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How Productive are Government Activities?

Evidence from a Sample of OECD Countries

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Abstract

This paper estimates the productivity of government and private employment, and government and private capital for a panel of 23 OECD economies over the 1960 – 2004 period. A simple theoretical model shows that government employment and capital are optimally provided when their marginal products equal those of the private inputs. The paper's empirical results find that (i) the output elasticity of private employment is six to seven times higher than government employment's; (ii) neither the difference between the marginal products of private and government employment, nor the difference between the marginal products of private and government employment is statistically significant, so that both government employment and government capital can be characterized as optimally provided; and (iii) in most of the countries examined, government workers continue to be overpaid in the sense that the government / private wage ratio exceeds the corresponding ratio of marginal products.

JEL Codes: E24, E62.

Keywords: Employment, Government Employment, Productivity, Wages.

1. Introduction

This paper investigates the productivity of government and private employment, and the productivity of government and private capital in a sample of twenty-three OECD countries during the period 1960 – 2004. Estimating the productivity of the government factors is important because we would like to compare them to the productivity of the private factors and determine whether the government inputs are underprovided, optimally provided, or overprovided. In addition, a comparison of private and government employment productivities, will allow us to examine

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the extent to which wage differentials between the two sectors reflect differences in their labor productivities.

While a substantial amount of empirical research has been devoted to estimating the productivity effects of government *capital,* the productivity of government *employment* has been the topic of a much smaller number of studies.[1] Recent developments, however, have increased the urgency of this line of research. Budgetary pressures, labor market reforms, privatization, and other policies have resulted in a certain amount of government downsizing which may be expected to persist, and which has serious implications for the labor market in terms of both prices and quantities. The critical issue for policy makers is the determination of the optimal participation of the government in the labor market. Is government employment overprovided? How high should government wages be? In order to address these questions we must have a clear idea of how productive government employment is, particularly in relation to private employment's productivity. This is the subject of the present paper.

First, using a simple theoretical model, the paper shows that the government factors of production are optimally provided when their marginal products equal those of the corresponding private input. Thus, optimal provision of government employment requires that its productivity equal that of private employment. Similarly, government capital is optimally provided when its productivity equals the productivity of private capital.

Empirically, using annual data from the period 1960 – 2004 for 23 OECD countries, the paper estimates that the output elasticities of private and government employment are statistically significantly different from each other, private employment's elasticity being 6 to 7 times higher than government employment's. At the same time, the difference between the marginal products of private and government employment is statistically insignificant. This suggests that government employment can be characterized as neither overprovided nor underprovided, and thus, shifting employment from one sector to the other is not likely to produce substantial output gains. A similar conclusion is reached for government capital: while the point estimate of the productivity of government capital is higher than private capital's, the difference between the two productivities is again statistically insignificant. This implies that government capital cannot be characterized as underprovided (or overprovided). Finally, in the majority of the countries examined, government workers appear to be overpaid in the sense that the government / pri-

[1] This literature on the effects of government *capital* is well known. Contributions by Aschauer (1989), Evans and Karras (1994a), Holtz-Eakin (1994), Fernald (1999), Cohen and Paul (2004), and others, have focused on U.S. aggregate and state data. Berndt and Hanson (1992), Evans and Karras (1994b), Girard, Gruber, and Hurst (1995), Sturm and de Haan (1995), de Haan, Sturm, and Sikken (1996), among others, have investigated data from Europe and other OECD countries. For the effects of government *employment,* in addition to Karras (2000), see Demekas and Kontolemis (2000), Demetriades and Mamuneas (2000), and Algan, Cahuc, and Zylberberg (2002) who also survey the related literature.

vate wage ratio exceeds the highest estimated value of the corresponding ratio of marginal products.

The rest of the paper is organized as follows. Section 2 presents a simple theoretical model, while the empirical methodology is outlined in section 3. Section 4 discusses the data sources and definitions, and the empirical results are presented and discussed in section 5. Section 6 examines whether the ratio of private to government wages corresponds to the ratio of marginal products, on a country-by-country basis. Section 7 concludes.

2. A Simple Theoretical Framework

Suppose the production function can be written as

$$Y_t = F\left(N_t^P, N_t^G, K_t^P, K_t^G\right) \tag{1}$$

where Y is aggregate output, N is employment, K is the capital stock, and the superscripts P and G denote private- and government-sector values, respectively. It is assumed that the function F is time-invariant and twice continuously differentiable with $F_j > 0$, and $F_{jj} < 0$, for j = 1,2,3,4. Barro and Sala-i-Martin (2004) discuss some of the properties of "neoclassical" production functions such as this. The function F is also assumed to be linear homogeneous, so output per capita, $y \equiv Y/N$, can be expressed as

$$y_t = F\left(1 - n_t^G, n_t^G, k_t^P, k_t^G\right) , \tag{2}$$

where $n^G = N^G/N$, $k^G = K^G/N$, $k^P = K^P/N$, and we have made use of the fact that $n^P = N^P/N = 1 - n^G$.

The private sector's constraint is $Y_t = C_t^P + \dot{K}_t^P + \delta K_t^P + T_t$, where C^P is private consumption, $\dot{K}^P \equiv dK^P/dt$, the depreciation rate is $\delta > 0$, and T represents net taxes. Letting m denote the population growth rate, which is assumed to be exogenous, and making use of (2), the private sector's constraint can be written in per capita terms as

$$\dot{k}_t^P = F\left(1 - n_t^G, n_t^G, k_t^P, k_t^G\right) - c_t^P - (m + \delta)k_t^P - \tau_t \tag{3}$$

where $c^P = C^P/N$ and $\tau = T/N$.

Using w^G to denote the wage of government workers, and assuming that the depreciation rate is the same for private and government capital, the (balanced-budget) government constraint is $w_t^G N_t^G + \dot{K}_t^G + \delta K_t^G = T_t$, and in per capita terms,

$$\dot{k}_t^G = \tau_t - w_t^G n_t^G - (m + \delta)k_t^G . \tag{4}$$

The objective is to maximize $\int_0^{\infty} u(c_t)e^{-\rho t}dt$, subject to equations (3) and (4), where $c_t = c_t^P + w_t^G n_t^G$ is total consumption, the rate of time preference is $\rho > 0$, and $u(\cdot)$ is a concave utility function.

Setting up the problem's Hamiltonian,

$$H = \{u\big(c_t^P + w_t^G n_t^G\big) + \lambda_{1,t}\big[F\big(1 - n_t^G, n_t^G, k_t^P, k_t^G\big) - c_t^P - (m+\delta)k_t^P - \tau_t\big] + \lambda_{2,t}\big[\tau_t - w_t^G n_t^G - (m+\delta)k_t^G\big]$$

the first-order conditions are

$$\frac{\partial H}{\partial c_t^P} = 0 \quad \Rightarrow \; u'(c_t) = \lambda_{1,t} \; , \tag{5}$$

$$\frac{\partial H}{\partial n_t^G} = 0 \quad \Rightarrow \; u'(c_t)w_t^G = -\lambda_{1,t}\big(MPN_t^G - MPN_t^P\big) + \lambda_{2,t}w_t^G \; , \tag{6}$$

$$\frac{\partial H}{\partial \tau_t} = 0 \quad \Rightarrow \; -\lambda_{1,t} + \lambda_{2,t} = 0 \; , \tag{7}$$

$$\frac{d\big(\lambda_{1,t}e^{-\rho t}\big)}{dt} = -\frac{\partial H}{\partial k_t^P} \Rightarrow \; \frac{\dot{\lambda}_{1,t}}{\lambda_{1,t}} = n + \rho + \delta - MPK_t^P \; , \tag{8}$$

and

$$\frac{d\big(\lambda_{2,t}e^{-\rho t}\big)}{dt} = -\frac{\partial H}{\partial k_t^G} \Rightarrow \; \frac{\dot{\lambda}_{2,t}}{\lambda_{2,t}} = n + \rho + \delta - MPK_t^G \; , \tag{9}$$

where λ_1 and λ_2 are the Hamiltonian multipliers; $MPN^P = \partial F/\partial N^P$ and $MPN^G = \partial F/\partial N^G$ are the marginal productivities of private and government employment, respectively; and $MPK^P = \partial F/\partial K^P$ and $MPK^G = \partial F/\partial K^G$ are the marginal productivities of private and government capital, respectively.

Combining equations (5), (6), and (7), it follows that the optimal solution is characterized by

$$MPN_t^P = MPN_t^G \; , \tag{10}$$

which says that government employment is optimally provided when its marginal product equals the marginal product of private employment. Intuitively, of course, this means that total employment is optimally allocated when any other allocation would result in less output. Note that a violation of condition (10) in the form of $MPN_t^P > MPN_t^G$ (or $MPN_t^P < MPN_t^G$) would mean that output could be increased by transferring employment from the government to the private sector (or vice versa).

Combining equations (8) and (9), at the steady state, where $\dot{\lambda}_{1,t} = \dot{\lambda}_{2,t} = 0$, it will also be that

$$MPK_t^P = MPK_t^G \ , \tag{11}$$

so that government capital is optimally provided when its marginal product equals the marginal product of private capital. Intuitively, condition (11) ensures that the allocation of capital maximizes output. Again, if (11) is violated, output can be increased simply by transferring investment funds from one sector to the other.

3. Empirical Methodology

The empirical methodology implements a modification of the approach of Karras (2000). Rewrite the production function as

$$Y_{i,t} = A_{i,t} F\left(N_{i,t}^P, N_{i,t}^G, K_{i,t}^P, K_{i,t}^G\right) \ , \tag{12}$$

where i indexes over countries and t over time, A is total factor productivity, and once more Y is real output, N^P is private employment, N^G is government employment, K^P is private capital, and K^G is government capital.

Differentiating equation (12) with respect to time and dividing by Y, we obtain

$$\left(\frac{\dot{Y}}{Y}\right)_{i,t} = a^P \left(\frac{\dot{N}^P}{N^P}\right)_{i,t} + a^G \left(\frac{\dot{N}^G}{N^G}\right)_{i,t} + MPK^P \left(\frac{\dot{K}^P}{Y}\right)_{i,t} + MPK^G \left(\frac{\dot{K}^G}{Y}\right)_{i,t} + u_{i,t} \ , \tag{13}$$

where a dot indicates a time derivative, and $u_{i,t} = (\dot{A}/A)_{i,t}$ is multifactor productivity growth.[2] The parameters to be estimated are $a^P = (\partial F/\partial N^P)(N^P/Y)$ and $a^G = (\partial F/\partial N^G)(N^G/Y)$, the elasticities of output with respect to private and government employment, respectively; and $MPK^P = \partial F/\partial K^P$ and $MPK^G = \partial F/\partial K^G$, the marginal products of private and government capital, respectively. Empirical estimation of equation (13) will also permit an evaluation of the marginal products of private and government employment, MPN^P and MPN^G respectively. This in turn will allow us to compare them, and examine whether private and government workers are paid in proportion to their marginal productivities.

4. The Data

All data are from the OECD *Statistical Compendium* on CD-ROM. Output is measured by real GDP. Private investment is measured by real Private Fixed Capital Formation, and government investment by the difference between real Total

[2] See Karras (1996, 1997, 2000) for similar applications. Lack of capital stock data for many of the countries in the sample for sufficiently long time periods precludes estimation of specific functional forms like CES, translog, or the cost function approach of Morrison and Schwartz (1992), and Berndt and Hansson (1992).

Fixed Capital Formation and private investment. Total and government employment are obtained from the Economic Outlook database, and private employment is calculated as the difference between the total and government series. Compensation per employee (private sector) is used for the private wage, and the government wage is calculated by dividing the wage component of government consumption by government employment. These series are also from Economic Outlook.

Table 1

Summary Statistics and Estimated Marginal Product Ratios: 1960 – 2004

	Sample Statistics			Estimated $MPN^G MPN^P$	
	N^G/N	I^G/I	W^G/W^P	(FE)	(RE)
1. Australia	15.48	12.53	1.30	0.80	0.95
2. Austria	11.92	16.33	1.47	1.12	1.33
3. Belgium	16.67	11.76	1.06	0.75	0.89
4. Canada	20.80	15.14	1.05	0.55	0.66
5. Denmark	24.92	11.90	1.03	0.50	0.60
6. Finland	19.82	13.76	1.14	0.67	0.80
7. France	20.46	16.57	0.97	0.58	0.69
8. Germany	12.50	13.53	1.18	1.05	1.24
9. Greece	9.76	13.91	1.92	1.49	1.77
10. Iceland	15.97	19.28	1.06	0.81	0.96
11. Ireland	12.42	20.39	1.32	1.07	1.26
12. Italy	14.67	15.08	1.30	0.88	1.04
13. Japan	8.31	27.77	1.08	1.61	1.91
14. Netherlands	12.30	17.58	1.68	1.05	1.24
15. New Zealand	15.58	25.72	1.30	0.80	0.94
16. Norway	24.62	12.98	0.82	0.49	0.58
17. Portugal	11.86	12.54	1.74	1.32	1.56
18. Spain	10.66	14.04	1.61	1.51	1.78
19. Sweden	27.57	16.81	0.96	0.43	0.50
20. Switzerland	11.52	12.66	1.03	1.16	1.38
21. Turkey	7.85	–	1.55	1.72	2.04
22. U.K.	24.04	13.84	0.60	0.47	0.56
23. U.S.	15.46	19.46	1.08	0.80	0.94

Notes: N^G is government employment; N is total employment; I^G is government investment; I is total investment; W^G and W^P are the government and private wage, respectively; MPN^G and MPN^P are estimated marginal products of government and private employment, respectively. *FE* refers to the model with fixed effects, and *RE* to the model with random effects. Variables are averaged over the 1960 – 2004 period.

Since 1960, government employment in the OECD has varied significantly both across countries and over time. The first data column of Table 1 reports government employment as a fraction of total employment for 23 OECD countries, averaged over the 1960 – 2004 period. The average share of government employment has ranged from 7.85% in Turkey to 27.57% in Sweden. In addition to Turkey, the share of government employment takes relatively low values in Japan (8.31%), Greece (9.76%), and Spain (10.66%). Similar to Sweden, the other two Scandinavian countries also have a relatively high average government employment ratio (Denmark 24.92%, Norway 24.62), but so do the UK (24.04%), France (20.46%), and Canada (20.80%).

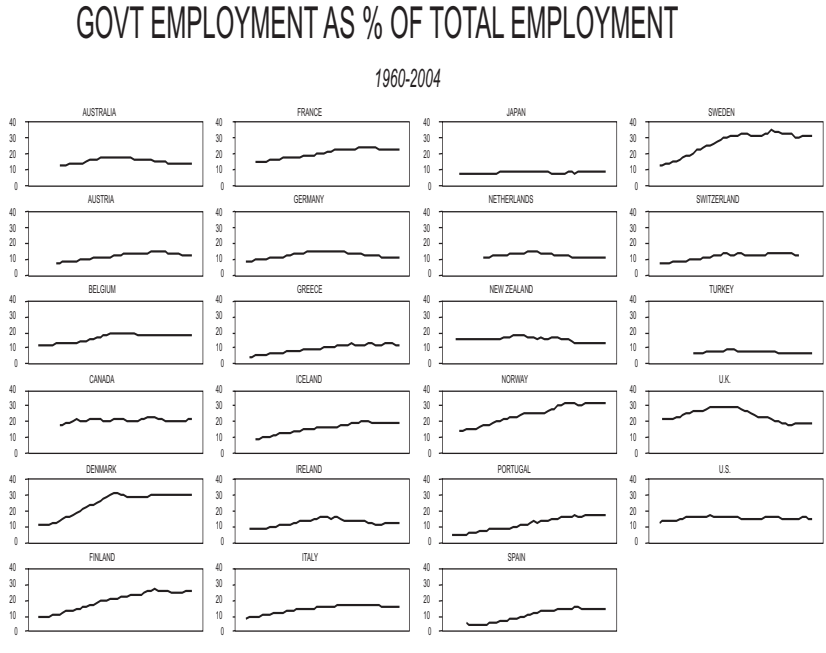


Figure 1: Government Employment as a percent Total Employment, 1960 – 2004

Figure 1 adds a time dimension to these numbers. For most of these 23 countries (such as Austria, Denmark, Finland, France, Germany, Greece, Iceland, Italy, Norway, Sweden, and the U.K.), the fraction of employment absorbed by government increased almost monotonically during the 1960s, 1970s, and the early 1980s. However, even in some of the countries with the steepest increase, such as the Scandinavian countries, the trend has been mitigated and often reversed since the mid-1980s (note particularly Germany, Ireland, and the U.K.; but also Denmark, Finland, the Netherlands, and Sweden).

Government investment in the OECD has also varied since 1960, somewhat less markedly than government employment across countries, though perhaps more so over time. The second data column of Table 1 reports government investment as a fraction of total investment for 22 OECD countries (data for Turkey are unavailable), averaged again over the 1960 – 2004 period. The average share of government investment has ranged from 11.76% in Belgium to 27.77% in Japan. In addition to Belgium, the share of government investment is also relatively low in Denmark (11.90%), and in Australia, Norway, Portugal, and Switzerland. At the other end of the spectrum, next to Japan, New Zealand (25.72%) also has a relatively high average government investment ratio, but to a lesser extent so do Iceland, Ireland, and the U.S.

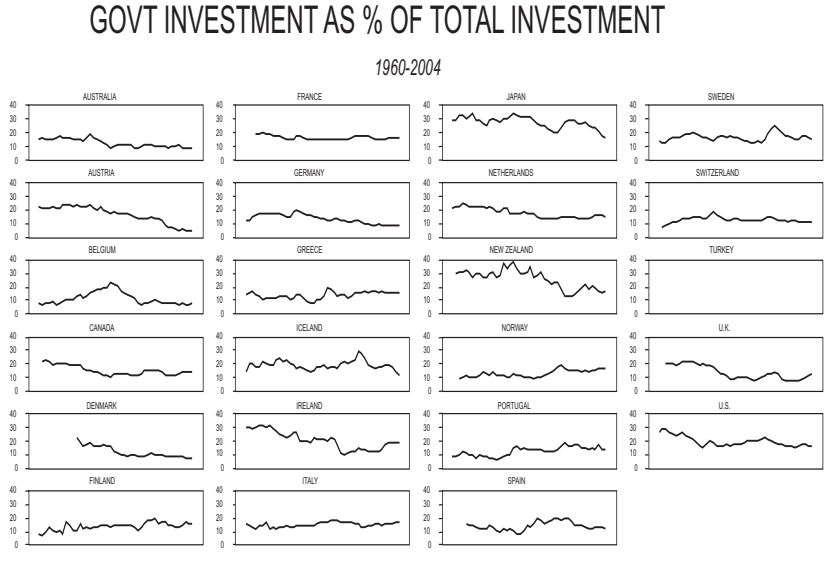


Figure 2: Government Investment as a percent Total Investment, 1960 – 2004

Figure 2 looks at how the government investment ratio has evolved over time in each of the 22 economies. For many of these countries (such as Australia, Austria, Canada, Denmark, Germany, Japan, the Netherlands, the U.K., and the U.S.), the fraction of investment undertaken by government has followed a steadily decreasing trend. On the other hand, the government investment ratio has been fairly steady in several other countries (such as France, Greece, Italy, and Sweden) while almost steadily increasing in others (Finland, Norway, and Portugal).

Whether the result of conscious policy choices or the outcome of historical or economic circumstances, this sizable variability of government employment and

investment, both across economies and over time, should facilitate the empirical identification of their role in economic growth.

5. Empirical Results and Discussion

Table 2 reports several estimated versions of equation (13), together with *F*-statistics for the null hypotheses (i) that the output elasticities of private and government employment are equal, (ii) that the marginal products of private and government employment are equal, as suggested by equation (10), and (iii) that the marginal products of private and government capital are equal, as suggested by equation (11).[3]

The appropriate method of estimation depends on the modeling of $\dot{A}/A$, the growth rate of multifactor productivity. The simplest approach would be to model it as

$$\left(\frac{\dot{A}}{A}\right)_{i,t} = c + B(L)oil_t + u_{i,t} \ , \tag{14}$$

where c is a constant, $B(L)$ is a polynomial in the lag operator L, *oil* is the growth rate of the price of oil, included in order to capture the effects of energy prices on multifactor productivity, and $u_{i,t}$ an error term.

Assuming $u_{i,t}$ is uncorrelated across countries, equation (13) can be consistently estimated by Ordinary Least Squares (OLS), as reported in the first column of Table 2. To account for the persistence exhibited by the output growth rate, the error term is modeled as $u_{i,t} = \rho u_{i,t-1} + e_{i,t}$, where ρ is the autoregressive parameter and e is assumed to be white noise.[4] All estimated coefficients have the right sign, and all but the contemporaneous oil parameter are statistically significant at the 5% level at least. In addition, the estimated values for the private inputs are quite plausible: the estimated elasticity of output with respect to private employment is $a^P = 0.506$, and the estimated marginal product of private capital is $MPK^P = 0.162$. The elasticity of output with respect to government employment is estimated at $a^G = 0.078$, suggesting that a 10% decrease in N^G, holding all other inputs constant, would reduce output by 0.78%. Interestingly, while the null

[3] All series used in equation (13) were pretested for stationarity, following the panel unit-root procedures developed by Levin, Lin, and Chu (2002), Im, Pesaran, and Shin (2003), and Pedroni (1999, 2004). The null hypothesis of a unit root could be decisively rejected for all series regardless of the procedure followed, except for $\frac{\dot{K}^G}{Y}$ which rejects a unit root with Levin-Lin but not with Im-Pesaran-Shin.

[4] Higher-order processes were also tried for the autocorrelation adjustment, but AR(1) seemed to be sufficient. Also note that the Durbin-Watson statistic, *DW,* should be interpreted with caution because of the AR(1) terms.

Table 2

Regression Results: Estimation of Equation (13)

	OLS	GLS			
		Fixed Effects		Random Effects	
	(1)	(2)	(3)	(4)	(5)
a^P	.506**	.507**	.531**	.506**	.524**
	(.038)	(.040)	(.039)	(.038)	(.038)
a^G	.078*	.077*	.078*	.079*	.083**
	(.032)	(.034)	(.033)	(.032)	(.032)
MPK^P	.162**	.211**	.218**	.184**	.186**
	(.031)	(.038)	(.036)	(.035)	(.032)
MPK^G	.181*	.259*	.341**	.197*	.246*
	(.076)	(.122)	(.111)	(.093)	(.096)
(oil_t)	-.003	-.003	-.004*	-.003*	-.004*
	(.002)	(.002)	(.002)	(.002)	(.002)
(oil_{t-1})	-.009**	-.009**	-.009**	-.009**	-.009**
	(.002)	(.002)	(.002)	(.002)	(.002)
ρ	.345**	.305**		.324**	
	(.032)	(.033)		(.033)	
ρ_i			$.01 < \rho_i < .69$		$.03 < \rho_i < .70$
R^2	.377	.357	.384	.365	.388
DW	2.04	2.02	1.95	2.03	1.96
F-Tests					
$a^P = a^G$	68.94**	61.38**	70.24**	66.14**	71.22**
$MPN^P = MPN^G$	0.07	0.08	0.15	0.06	0.03
$MPK^P = MPK^G$	0.05	0.14	1.15	0.02	0.37

Notes: The estimated fixed and random effects are not reported here and are not included in the calculation of the R^2s. Estimated standard errors in parentheses. – **: significant at 1%, – *: significant at 5%.

hypothesis that $a^P = a^G$ is soundly rejected ($F = 68.94$, in favor of $a^P > a^G$), the null of $MPN^P = MPN^G$ cannot be rejected at any reasonable significance level ($F = 0.07$). Thus, there is no evidence that the marginal productivities of private and government employment differ statistically.[5] The estimated marginal product of government capital is $MPK^G = 0.181$, and thus a little higher than the estimated MPK^P. Note, however, that the null of $MPK^P = MPK^G$ cannot be rejected ($F = 0.05$), so that the difference between the marginal products of private and government capital is statistically insignificant.

[5] For the purposes of this test, the *MPN*s are estimated at sample means, as $MPN^j = a^j(\bar{Y}/\bar{N}^j)$ for $j = P, G$. Thus, given the estimated a^P and a^G elasticities and the observed N^G/N ratios, it is not surprising that the estimated *MPN*s are almost equal.

If $u_{i,t}$ is not uncorrelated across countries, its variance-covariance matrix will not be diagonal, and OLS will not be appropriate (see Judge et al., 1985; Arellano, 2003). To address this possibility, we may allow for country-specific effects by modeling technological growth as

$$\left(\frac{\dot{A}}{A}\right)_{i,t} = w_i + B(L)oil_t + u_{i,t} \ , \tag{159}$$

where the w_is can be treated as fixed or random effects.[6] Then, equation (13) can be estimated by Generalized Least Squares (GLS).

Columns 2 and 4 of Table 2 report the results for fixed and random effects, respectively, again modeling the error term as AR(1): $u_{i,t} = \rho u_{i,t-1} + e_{i,t}$. The results are very robust across the two specifications and, qualitatively, very similar to those obtained by OLS. Regarding the employment estimates, the estimates of both a^P and a^G are virtually unchanged. Note that again $a^P = a^G$ can be safely rejected (F = 61.38 for fixed effects and F = 66.14 for random effects), whereas MPN^P and MPN^G are not statistically different (F = 0.08 for fixed effects and F = 0.06 for random effects). With respect to the MPKs, both MPK^P and MPK^G estimates are increased, and more so with the fixed effects. The point estimates still suggest $MPK^G > MPK^P$, but the F-tests suggest that the difference between the two is not statistically significant in either specification (F = 0.14 for fixed effects and F = 0.02 for random effects). Thus, there is no evidence that the marginal products of private and government capital differ statistically. Do the fixed effects belong in the equation? The answer is probably Yes, as the F-statistic for the null hypothesis that the estimated w_is (as fixed effects) are jointly zero is 1.43 (significance level: 0.097).

Next, the assumption that the autoregressive parameter is the same for all countries is relaxed, specifying $u_{i,t} = \rho_i u_{i,t-1} + e_{i,t}$, so that a different ρ is estimated for each country. These results are found in columns 3 and 5 of Table 2 for the fixed and random effects, respectively. It is clear that allowing the ρs to differ across countries generally strengthens the results. This is not so surprising, once it is noted that the estimated ρs have quite a substantial range (from 0.01 to 0.69 for the fixed effects, and from 0.03 to 0.70 under random effects). It follows that estimating a common ρ for all countries may impose a false restriction on the data.

Interestingly, however, allowing the ρs to vary across countries does not alter the statistical comparisons of the output effects of the two types of employment

[6] Technological growth was also modeled as $\left(\frac{\dot{A}}{A}\right)_{i,t} = w_i + v_t + u_{i,t}$, which includes time-specific effects but excludes oil prices, and GLS was again used for (13). The results are not appreciably different for the private variables, but the coefficients of the government inputs are much less precisely estimated. As the oil price variable clearly belongs in the equation, we prefer the specification implied by (15). All results are available on request.

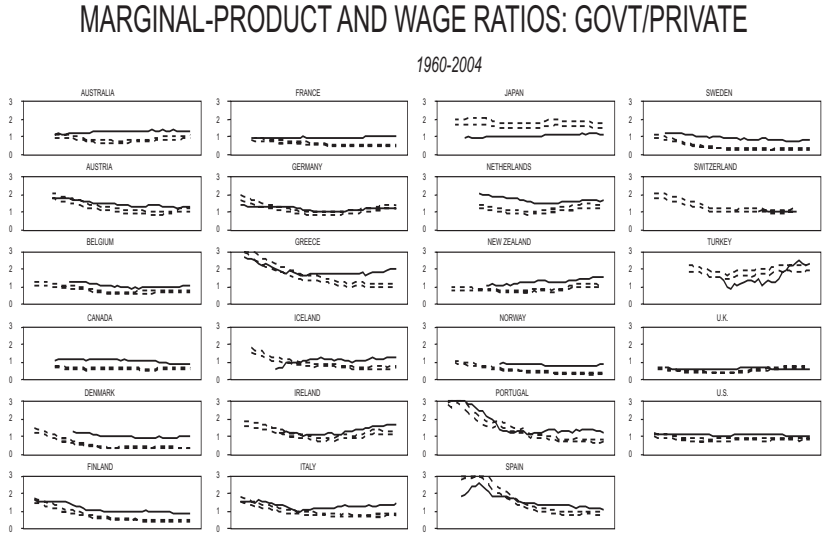
and the two types of capital. Starting with the employment estimates, once more the elasticity of output with respect to private employment, a^P, is statistically significantly higher than the elasticity with respect to government employment, a^G (F = 70.24 for fixed effects and F = 71.22 for random effects), whereas the two marginal products, MPN^P and MPN^G, are not statistically different (F = 0.15 for fixed effects and F = 0.03 for random effects). Regarding the capital productivities, the point estimates of MPK^G are still higher than those of MPK^P, but the F-tests continue to reject the null of $MPK^G = MPK^P$ in both models (F = 1.15 for fixed effects and F = 0.37 for random effects). Do the fixed effects belong in the equation with varying ρs? The answer is an even stronger Yes, as the F-statistic for the null hypothesis that the estimated w_is (as fixed effects) are jointly zero is 2.21 (significance level: 0.0014).

6. Are Government Workers Overpaid?

We are now ready to ask whether the government-private wage structure is consistent with the corresponding marginal products. If private and government workers are paid their marginal products, the ratio of their wages, W^G/W^P, should equal the ratio of their marginal products, MPN^G/MPN^P, in each country. In essence, therefore, we now ask whether government workers are overpaid ($W^G/W^P > MPN^G/MPN^P$), underpaid ($W^G/W^P < MPN^P$), or "competitively" paid ($W^G/W^P = MPN^G/MPN^P$), relative to the private sector.

In practice, government / private wage ratios have been moderately less variable than the fraction of employment absorbed by the government. The third data column of Table 1 gives the government / private wage ratio for the 23 countries in the sample, averaged again over the 1960 – 2004 period. This wage ratio has ranged from 0.60 in the U.K. to 1.92 in Greece. The ratio's average value has been greater than one in all but four of the countries – the four exceptions being France, Norway, Sweden, and the UK, where the average government wage has been lower than the private wage.

These averages, however, may mask the ratio's variability over time, which for some of the countries is considerable. The solid lines of Figure 3 plot the W^G/W^P ratios over time for each of the countries. It is interesting to note that, with very few exceptions, government / private wage ratios have either hovered around one (as in Canada, France, and the U.S.), or have gradually approached unity from above (as in Austria, Finland, Portugal, and Spain). The main exceptions are Greece and Turkey, where the government / private wage ratios have not only been relatively high, but they have actually been diverging from unity (though divergence from unity is also observed in Ireland and New Zealand). As suggested by equation (10), of course, unity is the *a priori* "equilibrium" value for the MPN^G/MPN^P and W^G/W^P ratios: if $MPN^G \neq MPN^P$ (and assuming the skills of the representative private and government workers to be comparable), output in a



Notes: Solid lines: W^G/W^P.
Dashed lines: MPN^G/MPN^P (upper line from model with fixed effects, lower line from model with random effects).

Figure 3: Wage and Marginal-Product Ratios, 1960 – 2004

frictionless economy can be readily increased simply by shifting labor from one sector to the other.

Do the observed wage patterns correspond to the productivities implied by the estimated model? For each of the 23 countries, Figure 3 superimposes the W^G/W^P ratios on plots of two computed ratios of government-to-private marginal products of labor, MPN^G/MPN^P.[7] The upper MPN^G/MPN^P ratio is based on the model with fixed effects (column (3) of Table 2), and the lower one on the model with random effects (column (5) of Table 2).

Figure 3 shows that there is only one country, Japan, for which the wage ratio has been consistently below the band of the two marginal product ratios, and a few other countries (such as Germany, Greece, Iceland, Spain, Turkey, and the UK) for which the same has been true for at least part of the 1960 – 2004 period. For all the rest (as well as for Greece and Spain since at least the early 1980s), the W^G/W^P ratio is habitually above the MPN^G/MPN^P band's upper bound, suggesting that government workers are overpaid (in the sense that $W^G/W^P > MPN^G/MPN^P$).

[7] For country *i* at time *t,* the marginal products of government and private employment are computed using $MPN^j_{i,t} = a^j\left(Y_{i,t}\Big/N^j_{i,t}\right)$, for $j = G, P$. Note that the wage ratios are compared to the point estimate of the ratios of the marginal products, as our purpose is to measure the difference between the two and not test whether this difference is statistically significant.

Similar conclusions can be reached from the last two columns of Table 1, which report the MPN^G/MPN^P ratios by country, averaged over 1961 – 2001. With the exceptions of Japan, Spain, and Turkey, countries have had average government / private wage ratios that exceed the highest estimated ratio of government / private marginal products of labor. While it is possible that these trends are due to the effects of government employment policy, labor market rigidities, or different productivity gains between the tradable (mostly within the private sector) and nontradable sectors, further research is clearly needed in order to identify the empirical importance and policy implications of these results.

7. Conclusions

This study investigated the productivity of government and private employment, and government and private capital for a sample of 23 OECD countries during the 1960 – 2004 period, and compared the ratio of the estimated marginal products to the government / private wage ratio.

A simple theoretical model was used to show that the government factors of production are optimally provided when their marginal products equal those of the corresponding private input.[8] The paper's empirical results support the following conclusions:

(i) The elasticities of output with respect to private and government employment, a^P and a^G respectively, are statistically significantly different from each other. In fact, a^P (very tightly estimated at 0.50) is shown to be six to seven times greater than a^G (estimated around 0.08), depending on the econometric specification used.

(ii) At the same time, the hypothesis that the marginal products of private and government employment, MPN^P and MPN^G respectively, are equal cannot be rejected at any reasonable significance level. This suggests that government employment is neither overprovided nor underprovided. In other words, shifting employment from one sector to the other is not likely to produce substantial output gains.

(iii) The point estimate of the productivity of government capital, MPK^G, is higher than the point estimate of the productivity of private capital, MPK^P.

(iv) However, the difference between the two productivities is not statistically significant, as the null hypothesis of $MPK^G = MPK^P$ cannot be rejected at any reasonable significance level. This implies that government investment is neither overprovided nor underprovided, which is similar to the findings above regarding

[8] While these conditions are quite intuitive, further research should investigate how sensitive they may be to generalizing the model's assumptions along the following lines: (i) introducing leisure in the utility function, and perhaps allowing for different disutilities for working in the private versus the public sectors, (ii) taking into account the distortionary effects of income taxation, and (iii) modeling the productivity gains that may result from privatization.

the allocation of employment. Put differently, shifting investment funds from one sector to the other should not be expected to produce substantial output gains.

(v) Finally, in most of the countries examined, government workers appear to be overpaid, as the ratio of government to private wages exceeds the highest estimated value of the corresponding ratio of marginal products.

These results are robust to all the specifications examined.

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