Again we compute the difference between the actual size and the long run optimum. The Italian public sector should reduce its resources the most. It should optimally decrease its spending by 9.22 percentage points. Sweden, Germany, France and Finland complete the top-five biggest declines. Norway, New Zealand, Australia and United Kingdom should optimally enlarge their public sector to meet the PSP criteria even better.

The difference between the two models is largest for Norway. The optimal Norwegian spendings are 8.27 percentage points higher, if measured by PSP. The German government involvement should optimally be 3.18 percentage points smaller if measured by GDP growth as output variable in the first step. There is almost no difference between the two procedures for the United States (0.15 percentage points larger if measured by PSP as output in the first step) and Switzerland (0.11).

4 Concluding remarks

Government involvement expanded rapidly in the second part of the last century. Many economists insist on downsizing the government. Their arguments are based on the so-called 'Armey curve'. We indicate that these estimates rely on unrealistic assumptions, the ignorance of preferences and a confusion of correlation with causation. We find a strong negative correlation between family size and overall government size. On the one hand,

Table 6: Optimal government size with PSP

	Gross efficiency score ($\theta_i^{adj^0}$)	Residu Tobit ϵ_i	Net efficiency score ($\theta_i^{adj^3}$)	Size public sector	long run optimal size	change in long run size
	1	2	3	4	5 = 4*3	5 = 4
Australia	0.959	0.104	1.060	35.714	37.851	2.137
Austria	0.606	-0.042	0.914	50.222	45.894	-4.328
Belgium	0.642	0.038	0.994	47.593	47.303	-0.290
Canada	0.785	-0.032	0.924	42.935	39.688	-3.247
Denmark	0.577	0.015	0.971	56.160	54.514	-1.646
Finland	0.643	-0.037	0.919	54.501	50.092	-4.409
France	0.612	-0.051	0.905	49.136	44.486	-4.650
Germany	0.657	-0.067	0.889	44.779	39.808	-4.971
Greece	0.701	-0.061	0.895	40.716	36.440	-4.276
Iceland	0.771	0.012	0.968	42.084	40.728	-1.356
Ireland	0.963	0.005	0.961	38.414	36.898	-1.515
Italy	0.649	-0.160	0.796	45.290	36.070	-9.220
Japan	1.000	0.040	0.996	31.673	31.537	-0.136
Luxembourg	0.891	0.000	0.956	46.379	44.338	-2.041
Netherlands	0.705	0.023	0.979	46.675	45.693	-0.983
New Zealand	0.795	0.112	1.068	44.113	47.093	2.979
Norway	0.678	0.116	1.072	55.491	59.466	3.975
Portugal	0.741	0.008	0.964	38.871	37.463	-1.407
Spain	0.791	-0.018	0.938	38.671	36.291	-2.380
Sweden	0.551	-0.084	0.872	61.829	53.891	-7.938
Switzerland	0.876	0.000	0.956	33.253	31.789	-1.463
United Kingdom	0.821	0.054	1.010	40.166	40.580	0.413
United States	1.000	0.003	0.959	33.537	32.173	-1.364
average	0.757		0.955	44.270	42.178	-2.092
St. Deviation	0.138		0.064	7.866	7.534	3.118

Table 7: Tobit estimation with PSP

		Coefficient	Std. Error
efficiency =	Constant	2.553E-01	0.163
	Size household	9.142E-02	0.064
	Openess	-9.640E-04	0.001
	GDP/cap.	5.270E-06 ***	0.000
	Population	1.110E-09 **	0.000
	Population density	4.820E-04 **	0.000
	Urbanization	5.956E-03 ***	0.002
	R-squared	0.763	

where *** and ** denote, respectively, significance at 1 and 5% level.

the anorexia family forces the government to take up more tasks. On the other hand, as government involvement expands, families could emancipate.

We estimate by the use of a non-parametric 'Data Envelopment Analysis' (DEA) the gross efficiency of government spendings (1999 data). In a second stage, these gross-scores are corrected by linking them to classic control variables such as initial per capita income (Wagner 1877), degree of openness (Roderik 1996), country size, population density and urbanization. We introduce family size as a novel explanatory variable. By the use of a generous correction mechanism, we compute the optimal size of the government. The optimal average government involvement in the 23 OECD countries amounts to 41.22% of GDP. This means that the public sector should on average decrease by 3.74 percentage points. Whereas the largest decrease should occur in Italy with a reduction of 10.24 percentage points, New Zealand should optimally increase its government involvement by 2.30 percentage points.

Borrowing the composite indicator 'Public Sector Performance' (PSP) of Afonso *et al.* (2005), we enlarge the objectives of a benevolent government beyond economic growth. It appears that the average optimal tax burden slightly increases to 42.17%. However, Italy and Sweden should still decrease their government involvement by more than 5 percentage points.

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Notes

[1] In order to filter out the economic cycles from the raw data, we take the arithmetic mean of real GDP growth for the period 1988 - 2004. The variable thus obtained reads as the long-run GDP growth.

[2] Remark that when government taxes are considered as a proxy for the government size, the causation could be influenced by the design of the tax system. For a specific tax system, a larger family size could reduce government revenues.

[3] In the current research, we do not examine the causality formally as (1) the appropriate techniques are not available in the non-parametric DEA and as (2) selecting the appropriate IV are an intricate issue.

[4] Indeed, thanks to the law of large numbers we approximate a normal distribution, such that, the median value converges to the mean value.

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