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Government size and output volatility: is there a relationship?

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Abstract

This paper provides some further tests for the proposition that a larger public sector leads to smaller output volatility. Both Gali and Fatas & Mihov have provided some evidence which appears to support this proposition. Their evidence is, however, based on a relatively small sample of countries. In this study, we go beyond the OECD sample and focus on a much larger World Bank data set covering up to 208 countries for the period 1960–2002. We also seek to utilise some time series aspects of the material by using pooled cross-section time series data. Tests with different models and measures clearly indicate that the original results are not very robust and the relationship between government size and output volatility is either nonexistent or very weak at best.

Key words: government, fiscal policy, automatic stabilisers

JEL classification numbers: E62, H30, E32

Julkisen sektorin koko ja tuotannon volatiilisuus: onko niiden välillä riippuvuutta?

Suomen Pankin tutkimus
Keskustelualoitteita 8/2005

Matti Virén
Rahapolitiikka- ja tutkimusosasto

Tiivistelmä

Tutkimuksessa on testattu oletusta, jonka mukaan suurempi julkinen sektori johtaa pienempään kokonaistuotannon vaihteluun. Gali sekä Fatas ja Mihov ovat empiirisissä töissään päätyneet tulokseen, joka tukee tätä oletusta. Empiirinen tuki on kuitenkin perustunut verraten pieneen otokseen maailman maista. Tässä tutkimuksessa laajennetaan otosta OECD-maiden ulkopuolelle ja tukeudutaan paljon laajempaan Maailmanpankin tilastoaineistoon, joka käsittää suurimmillaan 208 maata ja kattaa ajanjakson 1960–2002. Tutkimuksessa pyritään myös käyttämään hyväksi tilastoaineiston aikasarjaominaisuuksia niin sanotun puulatun aikasarja-poikkileikkausaineiston mielessä. Testit eri malleilla ja mittaustavoilla osoittavat selvästi, että alkuperäinen tulos ei ole kovin robusti ja riippuvuus julkisen sektorin koon ja tuotannon vaihteluiden välillä on joko olematon tai parhaimmillaan hyvin heikko.

Avainsanat: julkisen sektorin koko, finanssipolitiikka, automaattiset vakauttajat

JEL-luokittelu: E62, H30, E32

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1 Introduction

Recently, the role of automatic stabilisers and the effectiveness of fiscal policy in general have become important issues in Europe, at least. The explanation is obvious: Euro and The Stability and Growth Pact (SGP). The importance of the issue has increased along with the recent structural and cyclical public sector financing problems which no more can be rescued by monetary policy measures.

The evaluation of the effectiveness of fiscal policy is a quite complicated matter because it requires that we are able to control the key economic variables and shocks. Basically, it would require a large macro-model which would among other things include all key fiscal policy parameters and behavioural equations and which would facilitate an evaluation of so-called automatic stabilisers. Although in the past several attempts have been made to assess the effectiveness of policy by using macro-model based approach it is now generally considered that some simpler devices have be found for that purpose.[1] The particular piece of analysis which has been used extensively in this literature is the paper by Gali (1994). More recent analyses include Fatas and Mihov (2001a,b) and Andres, Domenech and Fatas (2004). All of those use cross-section data from OECD countries and estimate a simple equation in which the standard deviation of output growth (or, the Hodrick–Prescott residual of GDP) is explained by the government expenditure/GDP ratio and by several control variables such as the openness of the economy.

Silgoner, Reitschuler and Crespo-Cuaresma (2003) go a bit further by not only using cross-section data but instead five-year period panel data for the OECD countries.[2]

Basically, this paper is an extension of the above mentioned empirical analyses in the following respects:

- We use more extensive international data set for more than 150 countries
- We use an extensive list of controls
- We use several empirical measures for both output volatility and government size
- We use both cross-section and panel data
- We use both a long (1960–2001) and a short (1987–2001) sample period

[1] See eg Christiano (1984) and Van den Noord (2000) for more detailed analysis on the automatic stabilisers. For macromodel based approach in evaluating the impact of automatic stabilisers, see eg Barrell, Hurst, Pina (2002) and Dudek, Pachucki and Virén (2004).

[2] Also Koskela and Virén (2003) use a panel data set-up to examine the government size – output volatility relationship. They find only little evidence on a (negative) relationship between output volatility and government size.

The data on described in more detail in the data appendix.

Bore going to the data and to empirical analysis it might be worthwhile to consider shortly the reasons why bigger government might lower output volatility. Take a very simple aggregate demand model which just includes the income tax rate. So, assume that private consumption is determined by a simple Keynesian classroom model:

$$C = c(1-t)Y$$

while $Y = C + G + X$.

One can then get the following derivative w.r.t the tax rate:

$$\frac{\partial \mathrm{Var}(Y)}{\partial t} = \left\{ \frac{-2c^2(1-t)}{(1-c^2(1-t)^2)^3} \right\} (\mathrm{Var}(G) + \mathrm{Var}(X)) < 0$$

Thus, the tax rate tends to diminish output volatility while public consumption expenditure volatility (similarly to exogenous demand component's volatility) obviously translates to larger output volatility.

Thus, the tax effect reflects the automatic stabiliser's effect while Var(G) reflects the fact that government itself may increase output volatility via various expenditure (and revenue) shocks. The relationship between tax rates and the government size is complex but, in general, we can argue that bigger government implies higher tax (income) rates. This fact is also supported by our data: thus the coefficient of correlation between gross tax rate (government revenues/GDP) and the highest marginal personal income tax rate is 0.41 and while with the highest marginal corporate tax rate it is 0.23[3]. In other words, it is not possible to run big government with flat income tax rates. Later on (Table 6), we present some

[3] If the total expenditures/GDP ratio is the indicator of government size, correlations are much lower. Thus eg cor(EXP,TAXC) = 0.17. Obviously the highest marginal income tax rate – which would be the proper indicator – is different from the average marginal income tax rate.

evidence that the marginal tax rate do indeed affect output volatility beyond the public sector size variable.[4]

It is important to notice that output volatility depends directly on government expenditure volatility. This clearly shows up in Table 1. The most volatile components of total output are investment, exports and imports. Public consumption appears to be a bit more volatile than private consumption. On the basis of these numbers one might argue that government size is not the key determinant of output volatility but instead the determinants of investment and foreign trade are of crucial importance.[5]

One thing that we can do here to distinguish different effects is to look at instead of total output (GDP) volatility also private output or private consumption (growth) volatility. That might give us a better estimate of the balancing role of automatic stabilisers (taxes, in particular). In fact, this is done in the subsequent empirical analysis to which we turn now.

2 Empirical analysis

The empirical analysis consists of scrutinizing (a) the pair wise relationship between various measures of output volatility and government size, (b) estimating the output volatility model with various control variables and (c) estimating the output volatility model with pooled cross-country data.

The pair wise correlations are illustrated in Figures 1 and 2 and the results with simple two-variable model in Tables 2 and 3. The bottom line in these

---

[4] The fact that 'taxes' reduce total output volatility shows up even if we did not introduce any consumption function but instead introduced more general macromodel set up. Thus, if one take the McCallum and Whitaker (1979) model as a point of reference, the following rational expectations solution can be derived for (total) output:

$y = a_0 + a_2 y_{-1} + (b_1 u + a_2 c_2 v + a_1 b_1 e)/(b_1 + a_1 b_1 c_1 + a_1 c_2 (1 - b_3 \tau))$

where u, v and e are aggregate supply, IS and LM equation shocks, a_1 denote the price 'surprise' term coefficient in aggregate supply equation, b_1 the real interest rate coefficient in the IS equation, c_1 the income variable coefficient in the LM equation, c_2 the interest rate coefficient in the LM equation and b_3 the tax liabilities coefficient in the IS curve equation. Taxes are modelled as $\tau_0 + \tau y$. It is straightforward to show that Var(y) decreases when the tax rate τ increases (basically up the level of $\tau = 1$). Notice that even if the mode includes a fiscal policy feedback rule in terms of public expenditure the parameters of this rule do not show in the solution of output. This is true as long as government spending does not depend on current output (or prices or the interest rate).

[5] These determinants might, of course, include tax rates and other public sector policy parameters. But those might not be related very strongly to the size of the public sector. Take for instance taxes on international trade. The median value of those taxes out of total government revenues is currently about 6 per cent).

analyses is the difference between OECD countries and the rest of the world. With the OECD data a negative relationship between volatility and public sector size might be detected although it is far from precise. With the larger data set, however, the relationship appears to be very weak, if nonexistent. As mentioned above, earlier studies have just made use of data from OECD countries. In this respect, our results are well in accordance with these earlier studies.

Even if the data for the OECD countries is presumably better than for most non-OECD countries, we have the problem that the OECD countries are relatively homogenous with relatively little variance for the size of the government. Moreover, the very small number of observations represents an obvious caveat as can already be seen from Figure 2, and this is not only due to the small sample bias. Thus a couple of influential observations can easily affect the main outcome.

When scrutinizing the results in Table 2, one may observe that the various proxies for government size behave somewhat differently. Thus, the gross tax rate (TAX) is more consistent with the negative relationship proposition. By contrast, the expenditure variable (EXP) behaves quite badly from the point of this proposition. Thus, the coefficient is practically always equal to zero. With public consumption (GGC), evidence is somewhat mixed: the coefficient is some cases negative (with reasonable t-ratios) but in some other cases the coefficient is clearly (and significantly) positive!

The result appears to be quite robust.[6] Thus, estimates for different sub-samples (in terms of output variability) do not make much difference (see Table 3).

One way of avoiding a possible spurious relationship is to have some controls in the output volatility model. Obviously, there is endless list of these variables but we concentrate here on variables which have been used previous studies and which take into account the structure of economy (share of agriculture of total output), openness of the economy (foreign trade/GDP)[7], size of the country (population and population density), monetary policy (failures) (the inflation rate) and the level of overall development (GDP per capita in USD). The list of controls also includes the military expenditures/GDP ratio which in fact appears to be quite important explanatory variable in the model suggesting that political crises have an important effect on output volatility. Thus, military expenditures

[6] The cross-section equations were also estimated with a robust (Huber) estimator. That did not make qualitative change in results. The values of the coefficients did change somewhat but even then the 't-ratios' remained very low thinking about the null hypothesis of zero coefficient for the government size variable. Take just one example: the regression between Var(g) and tax. The 't-ratio' changed from 1.06 to 0.68 for the log period (from 1.01 to 1.72 for the short period).

[7] The openness argument comes from Rodick (1998) who argues that there is a (positive) correlation between an economy's trade and the size of government because open countries are more subject to external shocks and to offset these shocks they choose a lager public sector. For more on issue see eg Alesina and Wacziak (1998).

may not stabilize the economy even if they would lead to bigger government. Finally, we have also the average growth rate of the economy to account he for possibility that higher average growth rate simply leads to higher volatility (in the same way as higher inflation shows up in higher inflation variability).

As pointed out above, the final analyses deal with the pooled cross country data which are reported in Table 5. When doing these analyses we face the problem of finding a measure for the 'annual' volatility of output. Because there is no perfect measure we chose to use the following alternative proxies:

- The squared value of the GDP growth rate (G^2)
- The squared value of Hodrick-Prescott (HP) residual (Yhp^2)
- The squared residual of an AR(1) model for the GDP growth rates (Res^2)

The HP trend is computed both for the GDP and private production (GDP-CQ). The latter variable in denoted by $Yhpp^2$. Accordingly, the growth rate is computed both for the unadjusted GDP growth rate, GDP per capita growth rate and the growth rate of private consumption. These variables are denoted by G, Gpc and Gcons, respectively. Thus all in all, we have a relative extensive set of measures for output variability which are supposed to cover all obvious measurement errors with the concept of government size.

Here we just report the coefficient estimates of the government size variable. That is because of space reasons and because the other coefficients behave more or less in the same way for all specifications. Anyway, to give some idea of the flavour of the complete results we present here just one equation (equation 1 in Table 5).

$$G^2 = \sum_i c_i - \underset{(0.38)}{.206}{}^{*}\,TAX + \underset{(1.17)}{.282}{}^{*}\,INF + \underset{(0.96)}{.526}{}^{*}\,AGRI + \underset{(1.10)}{.072}{}^{*}\,GDPpc + \underset{(2.83)}{.448}{}^{*}\,TRADE$$
$$- \underset{(4.70)}{.920}{}^{*}\,POP + \underset{(0.26)}{.006}{}^{*}\,DENSITY$$
$$R2 = .203,\ SEE = 72.35,\ DW = 1.77,\ n = 2321$$

The results follow the same pattern as in Tables 2–4. Thus, the coefficient of the TAX variable is negative marginally significant in several cases but in most cases the t-ratios are well below one. The other proxies give even less support to proposition that there is a negative relationship between output volatility and government size. Take for instance total expenditure/GDP ratio. Its coefficient is always either positive or insignificant (with conventional significance levels of the t-statistic).

Different estimators make some difference but the main difference comes from different proxies and sample periods. Thus, for instance, instrumenting the government size variables to take into account the possible (simultaneous) effects

from economics shocks to government behaviour does not seem to make any noticeable difference in results (and this really applies to a large set possible instruments). Similarly, different treatment of time and country effects does not produce any qualitative difference in results. As one might expect, the government size variables can be estimated (seemingly) more precisely when we nullify both the period and individual country effects. However, this shows up in the overall performance of the model in a negative way.

Thus, one may conclude that there is no robust relationship between government size and output volatility. It is also obvious that government size itself is not good stabilizing factor. Instead the marginal tax rates (and possible cyclically related expenditure effects) are more important. Some, although very marginal evidence on that can be obtained from regressions reported in Table 6.[8]

3 Conclusions

The question of whether automatic stabilisers work or not is no doubt very important. It is only that one cannot easily measure the contribution of these stabilisers. The idea to use the government size-output volatility relationship as evidence of the contribution of automatic stabilisers is obviously tempting but this paper suggests that things are not easy. First of all, there is no clear one-to-one link between the size of government and the effectiveness of automatic stabilisers. Secondly, it looks that there is no strong relationship between these variables and the previous findings may just reflect some peculiar features of the small samples which have thus far been used empirical analyses. Maybe, it would be more useful to try to get more accurate measures of the key determinants of automatic stabilisers (say, of the average marginal income tax rate) and relate those to indicators of cyclical activity. Just expanding the government may not increase stability but it can produce a contrary result, especially if the volatility of government expenditures cannot be properly controlled.

[8] Just recently, we were able to update the data so that it now cover 208 countries and the most recent observations are for 2002. The results with thesee new data qualitatively similar to the 'old' data although they may a bit better match with stabilization story. (see Appendix 2). In particular this is true with the robust estimates. This feature is also supported by the simple fiscal reaction equations in which the (components of) government deficits are explained by the growth rate of GDP (and some control variables). In these equations, deficits seem systematically to decrease along with higher GDP growth (ie in a counter-cyclical manner).

Table 1. **Descriptive cross-country data on aggregate demand and supply components**

	ΔGDP	ΔGC	ΔI	ΔCQ	ΔEXPO	ΔIMP
Mean	0.034	0.033	0.035	0.033	0.050	0.043
Median	0.037	0.033	0.041	0.034	0.054	0.050
Std. Dev.	0.053	0.110	0.171	0.080	0.157	0.146

Δ indicates here log differences. Number of cross sections is 155 while the number of observations is 3696.

Table 2. **Cross-section estimation results with a simple model**

dep var	regressor	Period	sample	coefficient	t-ratio/ PCT-ratio	R2
Var(g)	tax	1960–2001	OECD	-.241	2.26/2.47	.303
Var(g)	exp	1960–2001	OECD	-.141	1.43/1.61	.093
Var(g)	ggc	1960–2001	OECD	-.668	3.14/3.37	.331
Var(g)	tax	1987–2001	OECD	-.086	1.03/1.77	.050
Var(g)	exp	1987–2001	OECD	-.047	0.63/0.64	.020
Var(g)	ggc	1987–2001	OECD	-.012	0.07/0.07	.000
Var(g)	tax	1960–2001	World	-.525	1.06/1.76	.007
Var(g)	exp	1960–2001	World	-.162	0.43/0.72	.001
Var(g)	ggc	1960–2001	World	1.627	2.43/2.12	.032
Var(g)	tax	1987–2001	World	-1.046	1.01/1.49	.007
Var(g)	exp	1987–2001	World	-.233	0.25/1-30	.000
Var(g)	ggc	1987–2001	World	.349	0.61/0.02	.002
Var(yhp)	tax	1960–2001	OECD	-.022	2.00/2.76	.173
Var(yhp)	exp	1960–2001	OECD	-.015	1.47/1.92	.103
Var(yhp)	ggc	1960–2001	OECD	-.058	2.46/4.29	.241
Var(yhp)	tax	1987–2001	OECD	-.009	.058/1.02	.018
Var(yhp)	exp	1987–2001	OECD	-.004	0.30/0.53	.005
Var(yhp)	ggc	1987–2001	OECD	.014	0.42/0.51	.008
Var(yhp)	tax	1960–2001	World	-.061	1.39/1.56	.004
Var(yhp)	exp	1960–2001	World	-.036	1.08/1.19	.008
Var(yhp)	ggc	1960–2001	World	.088	0.800.88	.004
Var(yhp)	tax	1987–2001	World	-1.280	1.47/1.49	.016
Var(yhp)	exp	1987–2001	World	-1.171	1.54/1.30	.017
Var(yhp)	ggc	1987–2001	World	-.020	0.17/0.02	.000
Var(yhpp)	tax	1960–2001	World	-.648	1.32/1.83	.012
Var(yhpp)	exp	1960–2001	World	.142	0.39/0.46	.001
Var(yhpp)	ggc	1960–2001	World	4.964	1.64/1.55	.017
Var(yres)	tax	1960–2001	World	-.514	0.78/1.77	.004
Var(yres)	exp	1960–2001	World	-.085	0.17/0.45	.000
Var(yres)	ggc	1960–2001	World	.199	0.42/0.51	.001
Var(yres)	tax	1987–2001	World	-1.067	1.313.09	.012
Var(yres)	exp	1987–2001	World	-.329	0.450.95	.001
Var(yres)	ggc	1987–2001	World	.163	0.330.33	.001
Var(gcons)	tax	1960–2001	World	-.558	0.44/0.42	.001
Var(gcons)	exp	1960–2001	World	.721	0.77/0.58	.004
Var(gcons)	ggc	1960–2001	World	10.173	3.96/2.16	.089

All estimates are OLS estimates. The OECD data include 22 observations and the 'World' data 158 observations. The first t-ratio is unadjusted while the second (PCT) is corrected for cross-section heteroskedasticity.

Table 3. **OLS estimates of the simple model for different volatility regimes**

Var(g)	Coefficient	t-ratio
< 5	-.035	1.73
5–10	-.049	1.48
10–20	.026	0.46
20–30	.024	0.18
30–40	-.041	0.27
40–50	.108	0.68
> 50	-1.176	0.18

The regressor is the TAX variable.

Table 4. **Estimates of an extended cross-section model**

	1	2	3	4	5	6	7
TAX	-.407			-.074	-.411	-.284	-.641
	(1.52)			(1.87)	(1.43)	(1.22)	(1.44)
EXP		-.068					
		(0.49)					
GGC			-1.121				
			(1.55)				
MIL	7.115	7.436	6.032	4.529	6.570	4.860	3.078
	(2.47)	(2.62)	(3.36)	(0.70)	(2.38)	(2.51)	(1.86)
INF	.091	.093	.088	.147		.030	
	(2.24)	(2.26)	(2.30)	(3.66)		(1.88)	
POP	4.950	5.143	-5.906	-.012	-5.336	-4.662	-7.020
	(1.71)	(1.77)	(1.97)	(0.00)	(3.11)	(2.50)	(3.60)
TRADE	.057	.042	.071	.039		-.011	
	(0.60)	(0.46)	(0.75)	(2.88)		(0.18)	
GDPpc	-.008	-.016	-.011	-.005		.000	
	(0.07)	(0.14)	(0.01)	(0.49)		(0.32)	
AGRI	.488	.552	.442	.544	.450	.591	.744
	(1.07)	(1.23)	(1.02)	(1.09)	(2.12)	(2.01)	(2.13)
G	-1.734	-1.480	-2.511	-1.126		-.090	
	(0.68)	(0.57)	(0.98)	(4.96)		(0.05)	
R2	.311	.302	.302	.466	.216	.315	.145
SEE	38.97	39.19	40.45	47.38	40.67	25.81	47.50
DEP var	Var(g)	Var(g)	Var(g)	Var(yhp)	Var(yhp)	Var(res)	Var(g)
Sample	1960–2001	1960–2001	1960–2001	1960–2001	1960–2001	1960–2001	1987–2001

Cross-section heteroskedasticity corrected t-ratios are inside parentheses.

Table 5. **Estimates of the government size variable coefficient with pooled cross-country data**

Dependent variable	sample	estimator	definition of govsize	coefficient	t-ratio	DW
G^2	1960–2001	OLS-FE	TAX	-.206	0.38	1.77
G^2	1960–2001	OLS-FE	EXP	.206	0.60	1.77
G^2	1960–2001	OLS-FE	GGC	-.481	0.61	1.62
Gpc_2	1960–2001	OLS-FE	TAX	-.296	0.64	1.77
G^2	1960–2001	Random-e	TAX	-.550	1.25	1.64
G^2	1960–2001	Random-e	EXP	.128	0.49	1.65
G^2	1960–2001	Random-e	GGC	-.239	0.46	1.54
G^2	1960–2001	IV-FE	TAX	-.074	0.93	1.72
G^2	1987–2001	IV-FE	TAX	-1.133	0.64	2.46
Yhp^2	1960–2001	OLS-FE	TAX	-.403	0.72	1.11
Yhp^2	1960–2001	OLS-FE	EXP	.064	0.19	1.13
Yhp^2	1960–2001	OLS-FE	GGC	-.203	0.29	1.46
$Yhpp^2$	1960–2001	OLS-FE	TAX	-1.774	1.46	1.38
$Yhpp^2$	1960–2001	Random-e	TAX	-1.592	1.86	1.20
$Yhpp^2$	1960–2001	OLS-FE	EXP	.837	0.84	1.22
$Yhpp^2$	1960–2001	OLS-FE	GGC	4.777	2.00	1.31
G^2	1987–2001	OLS-FE	TAX	-1.076	0.87	2.39
G^2	1987–2001	OLS-FE	EXP	-.616	0.61	2.39
G^2	1987–2001	OLS-FE	GGC	1.112	0.78	1.88
res^2	1960–2001	OLS-FE	TAX	-.508	1.21	1.95
res^2	1960–2001	OLS-FE	EXP	.001	0.00	1.91
res^2	1960–2001	OLS-FE	GGC	.372	0.70	1.68
G^2	1960–2001	OLS	TAX	-.867	2.33	1.53
G^2	1987–2001	OLS	TAX	-1.479	2.57	1.98
G^2	1987–2001	IV	TAX	-1.481	2.32	2.03
G^2	1960–2001	OLS	EXP	-.054	0.26	1.50
G^2	1960–2001	OLS	GGC	-.327	0.96	1.42
Yhp^2	1960–2001	OLS	TAX	-.470	1.59	0.91
Yhp^2	1960–2001	OLS	EXP	-.348	1.39	0.92
Yhp^2	1960–2001	OLS	GGC	-1.216	2.51	1.29
res^2	1960–2001	OLS	TAX	-.511	2.62	1.69
res^2	1960–2001	OLS	EXP	-.013	0.12	1.61
res^2	1960–2001	OLS	GGC	.228	0.86	1.51
G^2	1960–2001	OLS-FE*	TAX	-.150	0.30	1.77
G^2	1960–2001	OLS-FE*	EXP	.285	0.80	1.77
G^2	1960–2001	OLS-FE*	GGC	-.485	0.64	1.60
G^2	1960–2001	SUR-FE	TAX	-.011	0.05	2.03
G^2	1960–2001	SUR-FE	EXP	-.030	0.20	2.06
G^2	1960–2001	SUR-FE	GGC	-.824	2.28	2.02
$Gcons^2$	1960–2001	OLS-FE	TAX	1.179	1.30	2.05
$Gcons^2$	1960–2001	Random-e	TAX	.085	0.19	1.92
$Gcons^2$	1960–2001	OLS	TAX	-.277	0.81	1.74
$Gcons^2$	1960–2001	OLS-FE	EXP	.231	0.48	2.02
$Gcons^2$	1960–2001	OLS-FE	GGC	-1.624	0.61	1.86

Cross-section heteroskedasticity corrected t-values are in the sixth column. All equation (except for the last three) include the following additional regressors: constant, INF, AGRI, GDPpc, TRADE, POP and DENSITY. The list of instruments for govsize includes (in addition to the exogenous variables) lagged values of TAX, EXP, DEF and DEBT plus RR (the latter three from the short sample only). FE refers to fixed effects, FE* to fixed cross-section and time-series effects, random-e to random cross-section effects and, finally SUR-FE the period SUR & fixed cross section effects estimation.

Table 6. **Cross-section estimates of different tax rate coefficients**

constant	EXP	GGC	TAXC	TAXP	R2	SEE
43.487	.133		-.747	-.085	.155	30.53
(2.65)	(0.38)		(1.35)	(0.38)		
34.69		.715	-.680	-.142	.072	26.74
(2.58)		(1.42)	(1.50)	(0.75)		

The dependent variable is Var(g). EXP, GGC, TAXC and TAXP are sample averages for 1998–2000.

Figure 1. **Output volatility and government size in the World data**

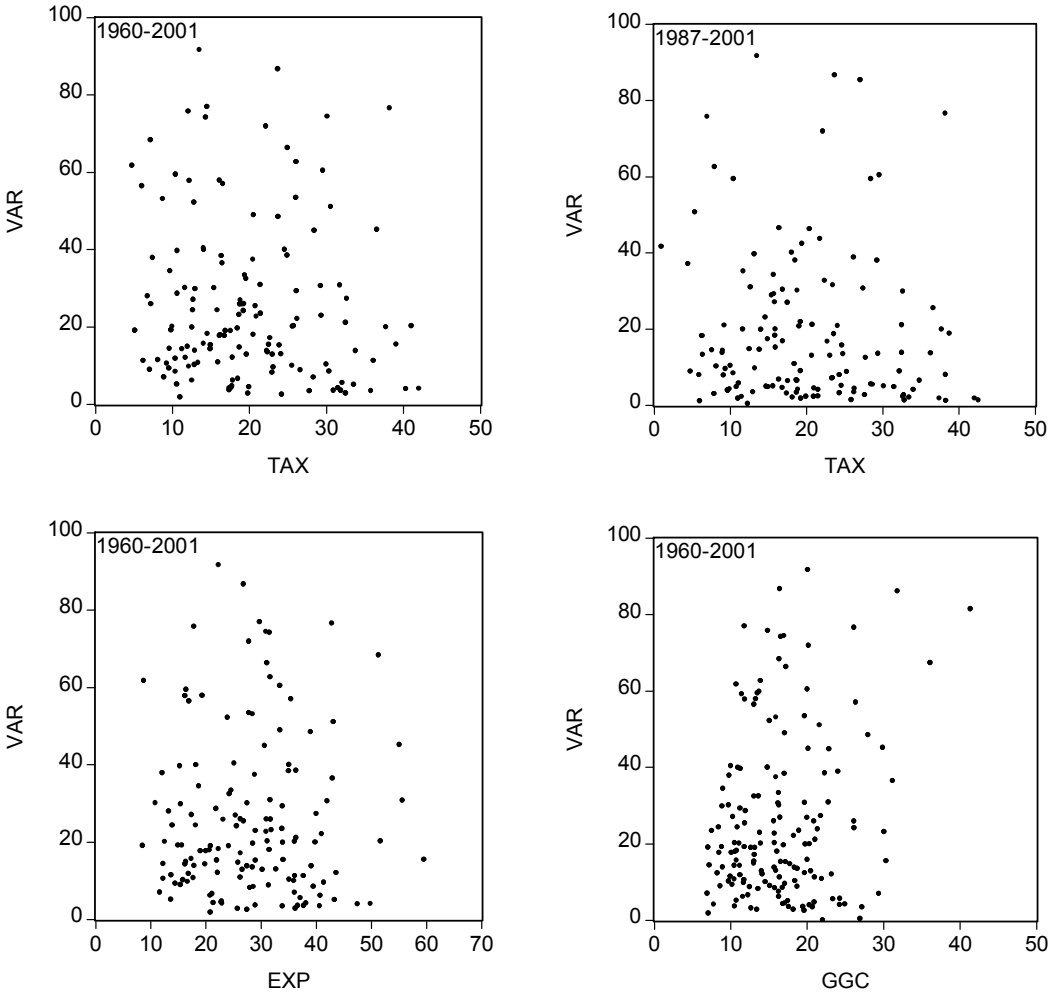
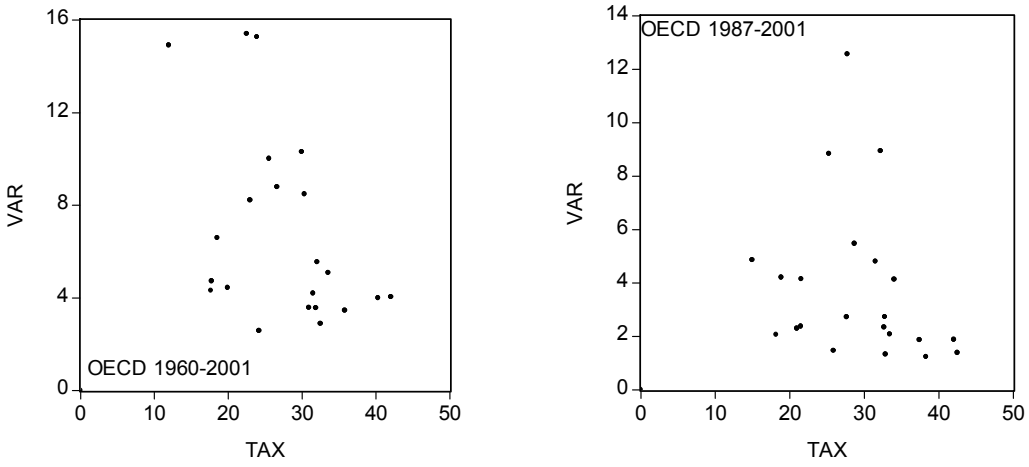


Figure 2. **Output volatility and government size (gross tax rate) in OECD countries**



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Appendix 1

Data definition and sources

AGRI	Agriculture output (% of GDP)
CQ	Private consumption expenditure at constant prices
DEBT	General government debt (% of GDP)
DEF	General government net balance (% of GDP)
DENSITY	Population density (people per sq km)
EXP	General government expenditure (% of GDP)
EXPO	Exports of goods and services at constant prices
G	growth rate of Gross Domestic Product (GDP), %
GDP	Gross Domestic Product
GDPpc	Gross Domestic Product per capita in USD
GGC	Government consumption expenditure (% of GDP)
Gpc	Growth rate of per capita GDP
GQ	Government consumption expenditure at constant prices
IMP	Imports of goods and services at constant prices
INF	Inflation (% rate)
IP	Investment expenditure constant prices
MIL	Military expenditure (% of GDP)
POP	Log of total population
RES	residual from an AR(1) model for G with gross-section specific AR parameters and fixed time effects
TAX	General government revenues (% of GDP)
TAXC	Highest marginal rate in corporate taxation
TAXP	Highest marginal tax rate in personal taxation
TRADE	Foreign trade (% of GDP)
Var(g)	Sample variance of G
Var(gcons)	Sample variance of private consumption growth rate
YHP	Hodrick-Prescott residual of log(GDP) with weight parameter 100
YHPP	Hodrick-Prescott residual of log(GDP-GQ) with weight parameter 100

Most of the data come from the World Development Indicators 2003 CD (World Bank). The data cover the period 1960–2001. For several series the data are deficient so that the models which include the control variables can be estimated from 1975–2001 only. The total number of countries is 192 but in data deficiencies reduce the final sample to 158 countries. The OECD sample consists of 22 countries. The data are annual. Basically two alternative samples are used: the long one for 1960–2001, and the more recent one for 1987–2001.

Results in Appendix 2 represent an updated version of the data from World Development Indicators 2004 CD and cover 208 countries for the period 1960–2002. These data are organized in the same way as the old data.

Appendix 2

Results with the updated data for 1960–2002

Table A1. **OLS estimates for the updated panel data**

Estimator Dependent variable	EXP	GGC	TAX	R^2	SEE	n
OLS	-.040			0.001	1.39	3232
VAR(y)	(0.40)			0.007		
OLS	-.007			0.002	1.28	3232
ABS(y)	(2.00)			0.039		
OLS		.00		.000	1.35	5402
VAR(y)		(0.36)		0.016		
OLS		-.027		0.002	1.18	5402
ABS(y)		(2.06)		0.047		
OLS			-.059	0.008	1.40	3226
VAR(y)			(4.32)	0.007		
OLS			-.414	0.016	1.29	3226
ABS(y)			(5.27)	0.038		
OLS			-.075	0.058	1.35	2961
VAR(y)			(4.26)	0.037		

Numbers inside parentheses are autocorrelation and heteroskedasticity adjusted t-ratios. The dependent variable is either the squared growth rate of GDP Var(y) or the corresponding absolute value ABS(y). With last equation (last row), the equation also includes the AGRI, POP and TRADE variables. n denotes total number of observations.

Table A2. **Robust coefficient estimates for the updated panel data**

Dependent variable	EXP	GGC	TAX
VAR(y)	-.016		
	(6.05)		
ABS(y)	-.228		
	(6.25)		
VAR(y)		-.055	
		(10.73)	
ABS(y)		-.684	
		(9.95)	
VAR(y)			-.025
			(6.65)
ABS(y)			-.401
			(7.99)

Numbers inside parentheses are (approximate) t-ratios. All estimates are Huber M - estimates. All equations include in addition to the government size variable also the AGRI, POP and TRADE. The dependent variables is VAR(y)

Table A3. **Panel data estimates for the updated panel data**

Estimation method	EXP	GGC	TAX	R^2/SEE	DW
FE	-.001			0.200	1.76
	(0.07)			0.007	
RE	-.004			0.020	1.66
	(0.26)			0.007	
FE		-.274		0.127	1.58
		(1.74)		0.015	
RE		-.112		0.018	1.51
		(0.95)		0.016	
FE			-.031	0.200	1.73
			(1.30)	0.007	
RE			-.042	0.027	1.62
			(1.97)	0.007	

Numbers inside parentheses are autocorrelation and heteroskedasticity adjusted t-ratios. FE refers to the fixed affects model and RE the random effects model. All estimating equations also include the AGRI, POP and TRADE variables.

Table A4. **Dynamic panel data estimates for the updated panel data**

Dependent variable	$VAR(y)_{-1}$	EXP	GGC	TAX	SEE	J/NI
EXP	.140	-.037			.0044	78.7
	(19.44)	(3.40)				77
GGC	.139		-.148		.0043	78.8
	(18.27)		(4.64)			77
TAX	.137			-.043	.0043	78.3
	(18.38)			(4.11)		77

All estimates are Arellano-Bond GMM estimates were both first differences and lagged levels are used as instruments. All estimating equations also include the AGRI, POP and TRADE variables. J refers the over-identification J-test and NI refers the corresponding instrument rank.

Table A5. **Panel data estimation results for the fiscal equations**

Dependent variable	lagged dependent	G	R^2/SEE	DW
TAX-EXP	.605	.082	0.720	2.30
	(12.91)	(3.26)	4.89	
TAX	.702	-.008	.841	2.45
	(12.51)	(0.34)	4.78	
EXP	.682	-.098	0.778	2.49
	(9.90)	(2.55)	7.76	
ΔGG	-.046	.550	0.109	2.03
	(1.68)	(8.40)	0.108	

Numbers inside parentheses are autocorrelation and heteroskedasticity adjusted t-ratios. All estimates OLS estimates with cross-section fixed effects. All estimating equations also include the AGRI, POP and TRADE variables. ΔGG indicates the growth rate of public consumption.

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