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On the substitutability between public and private employment

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Abstract

In this note we provide empirical evidence that shows that there seems to be a high degree of substitutability between public and private employment. We estimate an aggregated production function with a CES specification over labor inputs both public and private. Under the assumption that private and public workers are paid their marginal products, we obtain an equation that relates wages' ratios with employment ratios. By estimating that expression for a number of OECD countries we find that for most countries this simple model can explain strikingly well the dynamics of the observed relationship between private and public labor sectors.

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1. Introduction

Some recent empirical literature for OECD countries tends to find a strong positive correlation between wages in the public and the private sector (see Lamo et al., 2013; Demekas and Kontolemis, 2000; Alesina et al., 2002; and Afonso and Gomes, 2008). This would imply that on average over the samples considered in those studies, there was no permanent decoupling of wages in the public and the private sector; on the contrary, the dynamics of wages in both sectors would have been closely tied.

This empirical evidence can be read as supportive of the role of market forces in the determination of public wages and employment, whereby labor in the public and the private sectors would be paid its marginal product. Nevertheless, at the same time, one cannot rule out political-economy-based explanations of the above-mentioned empirical facts, like those posing the role of envy effects and public/private sector trade union's competition (as in Ardagna, 2007) or those stressing the importance of public finance constraints (as in Fernández-de-Córdoba et al., 2012). On different grounds, a broad strand of the literature stresses the influence of politicians' and bureaucrats' vote-producing activities in the determination of public employment and wages (for the key elements see Reder, 1975); the empirical prescriptions of the latter literature would lean towards the prediction that public and private wages and employment are decoupled from each other.[1]

In this paper we explore the role of market forces in the determination of public wages and employment. To do so, we estimate an aggregated production function with a CES specification over labor inputs both public and private. Under the assumption that private and public workers are paid their marginal products, we obtain an equation that relates wages ratios with employment ratios. By estimating that expression for a number of OECD countries we find that for most countries this simple model can explain strikingly well the dynamics of the observed relationship between private and public labor sectors. The main implication of our results is that the relationship between the private and the public labor sectors can be well accommodated within the standard neoclassical theory.

In Section 2 we present the model and some descriptive facts, while in Section 3 we provide and discuss the model estimation results.

[1] In fact, a number of arguments linked to a higher degree of unionization in the public sector, the influence of political objectives, or a separate agenda of public employees (rent-seeking behaviour) would favour such an explanation. Taken to their extreme versions, political economy explanations based on the rent-seeking behaviour of bureaucrats and election cycles would imply a very weak correlation between public and private sector wages. Nevertheless, at least for OECD countries, the most recent empirical literature seems to display a relatively high degree of correlation between wages in both sectors.

2. A simple model of public and private labor markets

The standard theory by which labor in the public and the private sector are paid at their marginal products would predict that the ratio of wages in both sectors should be closely tied to the ratio of employees in the two sectors. In fact, models with free labor mobility imply that wages should be equalized across sectors for the same type of labor. Indeed, as witnessed in Figure 1, the behavior of the public to private wage ratio has had a somewhat (inverse) parallel reflection in the dynamic evolution of the ratio of government sector employees to private sector employees.[2] For instance, the ratio of public to private employees in the euro area[3] reached a maximum in the second half of the 1980s, the same period in which the wage premium reached its minimum. A similar though less marked pattern is apparent for Sweden, while in the case of the US the link is less clear by simple inspection.

To deepen this intuition, we look now at the relationship between public and private labor markets variables through the lens of the assumption that workers in both the public and the private sector are paid at their marginal products. Domeij and Ljungqvist (2006) and Katz and Autor (1999) take a similar approach to analyze different, though related problems. They break the work force into skilled (or high school equivalents) and unskilled (or college equivalents) workers in order to study the skill wage premium. Following their approach we consider an aggregated production function for the economy with a CES specification over labour inputs, which is nested inside a Cobb-Douglas specification with capital,

$$Y_t = A_t K_t^{\alpha} \left[\mu L_{p,t}^{\eta} + (1-\mu) L_{g,t}^{\eta}\right]^{\frac{(1-\alpha)}{\eta}} \tag{1}$$

where $L_{p,t}$ and $L_{g,t}$ denote private and public sector employment respectively, K_t is capital, Y_t is aggregate output and A_t is a measure of total-factor productivity. Time invariant production parameters are α that pins down the private capital share of income, μ that measures the weight of public employment relative to private employment, and $\sigma = 1/(1-\eta)$ that is a measure of the elasticity of substitution between public and private labor inputs. The elasticity of substitution measures the percentage change in factor proportions due to a change in relative factor prices. If $\sigma = 0$ there is no substitution between the two factors, while if $\sigma \to \infty$ public and private employment would be perfect substitutes.

[2]The data is taken from the OECD Economic Outlook database December 2007 Issue, for the period 1970-2006. Regarding the measures of wages we take compensation of employees, deflated with the private consumption deflator. Results are equivalent when the GDP deflator is used instead.

[3]The euro area aggregate has been computed on the basis of the current members, with the exception of Cyprus, Estonia, Luxembourg, Malta, Slovenia and Slovakia, due to limitations of the available data.

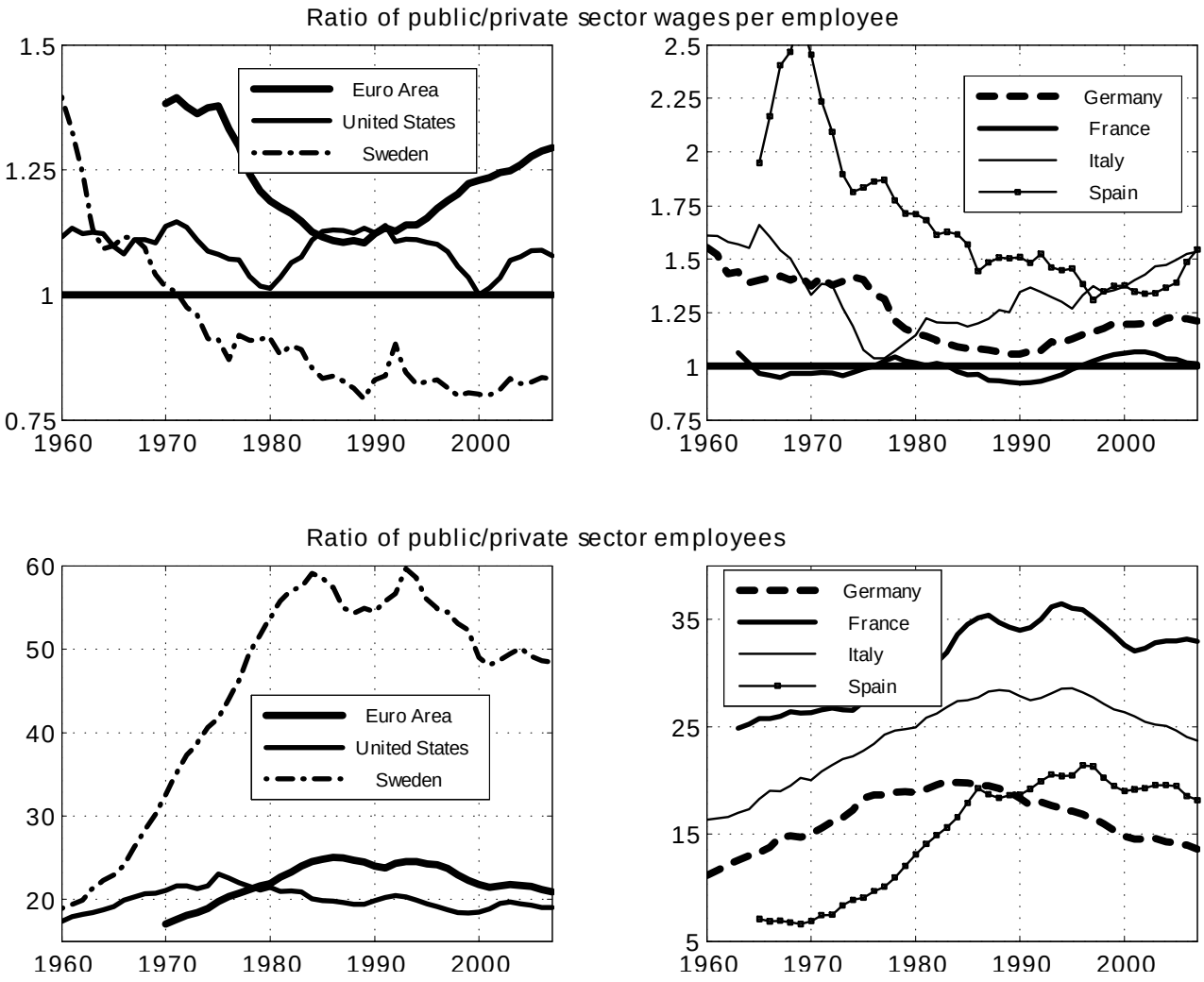

Figure 1: The ratio of public to private sector employees and of public to private sector wages for some selected OECD countries.

Under the assumption that public and private sector workers are paid their marginal products, the problem of the firm is to find optimal values for the utilization of labor and capital given the presence of public inputs. Thus, we obtain that wages are given by:

$$W_{p,t}^{comp} = \mu(1-\alpha)A_t K_t^{\alpha}\left[\mu L_{p,t}^{\eta} + (1-\mu)L_{g,t}^{\eta}\right]^{(1-\alpha-\eta)/\eta} L_{p,t}^{\eta-1} \tag{2}$$

and

$$W_{g,t}^{comp} = (1-\mu)(1-\alpha)A_t K_t^{\alpha}\left[\mu L_{p,t}^{\eta} + (1-\mu)L_{g,t}^{\eta}\right]^{(1-\alpha-\eta)/\eta} L_{g,t}^{\eta-1} \tag{3}$$

So that the ratio of public to private sectors wages turns out to be:

$$\frac{W_{g,t}^{comp}}{W_{p,t}^{comp}} = \frac{1-\mu}{\mu}\frac{L_{g,t}^{\eta-1}}{L_{p,t}^{\eta-1}} \tag{4}$$

Thus, the public-private wage gap would depend on the relative employment level between the two sectors and on the parameters μ and η. As the relative employment level of the private sector with respect to the public sector increases the public-private wage premium also increases via job market flows.[4]

3. Empirical analysis and discussion of the results

Applying logs to expression (4) we obtain that:

$$\log\left(\frac{W_{g,t}^{comp}}{W_{p,t}^{comp}}\right) = \log\left(\frac{1-\mu}{\mu}\right) + (\eta-1)\log\left(\frac{L_{g,t}}{L_{p,t}}\right) \tag{5}$$

We estimate by OLS the above equation for a number of OECD countries.[5] Table 1 shows the estimated parameters. To account for the endogeneity of $\frac{L_{g,t}}{L_{p,t}}$ in the regression, we instrument it using one lag of the ratio and one lag of the independent variable (shown in the Table) and two lags (not shown) and the results barely change.[6]

[4] Our analysis is done at an aggregate level. However, composition effects among both public and private workers may be outstanding. The existence of such a positive premium is a well documented empirical fact of developed economies, as shown in the surveys of Ehrenberg and Schwarz (1986) and Bender (1998). The main findings from this, mainly microeconometric, literature can be summarized as follows: (i) most articles find a positive premium paid to central government workers, even after controlling for differences in the productive characteristics of workers; (ii) women and minorities get higher wages in the public sector relative to their private sector counterparts. Bender (2003) signals that the largest difference in public/private wages can be found in the low-skilled part of the distribution of earnings, while workers at the upper end earn less than

Table 1: Estimation of the equation $\log\left(\frac{W_{g,t}}{W_{p,t}}\right) = constant + linear\ trend + (\eta - 1)\log\left(\frac{L_{g,t}}{L_{p,t}}\right)$, where $L_{p,t}$ and $L_{g,t}$ denote private and public sector labour respectively, and $W_{p,t}$ and $W_{g,t}$ private and public sector wages per employee.

	OLS estimation			IV estimation		
	$\sigma = -\frac{1}{\eta-1}$	$\eta - 1$	*U-root p-val*	$\sigma = -\frac{1}{\eta-1}$	$\eta - 1$	*U-root p-val*
Euro area aggregate	1.4	-0.73 (0.03)	0.000	1.8	-0.56 (0.09)	0.000
Euro area pool ($n = 443$)	1.4	-0.70 (0.03)	0.000	1.4	-0.70 (0.03)	
Euro area pool (weighted)	1.6	-0.62 (0.02)	0.000	1.6	-0.61 (0.02)	
Germany	2.5	-0.41 (0.05)	0.004	2.4	-0.42 (0.05)	0.007
France	2.5	-0.39 (0.07)	0.007	2.5	-0.39 (0.07)	0.027
Italy	1.1	-0.93 (0.11)	0.032	1.1	-0.93 (0.11)	0.028
Spain	2.7	-0.37 (0.05)	0.004	2.7	-0.37 (0.06)	0.046
Netherlands	1.4	-0.71 (0.03)	0.017	1.4	-0.73 (0.03)	0.000
Austria	3.1	-0.32 (0.06)	0.000	3.1	-0.32 (0.06)	0.004
Belgium	0.6	-1.73 (0.12)	0.026	0.5	-1.98 (0.11)	0.004
Greece	1.1	-0.89 (0.08)	0.025	1.1	-0.89 (0.09)	0.008
Ireland	1.8	-0.57 (0.05)	0.004	1.9	-0.53 (0.05)	0.009
Portugal	1.0	-1.03 (0.08)	0.058	1.0	-0.99 (0.10)	0.001
Finland	2.2	-0.46 (0.06)	0.001	2.0	-0.49 (0.07)	0.001
Sweden	3.8	-0.26 (0.03)	0.000	4.0	-0.25 (0.03)	0.000
Denmark	1.8	-0.57 (0.04)	0.000	1.9	-0.53 (0.04)	0.001
Norway	2.9	-0.35 (0.03)	0.000	2.6	-0.38 (0.03)	0.000
United Kingdom	3.6	-0.28 (0.05)	0.001	4.7	-0.21 (0.05)	0.009
United States	> 10	-0.09 (0.08)	0.005	> 10	-0.08 (0.08)	0.004
Japan	$\gg 10$	-0.00 (0.00)	0.002	$\gg 10$	-0.01 (0.10)	0.003
Korea	$\gg 10$	-0.00 (0.00)	0.000	$\gg 10$	0.00 (0.00)	0.000
OECD pool ($n = 863$)	1.9	-0.53 (0.01)		1.9	-0.53 (0.02)	
OECD pool (weighted)	2.3	-0.44 (0.01)		2.3	-0.43 (0.01)	

Notes: Pool estimates include fixed effects and country-specific linear trends. Weighted estimates account for cross-section heteroskedasticity. The OECD pool includes all the countries listed in the table plus Island, Canada, and New Zealand. The euro area pool includes Austria, Belgium, Germany, Spain, Finland, France, Ireland, Netherlands, Portugal and Greece.

IV estimation: lagged $\log\left(\frac{L_{g,t}}{L_{p,t}}\right)$ and lagged $\log\left(\frac{W_{g,t}}{W_{p,t}}\right)$ used as instruments.

Unit root tests' null hypothesis is H_0: the residual of the regression has a unit root. Lag-length selection using the SIC criterion.

Listed are coefficients. Standard errors are in parentheses.

Of special interest is the parameter σ, an estimate of the degree of substitution between public and private sector employees. For all OECD countries the elasticity of technical substitution between public and private sector workers is greater than one with the only exception of Belgium. The numbers in the table range from a minimum of 0.6 in Belgium to perfect substitution ($\sigma \to \infty$) in the cases of Japan and Korea, and to a lesser extent the US. In fact, the elasticity of substitution for the average of the euro area is estimated at 1.4-1.6 – for the euro area aggregate and the pool of euro area countries – below the values of the Japan, the US, the UK (3.6), Sweden (3.8) and thus the OECD pool (range 1.9-2.3). Within the euro area, countries with lower degree of substitution are Italy (1.1), Netherlands (1.4), Belgium (0.6), Greece (1.1) and Portugal (1.0).

As shown by the information in Figure 2 for some selected countries, the fit of the estimated model is quite good in the case of all European countries. For the US the model only captures the average premium, even though the higher substitutability compared to EU countries might reflect a more competitive labor market (less segmented between public and private sector employees). In the case of Japan the apparent perfect substitution is related to the institutional setup of the country. As indicated by Ishida and Matsushima (2009), in Japan civil servants are typically not allowed to bargain collectively, and their wages are instead determined based on the advise of the National Personnel Authority, with its particular emphasis on the equalization between the private and public sectors. Although the advice formally covers only national employees, it typically sets the baseline and hence has strong implications for salaries of local government employees. Along the same lines, in the case of Korea perfect substitutability ($\sigma \to \infty$) stems from the institutional features of the country by which wages are equalized by law between workers of the same type working in different sectors (Song, 1999).

Overall, the results in Table 1 signal a high degree of substitutability between public and private sector workers, but also some heterogeneity across countries. Even though, as discussed in the previous paragraph, the underlying rationale of a high substitution differ

their private sector counterparts. Domeij and Ljungqvist (2006) show that this argument is at the heart of the compression of the skill premia in Sweden as compared to the US.

[5] We estimate expression (5), extended with a time trend to account for the potential presence of technological progress over time (following Domeij and Ljungqvist, 2006).

[6] Standard tests of stationarity would tend to reject the null hypothesis of stationarity of both the ratio of wages per employee and the ratio of employment for most countries. While from a theoretical point of view this is not reasonable and would point to weaknesses of the empirical tests, it is also arguable that within the confines of the actual sample used this is a possibility. In the latter case, the OLS estimates drawn from of the equation would be superconsistent. To reinforce this point we provide standard unit root tests for the residuals of the regressions in the Table.

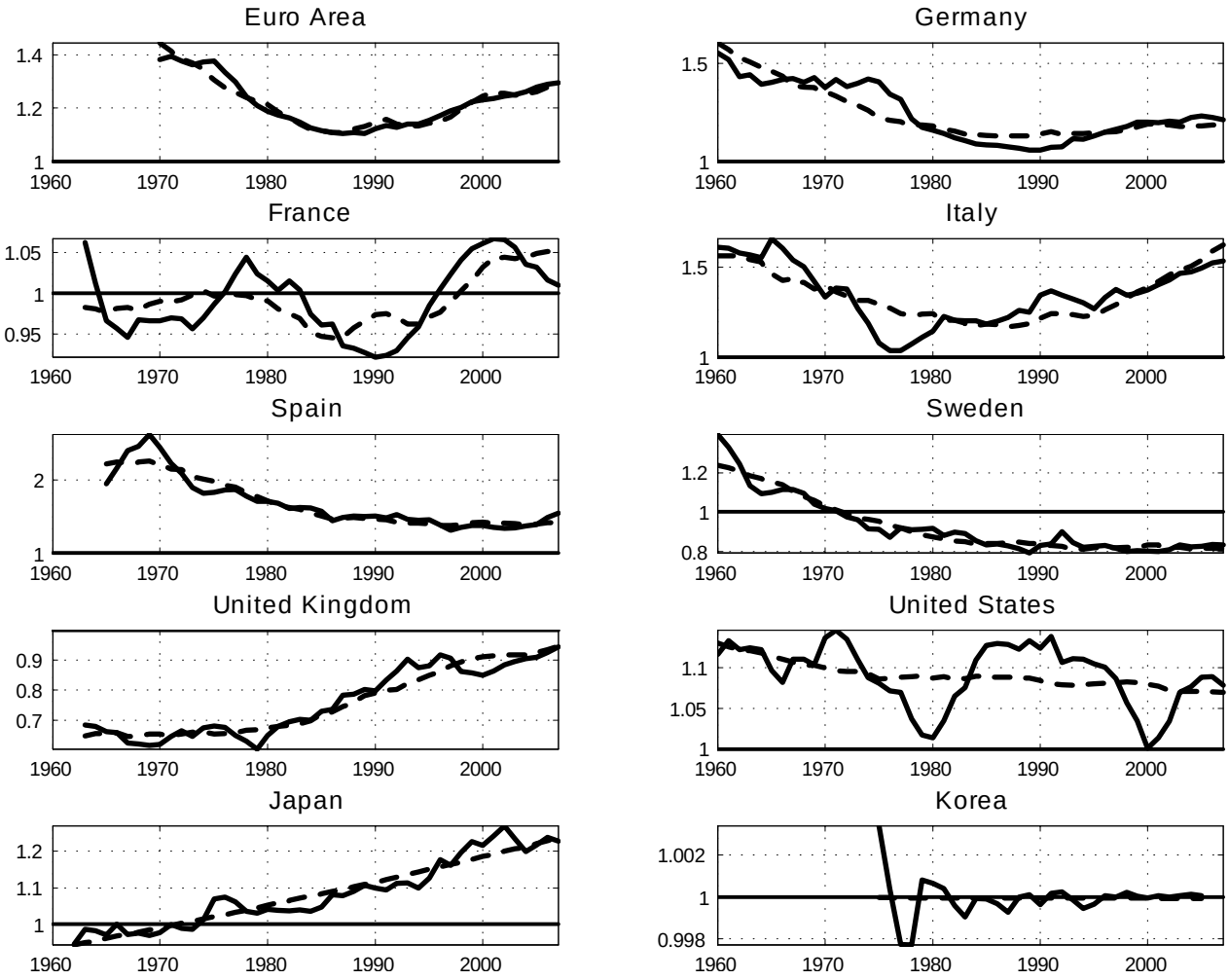

Figure 2: The ratio of public to private sector wages for some selected OECD countries: actual data (solid lines) and model fit (dotted lines).

among countries (from the market determinants that one may claim in the case of the US to institutional determinants in the cases of Japan and Korea), it is fair to say that our simple model accounts pretty well for the observed relationship between private and public labor sectors. Thus, an implication of our results is that the relationship between the private and the public labor sectors can be well accommodated within a standard neoclassical theory.

As mentioned in the Introduction, the obtained empirical evidence may also be used to back alternative, political-economy-based explanations that prescribe that public and private wages are closely tied. For example, public and private sector salaries may co-move because trade union's in one sector trace wage developments in the other sector, like models stressing the role trade union's competition through envy effects (Ardagna, 2007). Another sort of models in which public and private wages co-move would be those in which private and public wages are expanded in good times, in the latter case because the government budget constraint gets loosened (Fernández-de-Córdoba et al., 2012).

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