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IS THERE A LAFFER CURVE BETWEEN AGGREGATE OUTPUT AND PUBLIC SECTOR EMPLOYMENT?***

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ABSTRACT: This paper develops a model of the relationship between public sector employment, total output and aggregate real demand in market prices, where public employment has a positive productivity effect on private output. Public employment crowds out private employment and output because its increase induces higher wages and taxes. The valuation of government output is also taken into account. While public employment affects total output and aggregate real demand in an a priori ambiguous way, numerical simulations suggest that the relationship may be nonlinear; positive, when public sector is “small” and negative when it is “large”. Using the annual data from 22 OECD countries over the period 1960–1996 and estimating and testing for threshold models and more commonly used specifications with multiplicative interaction terms give support to this nonlinearity hypothesis between public employment and private sector output.

Keywords: public sector, Laffer curve, threshold models.

JEL classification: H11, J45

KOSKELA, Erkki – **VIRÉN**, Matti, **ONKO KOKONAISTUOTANNON JA JULKISEN SEKTORIN TYÖLLISYYDEN VÄLILLÄ LAFFER-KÄYRÄ?.** Helsinki: ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 2000, 19 s. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847; No. 737).

TIIVISTELMÄ: Tässä tutkimuksessa rakennetaan malli, joka käsittelee julkisen sektorin työllisyyden ja kokonaistuotannon välistä riippuvuutta. Kokonaistuotantoa tarkastellaan sekä kansantalouden tilinpidon mukaisena suureena että markkinahinnoin arvioituna. Mallissa julkisen sektorin työllisyydellä on positiivinen vaikutus yksityisen sektorin tuotantoon samalla kun työllisyyden kasvu syrjäyttää yksityisen sektorin työllisyyttä ja tuotantoa palkka- ja verovaikutusten kautta. Mallissa huomioidaan myös julkisen sektorin tuotannon arvostuksen kautta tapahtuvat vaikutukset. Jos kohta julkisen sektorin työllisyys vaikuttaa kokonaistuotantoon eri tavoin eikä vaikutuksen suuntaa voi selvästi nimetä, numeeriset simuloinnit viittaavat siihen, että riippuvuus on epälineaarinen: positiivinen kun julkinen sektori on ”pieni” ja negatiivinen kun julkinen sektori on ”suuri”. Empiirisissä analyyseissa käytetään tilastotietoja 22 OECD maasta ajanjaksolta 1960–1996 ja estimoidaan kynnysmalli, jonka puitteissa testataan teoreettisen mallin implikaatioita. Estimointitulokset antavat voimakasta tukea edellä mainitulle ”Laffer-käyrä” -hypoteesille epälineaarisesta riippuvuudesta julkisen sektorin työllisyyden ja kokonaistuotannon välillä. Tulokset tarjoavat myös selityksen niille ristiriitaisille tuloksille, joita on saatu aiemmissa tutkimuksissa lineaarisilla mallitäsmennyksillä.

Asiasanat: julkisen sektorin koko, Laffer-käyrä, kynnysmallit

JEL:n luokitusnumero: J21

Contents

1 Introduction

How does government spending affect total output or output growth? At the theoretical level the relationship is a priori ambiguous. On the one hand, one can argue for a positive relationship (i) due to the direct and/or indirect productivity effects of government expenditures, particularly public investments (see e.g. Aschauer (1989), Barro (1990), Grossman and Lucas (1974)). On the other hand, the relationship may be negative (ii) due to distortionary taxation (see e.g. Barro (1990)) or (iii) due to the crowding out of investment and/or output in the private sector. A large number of empirical studies have been carried out, but the results are ambiguous (see e.g. Barro (1989), Landau (1983), Ram (1986) and Singh and Sahni (1986)) for examples of earlier research and Agell and Lindh and Ohlsson (1997), Devarajan and Swaroop and Zou (1996) and Karras (1996) for examples of the recent research).[1]

Common to empirical research has been the use of standard national accounts data. For several reasons this may bias towards accepting the null hypothesis that increased government size will give rise to higher economic growth. First, because the national accounts data implicitly presumes that government output is produced with a constant returns to scale technology. Second, the whole government output is classified as the final product and, finally, the market value of the government output is assumed to be equal to the national accounts value of the government output, evaluated at its cost of production (see Carr (1989)). Some of those controversial assumptions have been relaxed. The assumption of the linear technology in government output has been dealt by Baumol (1967). Reich (1986), in turn, has produced some empirical evidence on the role of government goods as an intermediate product in private production. Kormendi (1983) has analysed the valuation problem of government goods by defining the concept of "government dissipation" as the difference between the resource cost of government output and the corresponding market value.[2]

In empirical studies the relationship between government size and output (or output growth) has been assumed to be linear and thus independent of the relative size of the public sector. According to the Laffer curve hypothesis the relationship between tax revenues and tax rates may be negative beyond some point of tax rates.[3] Analogously public sector may affect output in a nonlinear way.

The purpose of the paper is to develop a theoretical model of the relationship between public sector employment and total output, where public employment has productivity effects on private output, valuation of government output is taken into account and where public employment crowds out private employment and output via wage and tax effects. While the effect of a change in public employment on total output and aggregate real demand in market prices is a priori ambiguous, numerical simulations suggest that public employment affects total out-

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1 After reviewing theoretical and empirical evidence on the relation between growth and public sector Agell et. al (1997) end up by saying "the evidence is found to admit no conclusion". There exists an ever larger literature which deals with the reverse causation issue of what explains the size (and structure) of public sector over time and across countries. See e.g. Lybeck and Henrekson (1988)).

2 The System of National Accounts data are also used e.g. when testing for the hypothesis that there is a direct substitution between the public and private consumption. See e.g. Aschauer (1985).

3 In the context of taxation there is, however, evidence against it see e.g. Fullerton (1982).

put and total income in market prices in a nonlinear way, positively when public employment is “low” and negatively when public employment is “high”. Finally, and importantly, we present some empirical evidence using the data from 22 OECD countries over the period 1960–1996. The estimation and test results from both threshold models and more commonly used specifications with multiplicative interaction terms lie in conformity with the nonlinearity hypothesis about the relationship between the size of the public sector and private sector output.

We proceed as follows. A simple theoretical model and numerical simulations are presented in section 2, while the empirical results are reported in section 3. Finally, there is a brief concluding section.

2 A model of public sector employment and total output

This section presents a simple theoretical analysis, which describes the relationship between public sector employment and total output and total income in market prices. The model has the following features: First, we account for the possibility that public sector employment affects private production and marginal productivity of private labour. Second, we allow for the valuation of government sector output in the sense that the (unobservable) relative market price depends inversely on the size of the public sector. Third, and in the spirit of the so-called equilibrium approach to fiscal policy, we abstract from the financing issues of government output.[4]

2.1 A theoretical model

These ideas are captured by the following aggregative model, which determines the real wage, the price level, the employment, the total output, the tax rate and the total income in market prices in constant market prices. The model is “classical” with some additional features (see e.g. Sargent (1987)). It is presented in equations (2.1)–(2.4).

$$l^d(\omega, l_g) + l_g - l^s(\omega(1-\tau(\omega, l_g)) = 0 \qquad (2.1)$$

$$y^d(y(1-\tau(\omega, l_g)), m) - y^s(\omega, l_g) = 0 \qquad (2.2)$$

$$y - F(l^d(\omega, l_g), l_g) - G(l_g) = 0 \qquad (2.3)$$

$$q = y^d(y(1-\tau(\omega, l_g)), m) + zG(l_g) \qquad (2.4)$$

[4] This is compatible with the so-called equilibrium approach to fiscal policy, according to which the lump-sum financial policies are – to a first approximation – irrelevant to private sector outcomes. (see e.g. Seater (1993) for a survey of the issues involved).

where y denotes the total output, consisting of the private sector production function F and the public sector production function G, l^d and l_g the corresponding labour demands, l^s the aggregate labour supply, $\omega = w/p$ the real wage, $m = M/p$ the real money balances, p the price level, τ the endogenous tax rate and z the (unobservable) relative market price of public sector goods and services. The equations (2.1)–(2.3) form a simultaneous system, which determines the real wage, the price level, employment and the total output. The total income in constant market prices q is determined recursively by the equation (2.4). q is the true (correctly measured) disposable income of the economy.

Private output is produced by private labour. Public employment affects private output both directly and via the private labour demand by increasing the marginal product of private employment. For simplicity, capital input (and thus also capital depreciation) is disregarded.[5]

The labour market is cleared via changes in the real wage so as to equalize the aggregate labour demand to labour supply (see equation (2.1)). Like in models of unbalanced growth (see Baumol (1967)) we assume that real wages are equal in the private and public sector. This has no effect on qualitative results provided that there is some intersectoral rigidity in real wages. Private labour demand depends negatively on the real wage and is also affected by the public employment, while labour supply is a non-negative function of the net real wage $\omega(1-\tau(.))$, where τ is the tax rate. The price level p is determined by the equality of the private demand y^d and private supply y^s according to the equation (2.2). The private demand depends positively on disposable income $y(1-\tau(.))$ and real balances m, while the private supply depends negatively on the real wage ω and positively on public employment l_g.

In what follows variables with primes refer to partial derivatives for functions with one argument and variables with subscripts refer to partial derivatives for functions with many arguments. The total income in constant market prices is determined recursively by the equation (2.4), where we assume that $z = z(G)$ with $z'(.) < 0$ so that the higher the government output, the lower its marginal valuation rate, ceteris paribus. This is just a conventional assumption according to which the demand for government output is a decreasing function of relative market prices. The marginal valuation of government output is defined by $z' = z(G) + z'(G)G > 0$, where z is the market value of government output, which is assumed to be decreasing so that $z'' = 2z'(G) + z''(G)G < 0$.

Finally, the tax rate is endogenous and determined by the public sector resource costs

$$\tau = \omega l_g / (F + zG) \tag{2.5}$$

where the tax rate depends on the real wage and the public sector labour demand so that $\tau = \tau(\omega, l_g)$. It is quite likely that $\tau_1 > 0$ and $\tau_2 > 0$, where $\tau_1 = M\tau/M\omega$ and $\tau_2 = M\tau/Ml_g$. These assumptions are used in analyzing the comparative statics properties of the model. Equation (2.5) is, however, used in the subsequent numerical simulations.

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5 The effect of government capital stock is studied e.g. in Aschauer (1989)).

To see what are the effects of public employment on the real wage, price level, and total output we first form the differential of the system (2.1)–(2.3) in terms of endogenous variables and public employment. This gives

$$\begin{pmatrix} e_\omega & -e_\omega \omega/p & 0 \\ -f_\omega & f_\omega \omega/p - y_2^d m/p & y_1^d(1-\tau(.)) \\ -F_1 l_\omega^d & F_1 l_\omega^d \omega/p & 1 \end{pmatrix} \begin{pmatrix} d\omega \\ dp \\ dy \end{pmatrix} = \begin{pmatrix} -e_l \\ f_l \\ F_1 l_\omega^d + F_2 + G' \end{pmatrix} \begin{pmatrix} dl_g \end{pmatrix} \tag{2.6}$$

where $e_\omega = l_\omega^d - l_\omega^s(1-\tau)(1-\eta) < 0$ with $\eta = \omega\tau_\omega/(1-\tau) =$ elasticity of tax rate with respect to the real wage, $f_\omega = y_1^d y \tau_\omega > 0$, $e_1 = 1 + l_{lg}^d + l_\omega^s \omega \tau_{lg} > 0$ and $f_1 = y_1^d y \tau_{lg} + y_{lg}^s > 0$. Solving (6) for the real wage, the price level and the total output in terms of public employment yields

$$\left(\frac{d\omega}{dl_g}\right) = \Delta^{-1}\Big\{-e_l\big[f_\omega \omega/p - y_2^d m/p) - y_1^s \omega/p y_1^d(1-\tau)\big] \\ - e_\omega \omega/p\big[y_1^d(1-\tau)(y_2^s + G') - f_l\big]\Big\} \tag{2.7}$$

$$\left(\frac{dp}{dl_g}\right) = \Delta^{-1}\Big\{e_l\big[f_\omega + y_1^d(1-\tau)y_1^s\big] + e_\omega\big[f_\omega - y_1^d(1-\tau)(y_2^s + G')\big]\Big\} \tag{2.8}$$

$$\left(\frac{dy}{dl_g}\right) = \big(y_2^s + G') - e_l(y_\omega^s / e_\omega\big) \tag{2.9}$$

where $\Delta = -e_\omega y_2^d m/p > 0$ denotes the determinant of the coefficient matrix of (2.6) and where we have utilized the fact that $F(l^d(\omega,l_g)l_g) = y^s(\omega,l_g)$.

Comparative statics is a priori ambiguous reflecting various offsetting forces. According to (2.9) a rise in public employment increases public production ($G' > 0$) and raises private supply of goods so that public employment increases the marginal productivity of private labour $(y_2^s > 0)$. But a rise in public employment increases labour demand and the tax rate and the latter decreases the labour supply. For both of these reasons the real wage tends to rise so that private demand for labour and private production will at least partially be crowded out via the “real wage effect” (the last term in (2.7)). One might conjecture that the first (last) effect dominates for “small” (“large”) values of public employment. Finally, it is worthwhile to point out that the total output effects do not depend on what happens to the price level (described in (2.8)), which is a standard feature of “classical” models.

As mentioned earlier, the total income in constant market prices is determined recursively by the equation (2.4). Now the price level and valuation effects are additional factors. The total income effect can be decomposed as follows

$$\left(\frac{dq}{dl_g}\right) = y_1^d\left[\left(\frac{dy}{dl_g}\right)(1-\tau) - y\tau_2 - y\tau_1\left(\frac{d\omega}{dl_g}\right)\right] + \left[\left(y_1^d y\left(\frac{\omega}{p}\right)\tau_1 - y_2^d\left(\frac{m}{p}\right)\right)\right]\left(\frac{dp}{dl_g}\right) + Z' \tag{10}$$

and it is ambiguous a priori. The first three terms describe the positive output effect and the negative tax effects caused by increased government employment and higher (government) wages, respectively. The effect of a change in the price level is not clear. A rise in the price level tends to decrease the tax rate and to increase disposable income on the one hand, but a fall in real balances has the opposite effect. Finally, government employment has a positive effect on the (market) value of government output.

Although the equilibrium relationship between total output and public sector employment is a priori ambiguous, one can conjecture as follows: When the share of public employment from the total employment is "small", the positive marginal productivity and valuation effects dominate the negative crowding out effects due to the response of taxes and real wages for changes in public employment, and the other way round when the share is "large". Thus there might be a nonlinear Laffer curve -type relationship between the public sector employment and total output.

2.2 Numerical simulations

In order to shed further light on the potential relationship between public employment and aggregate real demand on the one hand and public employment and total output on the other hand, we present a simple parametrized model and solve it numerically. The model takes the following form

$$y = l_p^{\alpha_1} \cdot l_g^{1-\alpha_1} + l_g^{\alpha_2} \tag{2.11}$$

$$l_p + l_g = (\omega(1-\tau))^{\alpha_3} \tag{2.12}$$

$$\omega = \alpha_1\left(\frac{l_g}{l_p}\right)^{1-\alpha_1} \tag{2.13}$$

$$q = \alpha_4 y(1-\tau) + z l_g^{\alpha_2} + \alpha_6(m-\alpha_7) \tag{2.14}$$

$$z = l_g^{\alpha_5} \tag{2.15}$$

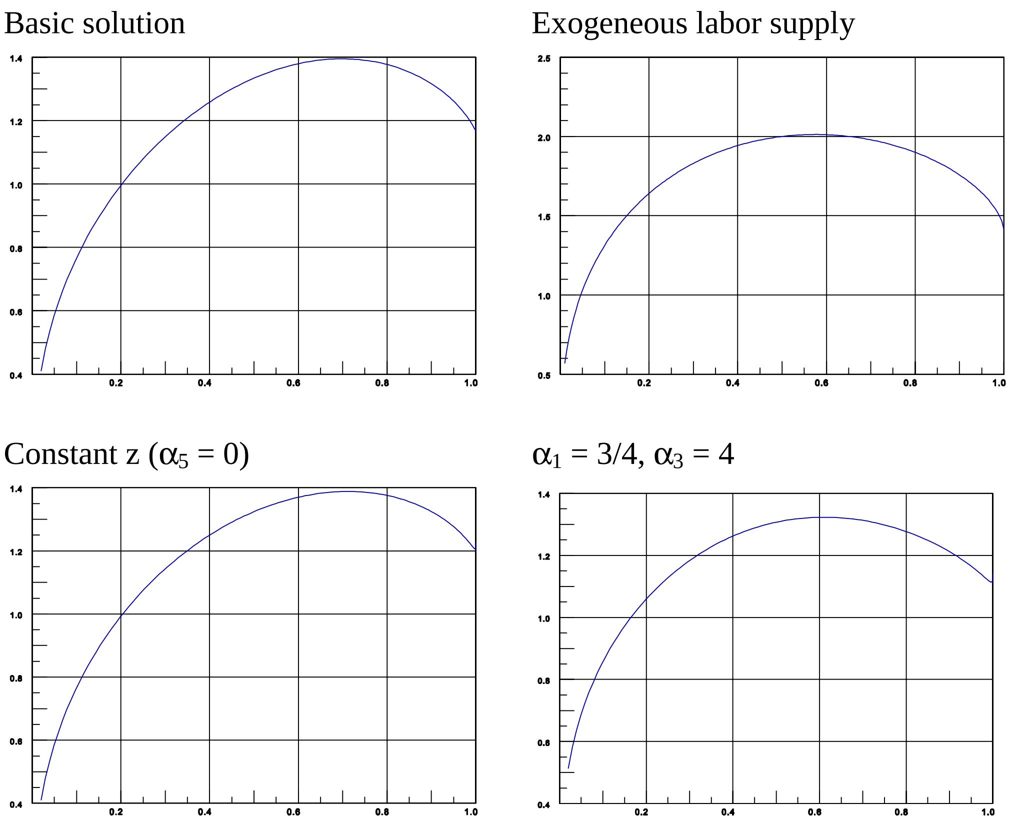
where

$$\tau = \frac{\omega l_g}{l_p^{\alpha_1} \cdot l_g^{1-\alpha_1} + z l_g^{\alpha_2}} \tag{2.16}$$

Equation (2.11) defines the total output, (2.12) and (2.13) denote labour market clearing and the inverse demand for labour, respectively, (2.14) is the definition of aggregate real demand in constant market prices and (2.15) parametrizes the valuation of output. The price level is determined by equalizing (2.15) to the first (private) part of the total output.

The following values of parameters were taken as the basic case. (1) the parameters in the Cobb-Douglas production function: $\alpha_1 = 2/3$, $\alpha_2 = .5$, (2) the net wage elasticity of labour supply $\alpha_3 = .3$, (3) parameters in the total income (in constant market prices) definition: $\alpha_4 = .9$, $\alpha_5 =$!.4, $\alpha_6 = .1$, $\alpha_7 = 1$ (the last parameter is a scaling parameter). Finally, the money supply m equals 1. The outcome of this simulation in terms of y and q is reported in Figures 1 and 2, where the horizontal axes describe the share of public sector employment and the vertical axes the total output (1) and aggregate real demand (2) in Figures 1 and 2 respectively.[6]

Figure 1. **Laffer curves between total output and public employment**



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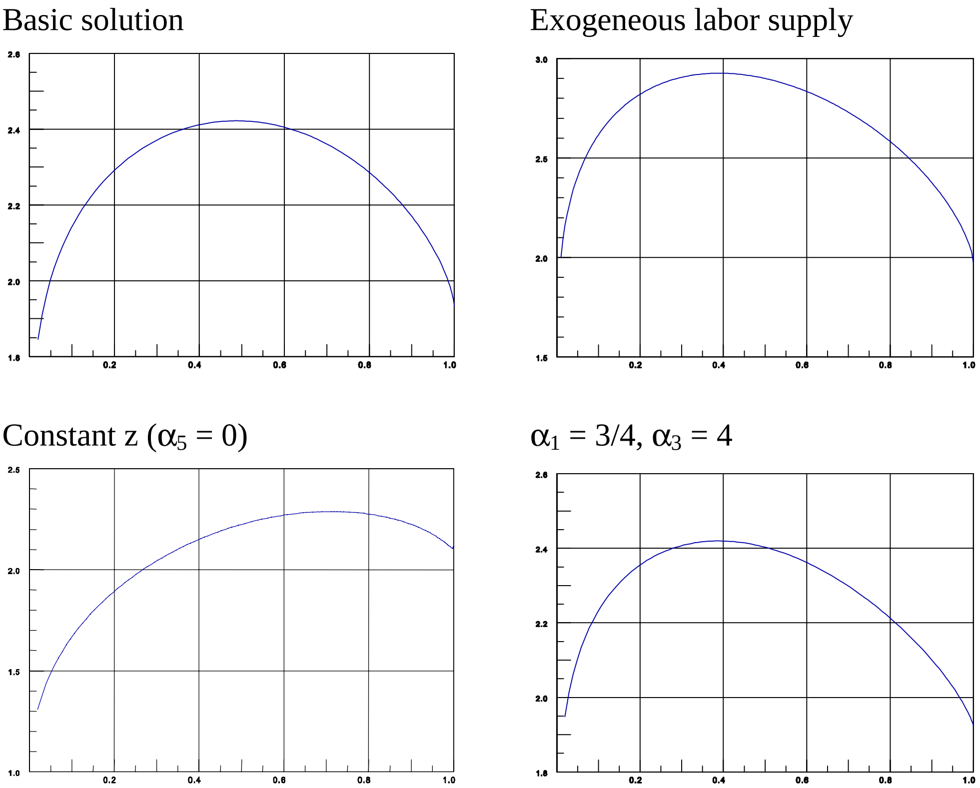
6 The results for ω, τ and p are available from the authors upon request.

Figure 2. **Laffer curves between total income in constant market prices and public employment**



Numerical simulations produce a nonlinear Laffer curve-type relationship between public employment and total output on the one hand and public employment and total income in market prices on the other hand. The relationship turned out to be rather robust for various changes in parameters. In particular, this was true for parameters α_4, α_7 and α_8. Changes in other parameters changed the maximum values of y and q, but left the shape of the curve practically unchanged. It is important to point out that the computed values do not directly correspond to actual data because the economy which is analyzed in here is a static and closed economy without investment, capital depreciation, exports and imports so that simulated critical values of the public sector size are about 30–40 % too large (compared with the national accounts numbers). Even so, one could achieve such (critical) values of y and q that are well in accordance with the subsequent empirical analyses (in particular, using sufficiently low values of $1–\alpha_1$ and α_2).

In order to check the robustness of results, some further experiments were carried out. First, we assumed that the net wage elasticity of labour supply is zero. Not surprisingly, this implied that the maximum values of y and q were obtained at lower values of public employment. Second, we assumed that the relative valuation rate of government output, z, is constant. This implied that the maximum values were obtained at higher values of public employment than in the basic case. Finally, we modified the output elasticity parameter α_1 by setting it to the value 3/4. This had the effect of turning the Laffer curves down at the lower value of public employment than in the basic case. The value of α_1 parameter is instrumental in determining the critical value of the size of public sector. This can be seen from the following set of simulated values for the government size (measured in terms of L_g/L) which produce the maximum output in terms of y and q. The values have been computed for the case of exogenous labour supply.

α_1	y	q
0.67	0.56	0.34
0.80	0.44	0.27
0.90	0.33	0.20
0.95	0.26	0.16
1.00	0.18	0.11

Clearly, if public sector employment affects private sector production (in addition to public sector production) in a significant way, the critical size of the public sector is quite large, and vice versa for "small" values of α_1 (so far these numbers can be compared with actual national account numbers).[7]

After these simulation exercises we turn to look at the econometric evidence in order to explore further whether the relationship between the public sector size, output and aggregate real demand is a nonlinear one.

3 Some empirical evidence

It is not possible to evaluate the nonlinearity hypothesis directly due to the lack of data on aggregate real demand and output in market value prices. There exists data, however, on private sector output and these data can be used to get some rough estimate of the sign and magnitude of the effect of a change in public sector employment when government size varies. Thus we use data on two observable variables, public sector employment and private sector output, which we denote by D. The data cover the period 1960–1996 from 22 OECD countries with some minor exceptions.[8]

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7 Of course, also the output elasticity of public sector employment, α_2 is important, but how important it is, that depends crucially on the specification of the valuation function z. Still, the critical value of y may even remain below 0.2 in the case of $\alpha_2 + \alpha_5 > 0$ with low values of α_2. The CD production function is a bit problematic in this context because it implies that private sector output goes to zero when l_g goes to zero. If we relaxed this assumption we would obtain a smaller critical size for the public sector.

8 Private sector output is measured either by "GDP-public consumption" or by "GDP-public sector production" and public sector employment by the number of employees in the "producers of government services" sector. Here we report results only for the conventional GDP-public consumption measure. Results with the other measure of private sector output turned out to be very similar.

Table 1. **Relationship between public sector employment and private sector output**

	L_g/L	G/Y	G/C	Corr	$\hat{\beta}$	t_β	F
Australia	0.158	0.160	0.210	–0.123	0.087	0.93	0.73
Austria	0.182	0.171	0.231	0.071	–0.009	0.03	1.30
Belgium	0.181	0.149	0.189	0.092	0.204	0.96	0.74
Canada	0.204	0.185	0.240	0.008	0.386	1.48	1.84
Denmark	0.272	0.225	0.285	0.035	–0.004	0.02	0.30
Finland	0.182	0.177	0.238	0.285	0.073	0.28	4.16
France	0.213	0.169	0.221	0.201	0.434	1.97	7.90
Germany	0.145	0.179	0.242	0.289	–0.066	0.71	1.56
Greece	0.103	0.113	0.135	0.105	–0.198	0.71	2.91
Iceland	0.162	0.158	0.205	0.155	0.181	0.77	2.40
Ireland	0.159	0.153	0.190	–0.199	0.189	0.76	1.63
Italy	0.158	0.152	0.200	0.432	0.531	1.71	3.34
Japan	0.084	0.089	0.134	0.049	–0.459	1.22	14.36
Netherlands	0.132	0.152	0.204	–0.084	–0.269	0.93	1.70
New Zealand	0.164	0.147	0.190	0.157	–0.112	0.36	0.09
Norway	0.249	0.181	0.262	0.134	0.171	1.08	1.90
Portugal	0.124	0.137	0.168	–0.037	0.009	0.09	1.92
Spain	0.105	0.121	0.156	–0.054	0.073	0.71	10.72
Sweden	0.294	0.243	0.310	0.326	0.031	0.23	3.39
Switzerland	0.127	0.121	0.168	0.428	0.270	0.75	1.43
UK	0.197	0.199	0.241	0.013	–0.022	0.19	2.72
USA	0.158	0.174	0.213	0.312	0.152	0.56	0.81
Mean	0.170	0.162	0.210	0.118	0.075	0.75	3.08

The three first columns correspond to the sample averages of alternative threshold models. Corr indicates the correlation coefficients between $\Delta\log D$ and $\Delta\log L_g$. The three last columns report the estimation results of the linear model (17). t_β denotes the t-ratio of β. F denotes the F test statistics for the hypothesis that the coefficients β and γ are identically equal to zero.

We started the empirical analysis by computing the coefficients of correlation between $\Delta\log D$ and $\Delta\log L_g$. As a point of reference for the coefficients, we used the values of public consumption relative to GDP at the current SNA prices denoted by G/Y, the share of public consumption out of total consumption denoted by G/C and, finally, the share of public sector employment out of total employment denoted by L_g/L as alternative measures of the size of the public sector. As one can see from Table 1, the correlation coefficients do not show any systematic pattern in terms of the size of the public sector. Moreover, with the exception of Italy and Switzerland the correlation coefficients are not significantly different from zero.

Next we estimated a simple linear VAR-type model for $\Delta \log D$ that allows for a partial adjustment of the public employment effect on private sector output:

$$\Delta \log D_t = \alpha + \beta \Delta \log L_{g,t-1} + \gamma \Delta \log D_{t-1} + u_t, \qquad (2.17)$$

where u refers to the error term. The estimation results from the linear model with the exception of the coefficient of the lagged dependent term are presented in the last three columns of Table 1.[9] There are several interesting features of results. First, there seems to be no clear pattern in the sign of the coefficient of public employment and it is never significant in the linear model. Second, in most cases (2.15 out of 2.22) the null hypothesis that the linear model explains nothing cannot be rejected. In fact, this should not be regarded as surprising but something one might expect in the light of considerations presented in section 2. The coefficient estimates might be positive, zero or negative depending on the size of the public sector, but the linear model cannot capture it.

An obvious way to try to account for the potential nonlinearity between public sector employment and private sector output is to use the so-called threshold model (see e.g. Granger and Teräsvirta (1993)).[10] Applying threshold specification means that the coefficients of the independent variables are allowed to vary depending on the value of the threshold variable. A simplest way to account for this kind of switching phenomenon in the context of explaining $\Delta \log D$ is to fit the following type of nonlinear specification to the data

$$\Delta \log D_t = \alpha + \beta_1 \Delta \log L_{g,t-1} + \gamma \Delta \log D_{t-1} + e_t \quad \text{if} \quad G/Y \leq (\hat{G}/\hat{Y}) \qquad (2.18a)$$

and

$$\Delta \log D_{tt} = \alpha + \beta_2 \Delta \log L_{g,t-1} + \gamma \Delta \log D_{t-1} + e_t \quad \text{if} \quad G/Y > (\hat{G}/\hat{Y}) \qquad (2.18b)$$

where e refers to the error term and $(\hat{G}/\hat{Y})$ denotes the threshold value of the size of the public sector. This specification collapses to the linear one if $\beta_1 = \beta_2$ .It is assumed in (2.18a–2.18b) that the coefficient of the lagged dependent term does not depend on the size of the public sector.[11] The threshold value − i.e. the value which gives the smallest residual variance − is obtained by using a search procedure in which all potential threshold values are scrutinized.[12]

The estimation results from the threshold specification (2.18a–2.18b) with the exception of the coefficient of the lagged dependent term are presented in Tables 2–4. In Table 2 we report the values of R^2 and the threshold variable for alternative threshold variables (that is, G/Y, G/C and L_g/L). For the sake of comparison, we also include the R^2 of the linear model. Tables 3 and 4, in turn, include the

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9 The VAR model was also estimated for $\Delta \log D$ so that the explanatory variables were $\Delta \log D_{-1}$, $\Delta \log L_{g,-1}$ and $\Delta \log Y_{OECD,-1}$, where the last variable refers to the OECD GDP (at constant prices). It was included into the estimating model to control the cross-country spillover effects of demand and supply shocks. The results were very similar to those reported and are available upon request. When estimating (2.17) and (2.18) $L_{g,t-1}$ was replaced by the corresponding contemporaneous value but that did not change the results either.

10 By using the threshold model we can take into account the effects of possible regime shifts. These effects could also modeled by using multiplicative interaction terms with the public sector size (see equation (2.19) below). I bit different result would come out if we introduced an additional quadratic $\Delta \log L_g$ term into (2.17). This term would imply that the employment effect depends on the size of the change in public sector employment (not on the size of the public sector). In the empirical analysis, this kind nonlinear “adjustment cost” effect turned out to be insignificant, however.

11 Our empirical results were in conformity with this assumption.

12 The estimation and test procedures made use of a GAUSS procedure, which is available on Bruce Hansen’s homepage: http://www.ssc.wisc.edu/

estimation results of the threshold model using either G/Y or G/C as the threshold variable. Discriminating between these two variables in terms of explanatory power turned out to be quite difficult, but as one can see also the difference in estimation results is very small. Results with L_g/L as the threshold variable were also very similar but the explanatory power of this specification was clearly lower (see Table 2 for the comparison of R^2s). All threshold model estimates represent interior solution, which have been obtained without imposing any additional constraints. Thus, the observations are distributed in a reasonable way to both regimes.

The following features of results merit attention. First, the threshold model fits the data much better than the linear model. Both the goodness-of-fit statistic is higher and the residual variance lower than with linear specification. Only very few diagnostic problems can be detected. Second, the coefficient estimates of the public employment are now considerably more precise and in accordance with the theoretical considerations suggesting that the effect of public sector employment on private output depends on the size of the public sector. Finally, and importantly, the coefficient of β_1 is except for a couple of cases positive and in all cases larger than the coefficient β_2; which also lies in conformity with considerations presented in section 2.[13] As the public sector gets larger, the effect of public sector employment on private output gets smaller and even negative. Indeed, β_2 is negative except for Australia, France, Italy and Norway and in these cases the β_2 coefficients are never significant. According to the estimation results the threshold value of the public sector (output) size varies between 10 and 30 per cent in the sample depending on the threshold variable. As one might expect, the critical size is highest with the public sector share of total consumption and lowest with the public sector share of total employment. With all threshold variables, the threshold values are very similar for all countries suggesting that there is indeed some invariance across countries.

[13] The existence of a threshold is indeed supported by the LM tests (FHO and FHT) reported in Table 3. But it is very difficult to judge what is the size of the test. The values of these F test statistics clearly exceed the conventional significance levels from F distribution, but they may not be relevant here (see Hansen (1996, 1999)). Computing the significance levels by bootstrap gives completely different values, which are also quite sensitive to heteroscedasticity. Obviously testing problems result partly from relatively small sample sizes. Even so, the tests still give additional support to the threshold model specification.

Table 2. **Descriptive statistics on the relationship between public sector employment and private sector output**

	R^2				Threshold parameter values		
	linear	G/Y	G/C	L_g/L	G/Y	G/C	L_g/L
Australia	0.044	0.107	0.107	0.098	0.140	0.190	0.133
Austria	0.075	0.345	0.360	0.345	0.153	0.236	0.143
Belgium	0.044	0.267	0.178	0.206	0.164	0.196	0.148
Canada	0.124	0.612	0.250	0.180	0.203	0.262	0.208
Denmark	0.019	0.219	0.290	0.219	0.121	0.299	0.221
Finland	0.206	0.357	0.357	0.357	0.207	0.275	0.207
France	0.353	0.496	0.496	0.496	0.149	0.206	0.186
Germany	0.089	0.292	0.352	0.136	0.198	0.260	0.125
Greece	0.158	0.337	0.335	0.335	0.091	0.112	0.083
Iceland	0.142	0.242	0.252	0.257	0.196	0.226	0.169
Ireland	0.095	0.196	0.177	0.129	0.169	0.219	0.174
Italy	0.173	0.309	0.337	0.279	0.139	0.188	0.122
Japan	0.489	0.598	0.637	0.644	0.081	0.121	0.077
Netherlands	0.129	0.490	0.542	0.412	0.167	0.221	0.138
New Zealand	0.006	0.126	0.126	0.085	0.147	0.192	0.154
Norway	0.148	0.183	0.184	0.177	0.193	0.230	0.220
Portugal	0.107	0.271	0.214	0.214	0.128	0.164	0.105
Spain	0.434	0.505	0.505	0.505	0.096	0.129	0.062
Sweden	0.175	0.313	0.313	0.313	0.218	0.290	0.209
Switzerland	0.246	0.359	0.475	0.359	0.110	0.169	0.108
UK	0.150	0.242	0.240	0.173	0.200	0.239	0.171
USA	0.058	0.197	0.152	0.162	0.176	0.219	0.152
Mean	0.157	0.321	0.313	0.276	0.157	0.211	0.152
Median	0.129	0.292	0.290	0.219	0.153	0.219	0.145
S.D.	0.126	0.142	0.144	0.145	0.040	0.051	0.047

The first four columns report the R^2 values of equations (17) and (18). In the case of equation (18), the values have been computed for different threshold variables.

All in all, estimation results from the linear and threshold specifications gives at least weak support to the hypothesis according to which the relationship between public sector employment and output is nonlinear, positive for “small” public sector and negative for “large” public sector.

Table 3. **Threshold model estimation results. G/Y as the threshold variable**

Country	$\hat{\beta}_1$	$\hat{\beta}_2$	SEE/DW	FHO	FHT	LM
Australia	.365	.049	.025	18.9	9.7	2.14
	(1.74)	(0.51)	(2.069)	(.051)	(.016)	(.154)
Austria	.580	–.568	.019	20.4	11.52	0.39
	(1.71)	(1.69)	(1.759)	(.046)	(.003)	(.538)
Belgium	.690	–.119	.023	36.7	7.5	0.120
	(2.34)	(0.48)	(2.159)	(.000)	(.119)	(.283)
Canada	.370	–.751	.027	4.9	4.3	2.86
	(1.57)	(1.26)	(1.714)	(.865)	(.663)	(.104)
Denmark	.113	–.700	.024	19.2	7.2	1.63
	(0.80)	(2.86)	(1.833)	(.046)	(.167)	(.212)
Finland	.458	–1.144	.032	10.6	3.6	1.25
	(1.68)	(2.25)	(1.648)	(.308)	(.876)	(.274)
France	1.417	.121	.017	12.9	8.7	.002
	(3.23)	(0.25)	(1.961)	(.270)	(.028)	(.966)
Germany	–.063	–1.537	.023	14.6	6.3	0.98
	(0.80)	(3.64)	(1.767)	(.138)	(.283)	(.331)
Greece	.933	–.354	.031	26.6	11.6	0.16
	(1.98)	(1.39)	(1.734)	(.007)	(.003)	(.696)
Iceland	.138	–1.021	.040	5.25	3.8	0.95
	(0.61)	(1.61)	(1.813)	(.862)	(.830)	(.338)
Ireland	–.109	–.941	.029	7.1	7.2	0.04
	(0.44)	(1.89)	(1.947)	(.697)	(.177)	(.845)
Italy	1.278	.293	.022	12.7	5.9	0.89
	(3.28)	(0.99)	(1.785)	(.221)	(.415)	(.354)
Japan	1.325	–.880	.024	24.3	6.8	2.74
	(2.16)	(2.55)	(2.366)	(.024)	(.237)	(.108)
Netherlands	.156	–1.617	.013	24.6	6.3	0.27
	(0.67)	(4.37)	(1.868)	(.040)	(.210)	(.605)
New Zealand	.418	–.697	.037	15.8	6.1	.04
	(1.06)	(1.69)	(2.047)	(.129)	(.360)	(.853)
Norway	.448	.159	.019	7.6	7.3	5.05
	(1.54)	(1.01)	(1.642)	(.663)	(.131)	(.033)
Portugal	.169	–.153	.032	7.7	3.5	0.28
	(1.37)	(1.23)	(2.076)	(.521)	(.935)	(.603)
Spain	.186	–.172	.020	17.6	5.8	0.31
	(1.14)	(1.57)	(2.272)	(.096)	(.359)	(.584)
Sweden	.330	–.123	.022	12.8	7.7	3.99
	(1.90)	(0.88)	(1.673)	(.222)	(.117)	(.055)
Switzerland	.325	–.904	.022	15.2	5.4	7.51
	(1.06)	(2.05)	(1.407)	(.106)	(.449)	(.010)
UK	.628	–.131	.024	7.9	4.6	12.41
	(1.74)	(1.04)	(1.488)	(.636)	(.681)	(.002)
USA	.551	–.008	.024	8.8	3.9	10.72
	(1.62)	(0.03)	(1.594)	(.491)	(.876)	(.003)

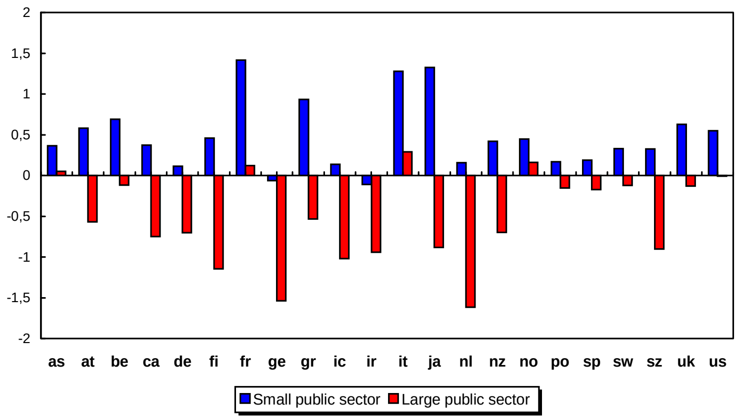
Numbers inside parentheses below the coefficient estimates are t-ratios. SEE is the standard error of estimate and DW the Durbin-Watson test statistic (which here suffers from the bias caused by lagged dependent variable). FHO denotes the LM (F) test for no threshold and FHT the corresponding test for threshold allowing for heteroskedastic errors. Numbers inside parentheses below the F statistics are bootstrap probability values. Finally, LM denotes a LM test for first-order autocorrelation of residuals (corresponding marginal significance levels are inside parentheses). When computing this LM test we have utilised Chan (1993), in which it is shown that the threshold parameter is superconsistent and can thus be treated as a known parameter.

Table 4. Threshold model estimation results. G/C as the threshold variable

Country	$\hat{\beta}_1$	$\hat{\beta}_2$	SEE/DW	FHO	FHT	LM
Australia	.365	−.049	.019	20.4	11.52	2.14
	(1.74)	(1.69)	1.759	(.046)	(.003)	(.154)
Austria	1.094	−.115	.019	16.6	11.5	2.92
	(2.52)	(0.37)	2.198	(.088)	(.001)	(.098)
Belgium	.565	−.361	.021	36.0	8.2	0.78
	(2.54)	(1.37)	2.170	(.008)	(.071)	(.385)
Canada	.278	−2.330	.020	38.4	5.7	2.09
	(1.64)	(4.57)	1.600	(.004)	(.329)	(.162)
Denmark	.088	−.590	.025	12.36	5.2	2.71
	(0.60)	(2.36)	1.869	(.231)	(.539)	(.132)
Finland	.458	−1.144	.032	10.9	4.5	1.25
	(1.68)	(2.25)	1.648	(.265)	(.648)	(.274)
France	1.417	.121	.017	12.9	9.1	.002
	(3.23)	(0.25)	1.961	(.260)	(.016)	(.966)
Germany	−.060	−1.633	.024	12.5	5.4	0.77
	(0.74)	(3.07)	1.799	(.196)	(.462)	(.388)
Greece	.987	−.346	.031	26.6	12.1	0.10
	(2.03)	(1.36)	1.775	(.020)	(.002)	(.766)
Iceland	.166	−1.001	.040	5.25	3.8	1.04
	(0.74)	(1.53)	1.813	(.862)	(.830)	(.317)
Ireland	−.041	−.598	.028	10.7	8.0	0.34
	(0.16)	(1.89)	1.894	(.374)	(.072)	(.564)
Italy	1.160	.292	.023	16.5	5.6	1.31
	(3.02)	(0.96)	1.803	(.102)	(.476)	(.262)
Japan	.956	−.815	.025	20.6	5.8	2.15
	(1.57)	(2.25)	2.285	(.050)	(.395)	(.154)
Netherlands	.478	−.988	.014	21.1	6.0	2.65
	(1.62)	(3.40)	1.610	(.075)	(.255)	(.119)
New Zealand	.418	−.697	.037	20.5	7.1	0.04
	(1.06)	(1.69)	2.047	(.037)	(.206)	(.853)
Norway	.169	.064	.019	12.4	7.1	1.37
	(1.08)	(0.24)	1.759	(.271)	(.152)	(.252)
Portugal	.205	−.187	.031	28.9	9.9	0.66
	(1.73)	(1.58)	2.144	(.003)	(.014)	(.424)
Spain	.186	−.172	.020	17.6	5.8	0.31
	(1.14)	(1.57)	2.272	(.102)	(.349)	(.584)
Sweden	.330	−.123	.022	12.8	7.7	3.99
	(1.90)	(0.88)	1.673	(.204)	(.122)	(.055)
Switzerland	.452	−.359	.024	8.3	5.4	0.85
	(1.30)	(0.83)	1.835	(.531)	(.402)	(.364)
UK	.638	−.133	.024	7.4	4.6	13.71
	(1.76)	(1.06)	1.471	(.715)	(.696)	(.001)
USA	.685	.008	.023	9.4	6.3	12.35
	(2.00)	(0.03)	1.528	(.424)	(.304)	(.002)

Here, the share of public consumption out of total consumption G/C is the threshold variable. Notation is the same as in Table 3.

Figure 3. **Effect of public sector employment on private sector output**



In order to alleviate the problem of small sample size with single country models and increase the efficiency of estimation (by using the SUR estimator) we estimated as a final check the model using pooled panel data from the 22 countries which are in our data set. In addition to linear and threshold models we also estimated a multiplicative specification which is of the following from:

$$\Delta \log D_t = \alpha + \beta \Delta \log L_{g,t-1} + \gamma \Delta \log D_{t-1} + \phi H_t \cdot \Delta Lg_{t-1} + e_t \tag{2.19}$$

where H denotes the threshold variable (either G/Y, G/C or L_g/L). According to this specification public employment effect depends on the interaction term $H_t \cdot \Delta L_{gt-1}$ and thus on the size of the government sector. According to our hypothesis ϕ should be negative. Using this specification we can compute the critical (or, in a sense “threshold”) value of this variable at which public sector employment growth has zero effect on private sector output growth. The estimation results are reported in Table 5.

Table 5. **Estimation results with panel data**

	β/β_1	β_2	γ	ϕ	SEE/R^2	$\hat{H}$
Linear	–.020		.294		.028	–
	(0.12)		(8.59)		0.171	
G/Y	.131	–.058	.325		.027	0.157
Threshold	(2.64)	(1.35)	(9.35)		0.185	
G/C	.044	–.037	.293		.028	0.211
Threshold	(1.65)	(1.71)	(8.57)		0.175	
L_g/L	.072	–.060	.294		.028	0.152
Threshold	(2.86)	(2.82)	(8.68)		0.178	
Eq (19) with	.404		.281	–2.460	.028	0.164
H = G/Y	(5.55)		(8.35)	(5.85)	0.186	
Eq (19) with	.299		.292	–1.400	.028	0.213
H = G/C	(3.98)		(8.62)	(4.23)	0.178	
Eq (19) with	.197		.291	–1.324	.028	0.149
$H = L_g/L$	(4.13)		(8.65)	(4.55)	0.178	

All estimates are SUR estimates with panel data consisting of 736 data points. All equations also include country intercepts, which are not reported. The threshold models (columns 2–4) are estimated using the average values of the threshold variable from the single country models. With the multiplicative model (the last three set of estimates) the "threshold values" are derived from the estimates of β and ϕ.

Clearly the results with panel data lie in conformity with the results from individual country data which suffer from relatively small sample sizes. With a linear model there is no relationship between public sector employment and private sector output while with the threshold model a quite clear relationship is obtained. We also find a similar relationship using a multiplicative specification (2.19) in which the public sector employment effect depends on the size of the public sector. When the size of the public sector increases, the employment effect diminishes and, after some critical value, becomes negative. The implied critical values are, in fact, quite close to the average threshold values in the context of threshold model estimation.[14]

[14] Recently Karras (1996) has estimated the optimal government size for several sets of economies by exploring the role of public services in the production process. As the theoretical framework he takes the analysis by Barro (1990), according to which government services are optimally provided when their marginal product equals unity (the so-called "Barro rule"). He finds by using a very large data set of 118 countries over the period 1960 to 1985 that in some cases government services are over–provided, in some cases under-provided and in many cases optimally provided. Karras finds that the optimal government size in the Barro sense is 23 per cent (±2 per cent) for the average country, which number, however, masks important differences across regions. Interestingly, this number is not very far away from the value of the threshold we obtained in our estimations. Our analysis is less ambitious in the sense that we do not study the welfare issues, but are only interested in the question of whether the relationship between the share of public sector and output is a non-linear one.

4 Concluding remarks

This paper has developed a model of the relationship between public sector employment and total output, where public employment has positive productivity effects on private output and where public employment crowds out provide employment and output via wage and tax effects, and where also the valuation of government output is taken into account. This simple model is used to show that while the effect of a change in public employment on total output and aggregate real demand in market prices is a priori ambiguous, numerical simulations suggest that the relationship may be a nonlinear one; it is positive when public sector is "small" and negative when it is "large".

We also present some empirical evidence using data from 22 OECD countries over the period 1960–1996. The estimation results using both the linear and the so-called threshold specifications lie in conformity with the nonlinearity hypothesis suggested by numerical simulations. The results from threshold models are, in turn, consistent with results from specifications that include multiplicative interaction terms with the size of the government sector. More specifically, while the linear model cannot explain anything, the threshold model gives results according to which the public sector employment effect on private output depends on the size of the public sector and decreases or even turns into negative when public sector grows. The results from threshold and multiplicative models may provide an explanation for the "mixed" results obtained from linear specifications.

Data sources:

GDP Gross Domestic Product at current or constant 1990 prices. Data source: OECD National Accounts, CD-ROM, OECD, Paris.

G Public consumption or public sector (i.e. producers of government services) production, both at current or constant 1990 prices. Data source: OECD National Accounts, CD-ROM, OECD, Paris.

L_g Public sector employment (thousands of persons). Data source: Employment in the Public Sector, OECD 1982, Paris; OECD National Accounts, CD-ROM, OECD, Paris; and some national sources. The data is available from the authors upon request.

L_p Private sector employment (thousands of persons). Data source: the same as with l_g.

References

Agell, J. – Lindh, T. – Ohlsson, H. (1997) **Growth and Public Sector: A Critical Review Essay.** European Journal of Political Economy, 13, 33–52.

Aschauer, D.A. (1985) **Fiscal Policy and Aggregate Demand.** American Economic Review, 75, 117–127.

Aschauer, D.A. (1989a) **Is Public Expenditure Productive?** Journal of Monetary Economics, 23, 177–200.

Aschauer, D.A. (1989b) **Does Public Capital Crowd Out Private Capital?** Journal of Monetary Economics, 24, 171–188.

Barro, R.J. (1990) **Government Spending in a Simple Model of Economic Growth.** Journal of Political Economy, 98, 5103–5125.

Baumol, W. (1967) **Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis.** American Economic Review, Papers and Proceeding, 57, 415–426.

Carr, J.L. (1989) **Government Size and Economic Growth: A New Framework and Some Evidence from Cross-Section and Time-Series Data: Comment.** American Economic Review, 79, 267–271.

Chan, K.S. (1993) **Consistency and Limiting Distribution of the Least Squares Estimator of a Threshold Autoregressive Model.** Annals of Statistics 21, 520–533.

Devarajan, S. – Swaroop, V. – Zou, H–F (1996) **The Composition of Public Expenditure and Economic Growth.** Journal of Monetary Economics, 37, 313–344.

Fullerton, D. (1982) **On the Possibility of an Inverse Relationship Between Tax Rates and Government Revenues.** Journal of Public Economics, 19, 3–23.

Granger, C.W.J. – Teräsvirta, T. (1993) **Modelling Nonlinear Relationships.** Oxford University Press.

Grossman, H. – Lucas, R.F. (1974) **The Macro-Economic Effects of Productive Public Expenditures.** Manchester School of Economic and Social Studies, 17, 162–170.

Hansen, B. (1996) **Inference when a Nuisance Parameter is not Identified under the Null Hypothesis.** Econometrica 64, 413–430.

Hansen, B. (1999) **Testing for linearity.** Journal of Economic Surveys 13. 551–576.

Karras, G. (1996) **The Optimal Government Size: Further International Evidence on the Productivity of Government Services.** Economic Inquiry, 34, 193–203.

Kormendi, R. (1983) **Government Debt, Government Spending, and Private Sector Behaviour.** American Economic Review, December, 73, 994–1010.

Koskela, E. – Virén, M. (1991) **Monetary Policy Reaction Functions and Saving – Investment Correlations: Some Cross-Country Evidence.** Weltwirtschaftliches Archiv, Heft 3, 452–471.

Landau, D. (1983) **Government Expenditure and Economic Growth: A Cross-Country Study.** Southern Economic Journal, 49, 783–792.

Lybeck, J.A. – Henrekson, M. (eds.) (1988) **Explaining the Growth of Government.** North-Holland, Amsterdam.

Ram, R. (1986) **Government Size and Economic Growth; A New Framework and Some Evidence from Cross-Section and Time-Series Data.** American Economic Review, 76, 191–203.

Reich, U.P. (1986) **Treatment of Government Activity in the Production Account.** Review of Income and Wealth, 32, 69–85.

Sargent, T.J. (1987) **Macroeconomic Theory.** 2nd edition, Academic Press, New York.

Seater, J.J. (1993) **Ricardian Equivalence.** Journal of Economic Literature, XXXI, 142–190.

Singh, B. – Sahni, B.S. (1986) **Patterns and Directions of Causality between Government Expenditure and National Income in the United States.** Journal of Quantitative Economics, 291–308.

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