WHY IS THE PUBLIC SECTOR MORE LABOR-INTENSIVE? A DISTORTIONARY TAX ARGUMENT

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Abstract

A relatively high labor-intensity in government-run entities need not imply slack in their organization. Rather, it is a rational reaction to various forms of wage tax advantage that the public sector has over private firms. Even though an unequal tax treatment of public and private sectors precludes production efficiency, it may improve welfare by mitigating the labor supply distortion. With inelastic labor supply, privatizing a previously government-run sector improves welfare, while with elastic labor supply a full outsourcing of government activities can never be optimal if it goes along with a decrease in net wages.

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1 Introduction

The main thrust of outsourcing and privatization is efficiency: Government-run enterprises or services often are thought to absorb substantial portions of the state budget without generating commensurate contributions to social welfare. Moreover, lack of competition and incentives, X-inefficiency, a soft budget constraint, and the failure to price properly inputs and outputs may result in significant misallocation of resources and welfare losses. Privatization and outsourcing of government activities have been essential in transforming former socialist economies. Also many market economies have chosen to privatize public utilities and state-owned enterprises or to outsource parts of government activities to the private sector (e.g., telephone services, waste collection and treatment, public transport, hospitals, and prisons).[1] Over the last 10 to 15 years, central government employment (excluding teachers and health sector) in OECD countries decreased from 2.9 to 1.9% of the population and the governmental wage bill reduced from 5.5 to 4.4% of GDP.[2] Local government administration employs in average 2.5 and teaching and health care 3.4 % of OECD population (Schiavo-Campo et al., 2003).

Privatization and outsourcing often result in lower labor inputs in the privatized firms (for a recent survey see Megginson and Netter 2001). E.g., in a study on 63 privatizations, Dewenter and Malatesta (2001) report a significant decline in the labor intensity after privatization. In a study on 218 privatizations in Mexico, La Porta and Lòpez-de-Silanes (1999) found that output on average increased by 54.3% while employment declined by almost half, which indicates a tremendous increase in labor productivity.[3] This is largely regarded as evidence that, under government-ownership, there had been overmanning and slack working practices, inefficiencies that private firms could not afford under the pressure of the marketplace.

While from everyday experience we would not dismiss the inefficiency hypothesis for the public sector entirely, we propose in this paper a different potential explanation why pri-

[1] For a survey on state-ownership and privatization in the Western world, see the edited volume by Toninelli (2000).

[2] For Non-OECD countries, figures may be dramatically different. Furthermore, for many countries data availability is very poor.

[3] An empirical investigation by Megginson et al. (1994) does, however, indicate an opposite effect on employment: In their sample of 18 countries they find that privatizsation on average led to a rise in employment following privatization.

vate firms have leaner workforces than state-run firms: They operate under a different tax regime with respect to factor inputs. Suppose that the government levies a distortionary wage tax. For a private firm, this means that if its workers should earn a certain *net* wage, the firm faces a higher labor cost (obviously, the gross wage) parts of which go to the government. If the firm is a state-owned, then the employees' net wage reflects the full labor cost for the government – since, by consolidating accounts, all intra-government tax payments net out. Thus, the government incurs a lower labor cost than a private firm and will hire a larger workforce than a private firm that produces the same level of output. Moreover, production in the tax-preferred realm of government is, *ceteris paribus*, less costly than production in the private sector.

However, reasoning under the *ceteris-paribus* assumption might be quite misleading in this context: Nationalizations or privatizations may impact on factor prices, output in other sectors, factor supplies, and the tax rate necessary to finance government expenditure. In this paper, we therefore employ a general-equilibrium model to study the effects of contracting out or outsourcing previously government-run activities in the case that the government has a tax advantage over private firms on the employment of labor. Consider an economy with two factors (labor and capital) and two sectors. Labor supply is endogenous and, possibly, distorted by taxation. One of the two sectors is always privately organized, while the other can be either government-controlled or privately-run. Real-world examples include hospitals, schools, public transportation, and utilities. We assume that output in this sector is provided to the citizenry free of charge by the government.

We compare two scenarios: one where the sector is outsourced (private economy) and one where it is run by the government (mixed economy). In the privatization case output will be purchased by the government which finances its purchases or factor expenses via a tax levied on labor. Since employment in the government sector is effectively not subject to labor taxation, production in the government sector will exhibit a higher labor intensity than in the private sector. We show that this pattern is not only a partial-equilibrium effect but also emerges when comparing the general equilibria of the mixed and the private economy. Moreover, it may (but need not) happen that the labor-market clearing after-tax wage (where the tax rate is adjusted such as to balance the government budget) is higher in the mixed than in the private economy, implying a smaller distortion on labor supply.

However, should this happen, it comes at a cost: Due to the government's tax advantage the allocation of factors across sectors in the mixed economy is distorted, implying a loss in overall output. Hence, society faces a trade-off between production efficiency (realized in the private economy) and small tax distortions (realized in the mixed economy). We identify conditions (mainly in terms of the elasticity of labor supply) such that either welfare loss is preferable to the other. In particular, we identify cases where it is optimal (in the second-best sense) to deviate from full privatization and, thereby, to entertain one sector in the economy with a labor intensity that would appear inefficiently high under market conditions.

We assume that government entities take wage and interest levels as given. When hiring labor, the government recognizes that it receives back (or is exempt from paying) at least some part of the taxes that a private firm would have to pay for the same sort of operations. The tax asymmetry between the government and the private sector can, however, take on different degrees: A fully centralized government whose officials perfectly see through the consolidated state budget would recognize that, in effect, it does not carry any tax burden at all. However, the government need not be that monolithic: E.g., the organization of public production may be spread over different ministries or departments, each of them being small relative to the whole government. The recruiters in these agencies may only partially see through to consolidated government budgets, and the cost accounting in their agencies may be based on statutory rather than net factor costs. The perceived tax advantage for the government would then be smaller than the full tax rate. Alternatively, consider that production takes place at a lower, say, the municipal level in a federal state such that only parts of the total tax on labor accrues to, and therefore is irrelevant from the perspective of, the employing municipalities. For such settings, there is some evidence that local governments are responsive to tax incentives, for example as concerns the VAT treatment of their activities. Wassenaar and Gradus (2004) compare its effect on outsourcing for seven EU countries and Norway. They find that a refund scheme for VAT costs of local governments facilitates outsourcing. Finally, varying degrees for the tax advantage of the government over private firms may result from different types of employment. In many countries, people working for the government can be separated into civil servants and "normal" employees, for whom standard labor legislation applies (see, e.g., Cardona, 2002). In some countries (e.g., in Germany, Italy, and Austria),

civil servants do not pay social security taxes (old-age income, unemployment, or health insurance), or pay only to a lesser extent, while employees typically do. This *prima facie* makes civil servants the less costly staff type to the government, limiting, however, the government's tax advantage to the degree to which it relies on civil servants as its personnel. By introducing a parameter which can take values between zero and one, our analysis takes into account that the government's actual or perceived tax advantage over the private sector depends, to a considerable extent, on institutional features of government organization.

The rest of our paper is organized as follows: Section 2 reviews related literature. Section 3 presents the model. In Section 4 we then derive the differences in factor allocations, factor prices, and tax rates that result from the different organizational modes in a mixed and in a private economy. Section 5 reports our main findings on welfare comparisons. Section 6 concludes.

2 Related Literature

There is an extensive literature on why private firms are more productive than public enterprises. Most popular is a Alchian-Demsetz type property-rights argument: Since there is no residual claimant in public enterprises, nobody really cares about its efficiency. Hence, workers slack off. Other explanations for the perceived inefficiency of the public sector range from political interference over the pursuit of objectives that are unrelated to efficiency to soft budget constraints and monopoly power in the output market. As observed in Mintz et al. (2000), taxation is a largely overlooked issue in the debate on privatization. Independently of any other effects, differential tax treatment between public and private sector amounts to substantial differences in effective marginal tax rates that, upon privatization or nationalization, would necessitate a re-allocation of factors of production. Tax issues play a role when privatization is made for the sake of levelling the playing field for all competitors in the market. Private firms, competing against public firms, often complain that tax treatment for public firms is more favorable, thereby generating artificial competitive advantages for such firms over investor-owned firms. Economists would add that differential tax treatment of firms of the same type

generates distortions and inefficiencies.[4]

In this paper we look at the relationship between privatization and taxation from a general-equilibrium perspective. Such a view is hardly ever taken in the literature — with three notable exceptions to which our contribution is related:

In a model where a range of production activities can, with different technologies, be carried out by either the government or by the private sector, Huizinga and Nielsen (2001) investigate the optimal boundary between public and private production. Their focus is on capital income taxation (which distorts private investment decisions), but the analysis could be recast as to deal with labor income taxes.[5] Huizinga and Nielsen (2001) predict that the size of the public sector, measured by the range of activities that are carried out through the state, is larger the higher is the budgetary need for, or the marginal damage resulting from, distortionary taxation. Moreover, privatization would generally go along with a decrease in the use of the taxed factor. For a simpler economy, our paper comes to quite similar conclusions — without having to resort to differences in the efficiencies of private and public production. In our framework, outsourcing may be beneficial or counterproductive even when the government and the private sector have access to the same production technologies.

Gordon et al. (1999) argue that organizing production in an inefficient government sector may be acceptable for society when the deadweight loss of taxation is sufficiently large. They argue that the inefficiency of the public sector is less than proportionately related to its size while the efficiency costs of taxation increase more than proportionately with the tax rate. At some point, nationalization of industries gets cheaper than financing government purchases through distortionary taxation. Unlike our similar-sounding finding, this results rests on an in-built inefficiency in the government sector. We replace this assumption by adding a second sector to the economy. For efficiency, the two sectors should

[4]In their case study on the (planned, but not executed) privatization of Ontario Hydro, a Canadian electricity company, Mintz et al. (2000) illustrate this for the case of capital, land and property taxes in the province of Ontario. However, by ignoring revenue impacts for the government and under a strict ceteris paribus clause, the focus in Mintz et al. (2000) is on the incentives in re-structuring the firm rather than on an overall assessment of the tax issue.

[5]Huizinga and Nielsen (2001) predict over-capitalization of the public sector in the presence of capital income taxes. This is at odds with reality which is characterized by an under-capitalized private sector (see also Gordon, 2003). Replacing capital by labor taxation would, however, render the model's forecasts compatible with reality.

not face different factor price ratios – but in the mixed economy they do, generating an *endogenous* inefficiency of public production.

In Gordon (2003), the focus is on the role of state-owned banks. By providing cheap loans, state-owned banks may help to counteract underinvestment problems in the private sector, caused by capital income taxation. Gordon also suggests that public firms may be more labor-intensive than private ones as the government may use state-owned firms to hire workers that would otherwise be unemployed, or hire unskilled workers to drive up their equilibrium wage. We assume that there is no capital income taxation and that labor markets are competitive, two conditions under which the model developed by Gordon (2003) would not predict any positive role for public ownership. Our model allows such a role since we endogenize labor supply. With exogenous labor supply, also our model predicts that privatization or outsourcing is always optimal.

3 The Model

Consider a closed economy with two sectors $i = 1, 2$. Sector i uses labor L_i and capital K_i to produce its output; there are no intermediate inputs. Good 1 will be provided and tax-financed (but not necessarily produced) by the government, and for good 2 we choose units such that it has unit price. Technologies are represented by neoclassical production functions $F^i = F^i(L_i, K_i)$ which are assumed to have the standard monotonicity and concavity properties. Denoting partial derivatives by subscripts, we assume, in particular, that $F^i_L > 0$, $F^i_K > 0$, $F^i_{LL} < 0$, $F^i_{KK} < 0$, and $F^i_{LL}F^i_{KK} - (F_{KL})^2 \geq 0$ for all $(L_i, K_i) \in R^2_{++}$. We assume that the supply of capital is fixed at a level $\bar{K}$. Full employment of capital therefore requires that

$$K_1 + K_2 = \bar{K} \tag{1}$$

always holds. We assume that the economy is populated by one (representative) individual who has preferences over the consumption of goods 1 and 2 and over leisure. We assume that the solution to the utility maximization problem gives rise to a supply function for labor that increases in the net wage rate:

$$L_S = L_S[w(1-t)]$$

with $L_S'[w(1-t)] > 0$. By w we denote the gross wage and by t the tax rate on labor income. Denote by

$$\eta^S := L_S' \cdot \frac{w(1-t)}{L_S}$$

the elasticity of labor supply with respect to the net wage.
In a labor market equilibrium the labor intake of the two sectors equals labor supply:

$$L_1 + L_2 = L_S[w(1-t)]. \tag{2}$$

We assume that sector 2 is always privately run and operating in a profit-maximizing way. Denoting by r the rental price of capital, profits in sector 2 amount to

$$\Pi_2 = F^2(L_2, K_2) - r \cdot K_2 - w \cdot L_2.$$

Profit maximization requires that marginal productivities equal factor prices (subscripts to production functions indicate partial derivatives):

$$F_L^2(L_2, K_2) = w \tag{3}$$

$$F_K^2(L_2, K_2) = r. \tag{4}$$

Sector 1 can be either government-operated or privately-run (think, e.g., of hospitals). We assume that the sector has to provide a certain and invariant level $\bar{F}^1$ of output:

$$F^1(L_1, K_1) \geq \bar{F}^1. \tag{5}$$

We assume that production is organized in a cost-minimizing manner. This is a prerequisite for profit maximization and therefore appears to be an appropriate hypothesis in case the sector is in private hands. Assuming cost efficiency in the public sector might be more controversial, given that there seems to be ample of evidence for governmental slack. We use the assumption of cost efficiency in order to deliberately ban all reasons for outsourcing that might obtain from an inefficient organization of the public sector.

- If the sector is privately-run, then the cost-minimization problem reads as:

$$\min_{L_1, K_1} \left\{ rK_1 + wL_1 | F^1(L_1, K_1) \geq \bar{F}^1 \right\}. \tag{6}$$

  To assess labor costs, the private firm uses the gross, tax-inclusive wage rate. A fraction t of wages are paid to the government as a wage tax such that workers earn

a net wage of $w(1-t)$ per unit of labor supply. The FOCs for cost efficiency are given by:

$$\frac{F_L^1(L_1, K_1)}{F_K^1(L_1, K_1)} = \frac{w}{r} \tag{7}$$

and the output requirement (5).

- If the sector is government-operated, the cost-minimization problem reads as:

$$\min_{L_1, K_1} \left\{ rK_1 + w(1-t)L_1 | F^1(L_1, K_1) \geq \bar{F}^1 \right\}. \tag{8}$$

The difference to the private-sector problem is that the government can use the *net* wage rate $w(1-t)$ to assess labor costs. When deciding on factor demands personnel recruiters in the government sector, thus, take gross and net wages as given but regard the government (or the entity to which they are hiring) as being effectively tax-exempt. Such a view would emerge if the recruiter, somewhat heroically, recognized that taxes paid by government entities cancel out entirely upon consolidation of all government accounts. The FOCs for cost efficiency in the government sector are given by:

$$\frac{F_L^1(L_1, K_1)}{F_K^1(L_1, K_1)} = \frac{w(1-t)}{r} \tag{9}$$

and, again, the output requirement (5).

Generalizing (6) and (8), we can introduce parameter α with $\alpha \in [0, 1]$ to measure the extent to which the government has, or its authorities that recruit staff into government services perceive the government to have, a relative tax advantage over the private sector: $\alpha = 0$ would be equivalent to the outsourcing production of good 1 to the private sector, with $\alpha = 1$ the public sector fully sees through its accounting mechanisms.[6] Variable α may reflect the degree to which employees in government-run entities are exempt from taxes or contributions that are collected in the private sector.

[6] With some leap of faith in the existence of aggregate production functions, one might also interpret α as the *fraction* of sector 1 that is government-operated. Such an interpretation might be appropriate for the case of public transport, where only parts of the network might be operated through private companies. However, this interpretation requires that production in sector 1 could be additively aggregated from a number of micro-production functions – which will only be possible under quite restrictive conditions. Cf., e.g., Felipe and Fisher (2003).

The variable α might also give rise to an interpretation in terms of a federalist structure. Suppose, e.g., that sector 1 is the hospital sector, run by local municipalities. Then $(1-\alpha)$ might be interpreted as that part of wage taxes that directly flows to municipalities (and that would therefore not be regarded as part of the labor costs by local decision makers) while α denotes tax revenues that first flow to a higher tier in the federal system in order to be returned, in a lump-sum fashion, to the local level afterwards. Then the local sector would employ labor on the base of a cost of $w(1-\alpha t)$ per hour.
Using α, the cost minimization procedure can be written as:

$$\min_{L_1,K_1} \left\{ rK_1 + w(1-\alpha t)L_1 | F^1(L_1,K_1) \geq \bar{F}^1 \right\} \tag{10}$$

and the attending FOC (apart from the output constraint) reads:

$$\frac{F^1_L(L_1,K_1)}{F^1_K(L_1,K_1)} = \frac{w(1-\alpha t)}{r} \tag{11}$$

Denote the solutions to (10) by $K_1(\alpha)$ and $L_1(\alpha)$. Similarly, we might index all other variables by α. From a mathematical perspective, the advantage from using continuous α rather than a dichotomous $\alpha \in \{0,1\}$ lies in making the whole problem "differentiable".
Equation (11) together with the output constraint obviously implies that labor input in sector 1 is higher and consequently capital input is lower the larger is α, implying that labor intensity is *ceteris paribus* higher when sector 1 is government-owned rather than when it is privatized. We will below show that this pattern also emerges in a general equilibrium.
Our model is closed by the government budget constraint:

- We assume that in the case where production in sector 1 is outsourced to the private sector, the government procures the output from there. The price for output $\bar{F}^1$ has at least to cover the costs of production; otherwise no private supplier can be found. I.e., the procurement cost for $\bar{F}^1$ are at least

  $$r \cdot K_1(0) + w \cdot L_1(0).$$

  Government revenues stem from taxes on employment in the two sectors, i.e., they amount to

  $$t \cdot w \cdot (L_1(0) + L_2(0)).$$

A balanced budget therefore requires

$$rK_1(0) + w(1-t)L_1(0) = twL_2(0).$$

- Now suppose that production of good 1 takes place in the government sector. From (8), the costs of production amount to $rK_1(1) + w(1-t)L_1(1)$. Revenues now only come from labor employed in the production of good 2 (since workers in sector 1 are paid there net wages directly and do not transfer back any money to the government), such that the budget constraint reads:

$$rK_1(1) + w(1-t)L_1(1) = twL_2(1)$$

— which is the same as in the previous case (noting, of course that the input variables may take on different values).

Generalizing with the use of α, this does not change; the government budget always has the form:

$$rK_1(\alpha) + w(1-t)L_1(\alpha) = twL_2(\alpha)$$

or, upon using that $r = F_K^2$ and $L_2 = L_S - L_1$,

$$F_K^2 \cdot K_1(\alpha) + w \cdot (L_1(\alpha) - tL_S) = 0. \tag{12}$$

Summarizing (1) to (5), and incorporating (11) and (12), the equilibrium of the economy can be characterized by the following system of equations:

$$\begin{aligned}
F_L^1(L_1, K_1) \cdot F_K^2\left(L_S[w(1-t)] - L_1, \bar{K} - K_1\right) & \\
-F_K^1(L_1, K_1) \cdot w \cdot (1-\alpha t) &= 0 \qquad (13)\\
F^1(L_1, K_1) - \bar{F}^1 &= 0 \qquad (14)\\
F_L^2\left(L_S[w(1-t)] - L_1, \bar{K} - K_1\right) - w &= 0 \qquad (15)\\
F_K^2\left(L_S[w(1-t)] - L_1, \bar{K} - K_1\right) \cdot K_1 + w \cdot (L_1 - tL_S[w(1-t)]) &= 0. \qquad (16)
\end{aligned}$$

The first of these equations is the cost-efficiency condition for the production of good 1, the second one is the minimal-output requirement for that good, the third one is the condition for profit-maximizing labor input in the production of good 2, and the last one

is the government budget constraint. The four equations (13) through (16) have to be solved for the variables L_1, K_1, w, and t from which all other endogenous variables of the model can then be determined. The solution can be parametrized by α.
Observe that an efficient allocation of factors of production requires that the marginal rates of factor substitution are equalized across sectors:

$$\frac{F_L^1}{F_K^1} = \frac{F_L^2}{F_K^2}. \tag{17}$$

In our model, this will happen if and only if $\alpha = 0$, i.e., if sector 1 is under private control.[7]

4 Comparative statics

To avoid some technical complications we will henceforth always assume that $F_{KL}^i \geq 0$ for $i = 1, 2$. This implies that a profit maximizing firm in sector i would decrease its demand for a factor whenever the price of the other factor increases. The assumption $F_{KL} \geq 0$ is, e.g., satisfied for all CES-functions $F = (\gamma_K \cdot K^\rho + \gamma_L \cdot L^\rho)^{1/\rho}$ with $\rho \leq 1$ and $\gamma_K, \gamma_L > 0$. We derive comparative statics of (13) to (16) with respect to the tax advantage α of public firms. We obtain:

Proposition 1 *Suppose that $L' > 0$, $F_{KL}^2 > 0$ and that the equilibrium of the economy exhibits Hicksian stability. Assume further that*

- *the elasticity of labor supply does not exceed $(1-t)/t$, or*
- *the tax rate t is small.*

Then labor input in sector 1 is higher and capital input is lower if the sector is government-run rather than if it is outsourced. The effects on the equilibrium gross wage and the tax rate are generally ambiguous.

Proof: Differentiating (13) to (16) with respect to α yields the following system of

[7] One could, of course, also nationalize sector 2 to obtain production efficiency in our simplified model. However, this would define away the problem we are interested in.

equations:

$$\begin{pmatrix} a_1 & a_2 & a_3 & a_4 \\ b_1 & b_2 & 0 & 0 \\ c_1 & c_2 & c_3 & c_4 \\ d_1 & d_2 & d_3 & d_4 \end{pmatrix} \cdot \begin{pmatrix} \mathrm{d}L_1 \\ \mathrm{d}K_1 \\ \mathrm{d}w \\ \mathrm{d}t \end{pmatrix} = \begin{pmatrix} -wtF^1_K \\ 0 \\ 0 \\ 0 \end{pmatrix} \cdot \mathrm{d}\alpha \tag{18}$$

with

$$\begin{aligned}
a_1 &= F^1_{LL}F^2_K - F^1_L F^2_{KL} - F^1_{KL} w(1-\alpha t) < 0 \\
a_2 &= F^1_{KL}F^2_K - F^1_L F^2_{KK} - F^1_{KK} w(1-\alpha t) \\
a_3 &= (1-t)F^1_L F^2_{KL} L'_S - F^1_K(1-\alpha t) \\
a_4 &= -wF^1_L F^2_{KL} L'_S + F^1_K w\alpha \\
b_1 &= -F^1_L \\
b_2 &= -F^1_K < 0 \\
c_1 &= -F^2_{LL} \\
c_2 &= -F^2_{LK} \\
c_3 &= F^2_{LL} L'_S(1-t) - 1 < 0 \\
c_4 &= -F^2_{LL} L'_S w \\
d_1 &= w - K_1 F^2_{KL} \\
d_2 &= F^2_K - K_1 F^2_{KK} \\
d_3 &= -tL_S + L_1 - wtL'_S(1-t) + K_1 F^2_{KL} L'_S(1-t) \\
d_4 &= -wL_S + w^2 tL'_S - K_1 F^2_{KL} L'_S w.
\end{aligned}$$

Denote the matrix on the LHS of (18) by A. Observe that we arranged the matrix such that the diagonal elements a_1, b_2, and c_3 are negative. Also d_4 will be negative for small values of t or, as long as $t \leq 0.5$ if the elasticity of labor supply is below unity. In order for the system to be perfectly stable (i.e., stable in the Hicksian sense), we must then have that A is negative semi-definite. In particular, $\det A > 0$ — which we will henceforth assume. For sake of abbreviation define:

$$\beta := \frac{wtF^1_K}{\det A} > 0,$$

where the positive sign prevails when A is stable. Now apply Cramer's Rule to (18):

$$\begin{aligned}
\frac{\mathrm{d}L_1}{\mathrm{d}\alpha} &= \beta \cdot (c_3 d_4 - c_4 d_3) \cdot F_K^1 \\
&= \beta \cdot w \cdot \left(L_S - L_S' wt + L_S' \cdot \left[-F_{LL}^2 (L_S - L_1) + K_1 F_{KL}^2\right]\right) \cdot F_K^1 \qquad (19) \\
&= \beta \cdot w \cdot \left(L_S \cdot \left[1 - \eta^S \cdot \frac{t}{1-t}\right] + L_S' \cdot \left[-F_{LL}^2 (L_S - L_1) + K_1 F_{KL}^2\right]\right) \cdot F_K^1 \\
\frac{\mathrm{d}K_1}{\mathrm{d}\alpha} &= -\beta \cdot (c_3 d_4 - c_4 d_3) \cdot F_L^1 = -\frac{F_L^1}{F_K^1} \cdot \frac{\mathrm{d}L_1}{\mathrm{d}\alpha} \qquad (20) \\
\frac{\mathrm{d}w}{\mathrm{d}\alpha} &= -\beta \cdot (b_2(c_4 d_1 - c_1 d_4) + b_1(c_2 d_4 - c_4 d_2)) \\
&= -\beta \cdot w \cdot \left(L_S' \cdot \left[\Gamma - F_L^1 F_K^2 F_{LL}^2\right] + L_S \cdot \left[F_K^1 F_{LL}^2 - F_L^1 F_{KL}^2\right]\right) \qquad (21) \\
\frac{\mathrm{d}t}{\mathrm{d}\alpha} &= -\beta \cdot (b_2(c_1 d_3 - c_3 d_1) + b_1(c_3 d_2 - c_2 d_3)) \\
&= -\beta \cdot \Big((1-t) L_S' \cdot \left[\Gamma + F_L^1 F_K^2 F_{LL}^2\right] + (L_1 - t L_S) \cdot \left[F_K^1 F_{LL}^2 - F_L^1 F_{KL}^2\right] \\
&\qquad -F_K^1 \cdot \left(w - K_1 F_{KL}^2\right) + F_L^1 \cdot \left(F_K^2 - K_1 F_{KK}^2\right)\Big). \qquad (22)
\end{aligned}$$

where we defined:

$$\Gamma := w(1-t) F_K^1 F_{LL}^2 + F_L^1 \cdot \left(K_1 \cdot \left[F_{KK}^2 F_{LL}^2 - (F_{KL}^2)^2\right] + wt F_{KL}^2\right),$$

which is of ambiguous sign. Given the assumptions mentioned in the proposition, the signs of (19) and (20) turn out as asserted, while the signs of (21) and (22) remain unclear in general. ■

Observe that the condition $\eta^S \leq (1-t)/t$ in Proposition 1 is equivalent to the requirement that the tax elasticity of labor supply is, in absolute terms, less than unity:

$$\eta_t^S := \frac{\partial L_S[w(1-t)]}{\partial t} \cdot \frac{t}{L_S} = -\frac{t}{1-t} \cdot \eta^S \geq -1$$

This is in harmony with stylized facts on labor supply elasticities. Moreover, if this condition were not satisfied, then an increase in t would *ceteris paribus* reduce (statutory) wage tax revenue $twL_S[w(1-t)]$. Next consider the case of a fixed labor supply ($L_S' = 0$):

Proposition 2 *Suppose that $L' = 0$ and that the equilibrium exhibits Hicksian stability. Then labor input in sector 1 is higher and capital input is lower if the sector is government-run rather than if it is outsourced. If production of good 1 is outsourced, the equilibrium gross wage will decrease while the effect on the tax rate is unclear.*

5 Welfare analysis

Should sector 1 be outsourced or government-run? There is a potential trade-off: Only if the sector is privatized ($\alpha = 0$), production efficiency in the sense of (17) would be achieved, meaning that the inputs available are used such as to maximize the output of good 2 (recall that the output of good 1 is exogenously fixed). On the other hand, if nationalizing production in sector 1 ($\alpha = 1$) leads to a higher net wage $w(1-t)$ and, thus, to larger labor supply, the total amount of available productive resources in the economy increases and output in sector 2 can be augmented.

An instructive way to view this trade-off is in terms of an Edgeworth box for the production possibilities of the economy:

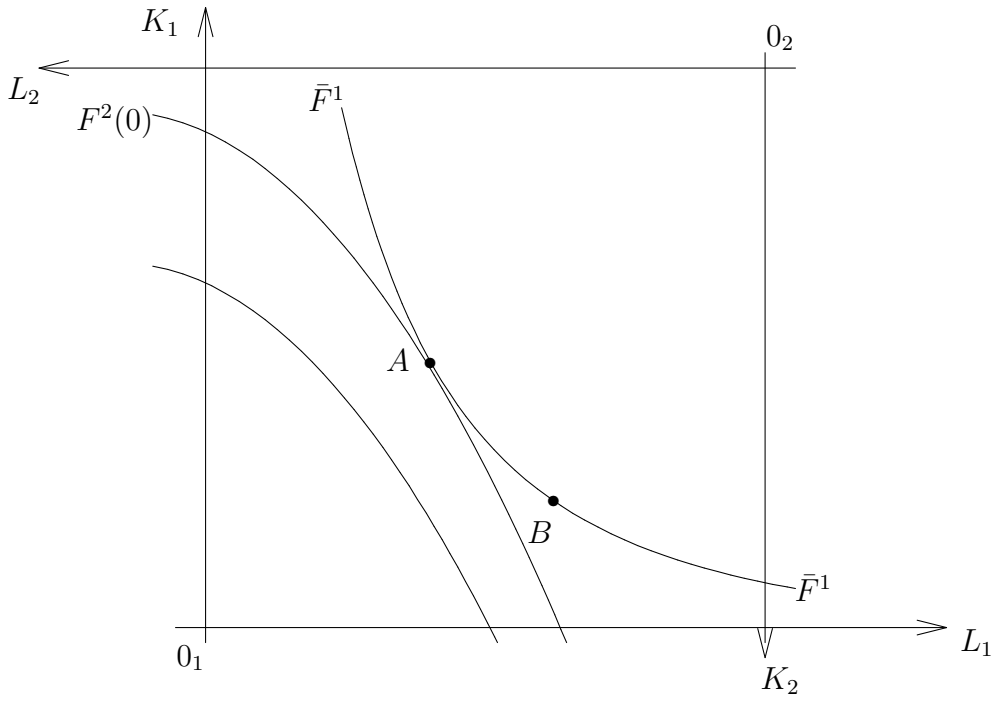

Figure 1

Figure 1 depicts production possibilities for $\alpha = 0$ (fully privatized economy). The economy will be in a point like A: Production is efficiently organized — the isoquants of the production functions in sectors 1 and 2 are tangent. The output level in sector 2 is $F^2(0)$. The second isoquant for good 2 in Figure 1 represents a higher but unattainable output level.

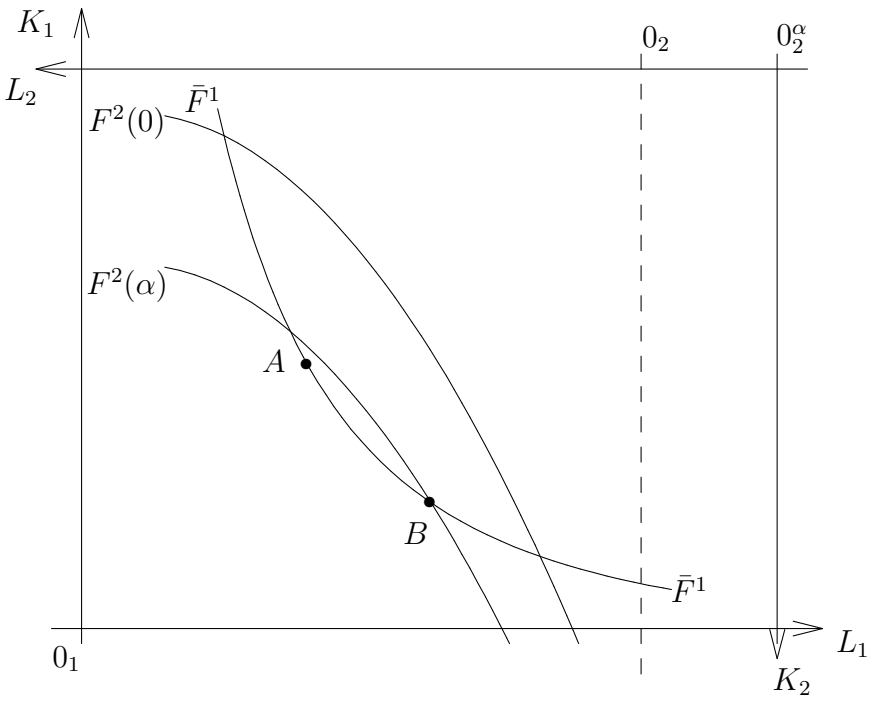

Figure 2

Figure 2 depicts production possibilities in the case of $\alpha > 0$ (mixed economy), provided that this leads to an increase in the net wage. As a consequence, the width of this Edgeworth box is larger than in Figure 1, reflecting the increase in labor supply. Compared to the box in Figure 1, the origin of sector 2 moves outwards and the previously unattainable output level $F^2(\alpha)$ becomes feasible now. However, the economy ends up in a point like B: Sectors 1 and 2 face different factor-price ratios, and consequently isoquants at the equilibrium output levels will intersect rather than being tangent to each other. In a nutshell, the potential difference between a fully private economy (Figure 1) and a mixed economy (Figure 2) boils down to operating efficiently in a "small" Edgeworth box and operating inefficiently in a larger one.

From Propositions 1 and equation (28), it is unclear whether the case depicted in Figure 2 can at all prevail; it requires an increase in labor supply. Moreover, our set-up and results so far do not allow for any welfare comparisons between the two cases. We therefore have to be more explicit on the underlying structure of our model.

Let us first, however, state quite an obvious result:

Proposition 3 *If labor supply is fixed ($L'_S \equiv 0$), then fully outsourcing sector 1 (i.e., $\alpha = 0$) is welfare-optimal.*

Proof: Both capital and labor are in fixed supply. Efficiency requires (17) to hold, which will only happen if $\alpha = 0$. ■

In the case of a variable labor supply, things get trickier. Implicitly underlying our model is a representative household with preferences over the consumed amounts of goods 1 and 2 and leisure. Let us represent these preferences by a standard utility function:

$$U = U(c_1, c_2, -L_S)$$

where all partial derivatives are positive. Consumption of good 1 equals the exogenous output in sector 1. The household maximizes utility subject to a budget constraint

$$c_2 \leq y + w(1-t)L_S$$

where y denotes income from sources other than labor supply (i.e., capital income and profits, if any, from sector 2 and capital income from sector 1). Optimal labor supply satisfies the FOC:

$$w(1-t)U_2 - U_3 = 0. \tag{23}$$

Again taking into account that output of good 1 is exogenously fixed, a change in α would then lead to an increase in utility if and only if

$$\frac{\mathrm{d}U}{\mathrm{d}\alpha} = U_2 \cdot \frac{\mathrm{d}c_2}{\mathrm{d}\alpha} - U_3 \cdot \frac{\mathrm{d}L_S}{\mathrm{d}\alpha} = U_2 \cdot \left(\frac{\mathrm{d}c_2}{\mathrm{d}\alpha} - w(1-t) \cdot \frac{\mathrm{d}L_S}{\mathrm{d}\alpha} \right) > 0$$

where we made use of (23). Hence, we have to check for conditions such that

$$\frac{\mathrm{d}c_2}{\mathrm{d}\alpha} > w(1-t) \cdot \frac{\mathrm{d}L_S}{\mathrm{d}\alpha}. \tag{24}$$

Obeying that $c_2 = F^2(K_2, L_2)$, we next investigate what happens to the output in the private sector 2 when α is varied. Differentiation of the production function yields:

$$\begin{aligned} \frac{\mathrm{d}F^2}{\mathrm{d}\alpha} &= F_L^2 \cdot \frac{\mathrm{d}L_2}{\mathrm{d}\alpha} - F_K^2 \frac{\mathrm{d}K_1}{\mathrm{d}\alpha} \\ &= \left(\frac{F_K^2 F_L^1}{F_K^1} - F_L^2 \right) \frac{\mathrm{d}L_1}{\mathrm{d}\alpha} + F_L^2 \frac{\mathrm{d}L_S}{\mathrm{d}\alpha} = w \left(\frac{\mathrm{d}L_S}{\mathrm{d}\alpha} - \alpha t \cdot \frac{\mathrm{d}L_1}{\mathrm{d}\alpha} \right) \\ &= w \left(\frac{\mathrm{d}L_S}{\mathrm{d}\alpha} - \alpha t \cdot \frac{\mathrm{d}L_1}{\mathrm{d}\alpha} \right). \end{aligned} \tag{25}$$

Here we invoked $\mathrm{d}K_1/\mathrm{d}\alpha = -(1-\alpha t)(F_L^2/F_K^2)(\mathrm{d}L_1/\mathrm{d}\alpha)$. If labor supply is fixed ($\mathrm{d}L_S = 0$), then output in sector 2 decreases whenever production of good 1 is nationalized. This

is intuitive: For $\alpha \neq 0$, the factor allocation will be inefficient. With a fixed output $\bar{F}^1$ and fixed total supplies of both factors, output in sector 2 cannot but decline (as shown in Proposition 3). A negative impact of α on labor supply would acerbate this effect; only with a positive impact on labor supply can the effect be turned.

Plugging (25) into (24) we get that welfare improves with an increase in α if and only if:

$$\begin{aligned} w\left(\frac{\mathrm{d}L_S}{\mathrm{d}\alpha} - \alpha t \frac{\mathrm{d}L_1}{\mathrm{d}\alpha}\right) &> w(1-t)\cdot\frac{\mathrm{d}L_S}{\mathrm{d}\alpha} \\ \frac{\mathrm{d}L_S}{\mathrm{d}\alpha} &> \alpha\cdot\frac{\mathrm{d}L_1}{\mathrm{d}\alpha} \qquad (26) \\ \frac{\mathrm{d}[w(1-t)]}{\mathrm{d}\alpha} &> \frac{\alpha}{L'_S}\cdot\frac{\mathrm{d}L_1}{\mathrm{d}\alpha}. \qquad (27) \end{aligned}$$

Condition (26) states a very simple requirement for an increase in α to be welfare-improving: The effect of such a change on labor supply (i.e., on total labor in the economy) must exceed α times the effect on labor intake in sector 1. An immediate consequence of this is that starting from a fully privatized economy ($\alpha = 0$), an increase in α will be welfare-improving if and only if it leads to an increase in labor supply or, which is the same, to an increase in the net wage.

Given that $dL_1/d\alpha > 0$ is very likely from Proposition 1, the equivalent condition (27) conveys that a welfare improvement is possible only if the net wage increases — and increases sufficiently sharply – upon an increase in α (or, conversely, if outsourcing leads to a sufficiently large drop in after-tax wages).

It is interesting to observe that whenever outsourcing would decrease the wage rate it can never be optimal to fully outsource sector 1: The LHS in (27) is always larger than zero. We sum this up in

Proposition 4 *Full outsourcing can never be optimal if it would lead to a decrease in net wages.*

Increasing α is welfare-improving if it would lead to a sufficiently large increase in the after-tax wage.

Proposition 4 is a typical second best result: With variable labor supply, wage taxation is distortionary in the sense that the marginal rate of substitution between leisure and the consumption of good 2, $U_3/U_2 = w(1-t)$, does not equal the marginal productivity of labor in the production of good 2, $F^2_L = w$. In such a scenario, it may then not be optimal

to achieve production efficiency in the sense of condition (17). Violations of condition (17) can be "fabricated" by giving sector 1 a tax advantage over sector 2, which in our framework means to (partly) have this sector government-operated. One visible impact of such a policy is then a higher labor intensity of the public sector, relative to what a private enterprise would choose to have. This is in line with empirical observations (cf., e.g., Megginson and Netter, 2001).

Proposition 4 states conditions such that full privatization ($\alpha = 0$) is not optimal. This need, however, not imply that welfare when the government fully takes over sector 1 ($\alpha = 1$) is higher. Rather, intermediate values of α might dominate the polar cases. As outlined above, one way to think of such intermediate values is in terms of a mixed personnel structure (both civil servants and normal employees) or of partial privatization. Then Proposition 4 conveys that entirely staffing sector 1 with normal employees (represented by $\alpha = 0$) is not optimal, but that to have some tax-favored civil servants ($\alpha > 0$) might actually be preferable. An alternative interpretation is that the mechanism that we identify provides an efficiency-justification for a federal structure in which lower-level governments have a tax-advantage in their production as they receive a certain fraction of wage tax revenues. As giving lower-level governments a full tax advantage ($\alpha = 1$) need not be optimal, our results also suggest an efficiency-explanation for a certain degree of fiscal churning in which the federal government would collect a share $(1 - \alpha)$ of the tax revenue and return it to lower-level governments as lump-sum transfers.

The crucial question arising from Proposition 4 is, of course, whether the net wage does at all (and then sufficiently steeply) increase in α. From Proposition 1 this is not clear. Combine (21) and (22) to calculate:

$$\begin{aligned}
\frac{\mathrm{d}[w(1-t)]}{\mathrm{d}\alpha} &= (1-t)\cdot\frac{\mathrm{d}w}{\mathrm{d}\alpha} - w\cdot\frac{\mathrm{d}t}{\mathrm{d}\alpha} \\
&= -\beta\cdot w\cdot\Big(-2(1-t)L_S'F_L^1F_K^2F_{LL}^2 + (L_S-L_1)\cdot\big[F_K^1F_{LL}^2 - F_L^1F_{KL}^2\big] \\
&\qquad +F_K^1\cdot\big[w - F_{KL}^2K_1\big] - F_L^1\cdot\big[F_K^2 - K_1F_{KK}^2\big]\Big) \\
&= -\beta\cdot w\cdot\Big(\underbrace{-2(1-\alpha t)\cdot\eta^S\cdot L_SF_{LL}^2F_K^1}_{\geq 0} + \underbrace{(L_S-L_1)\cdot\big[F_K^1F_{LL}^2 - F_L^1F_{KL}^2\big]}_{<0} \\
&\qquad +w\cdot\Big(\underbrace{\alpha tF_K^1}_{>0,\,small} + K_1\cdot\underbrace{\big[F_L^1F_{KK}^2 - F_K^1F_{KL}^2\big]}_{<0}\Big)\Big). \qquad (28)
\end{aligned}$$

To arrive at the final line of (28), we made use of $F_K^1w - F_L^1F_K^2 = F_K^1\cdot[w - rF_L^1/F_K^1] =$

$F_K^1 w\alpha t$ which stems from (3), (4), and (10). From this, we get that

- for the case of fixed labor supply, the net wage will increase in α, provided that αt is small;
- for the case of variable labor supply, the effect of α on the net wage is generally unclear: It is more likely to be positive [negative] if the labor supply elasticity is small [large].

Combining (27) and (28), one sees that there are opposing forces at work: If the supply elasticity of labor is too small, then the RHS of (27) tends to be large (making the whole condition less likely to be satisfied) while for a high supply elasticity the LHS gets small (again making the whole condition less probable to hold).
While this observation renders general results unobtainable, we can at least state that for low but positive labor supply elasticities a zero value for α cannot be optimal. To see this, recall from (27) that an increase in the net wage suffices to make deviations from $\alpha = 0$ worthwhile. From (28) we learn that this will happen in the case of positive, but small labor-supply elasticities. We summarize:

Proposition 5 *Full privatization ($\alpha = 0$) can never be optimal if the labor supply elasticity is positive, but small.*

6 Conclusion

In this paper, we analyze the relationship between privatization and taxation from a general-equilibrium perspective. We take as our starting point that several services, like hospitals, schools, and public transportation, can be produced privately, even if they would be ultimately financed by the government. Empirical evidence suggests that outsourcing or privatizing such activities tends to result in a leaner workforce and increasing capital intensity in their production. This is often viewed as an evidence of slack in public production, but we show that this need not be the case. Governmental entities often operate under a different tax regime with respect to factor inputs: In a consolidated government budget, tax payments by government entities cancel out; the government "pays taxes to itself". As a consequence, when the government purchases factor inputs,

its true factor costs are the net factor returns (as they are earned by the suppliers of these factors) rather than the tax-inclusive factor prices which underlie the cost calculations in private firms. This implies that the government sector has a cost advantage over the private sector for that factor that is taxed relatively more heavily. As labor is taxed more heavily than capital, the government would then *optimally* organize production in a more labor-intensive way than a private firm. Put differently: Observing a different factor mix in private and public production need not be indicative of wasteful slack in the government sector but may well be the entirely optimal response to tax-induced differences in factor price ratios.

Moreover, it is not at all evident that different factor price ratios and, therefore, different marginal rates of technical substitution in public and private production are an evil. We identify a key tradeoff in deciding whether to fully privatize or outsource government activities or not. On the one hand, different factor prices faced by public and private entities distort allocative efficiency. In a mainly market-based economy, this would call for fully outsourcing production from the tax-sheltered realm of government. On the other hand, a higher labor-intensity of government-run activities may serve as a countervailing distortion in the presence of distorting wage taxation. Outsourcing government production and then letting the government re-purchase the output may, under plausible circumstances, result in a larger overall tax bill. Privatization then would expose the economy to a higher degree of distortionary taxation than "nationalized" production. If the distortionary effects of taxation are sufficiently severe it may well prove beneficial to incur the production inefficiencies in a mixed economy with a private and a tax-favored public sector, compared to a production-efficient economy suffering from larger tax distortions. In our setting, tax distortions result from a reduction in labor supply, implying that the total amount of productive resources in a fully privatized economy falls short of that in a mixed economy. Consequently, we argue that full privatization is never optimal with positive but low labor supply elasticities, as in Europe. On the other hand, if labor supply is fixed, then full privatization will be efficient.

Huizinga and Nielsen (2001) conclude their analysis of privatization and capital income taxation by stating that the "need to impose distortionary taxes ... shifts the demarcation line between the two [i.e., private and public] sectors towards a larger public production sector" (p. 412) — where the size of the public sector refers to the range of different

outputs that is produced in government-owned firms. Defining the size of the public sector by its labor intake rather than by its range of outputs, our paper confirms this insight. However, unlike Huizinga and Nielsen (2001) and the rest of the literature, our analysis does not presuppose that the public sector *per se* is less efficient than private enterprises.

Our findings provide an efficiency-argument in favor of otherwise-puzzling tax advantage given to public employees in some countries, like Germany, Italy and Austria. There, civil servants are subject to social security taxation only to a lesser extent than normal employees, rendering them cheaper to hire for the government than standard employees. We find that such an arrangement is efficient at least to some degree, as long as labor supply is not completely inelastic.

For public production that takes place at lower-level jurisdictions, like municipalities, our analysis also suggests an efficiency argument for the otherwise puzzling phenomenon of fiscal churning in which the federal government would collect a share of tax revenues and return it as lump-sum transfers to all lower-level jurisdictions, and not just to poorer ones. We identified that even though full outsourcing would not be generally efficient, also giving the public sector a full tax advantage could be inefficient. Fiscal churning can then be used to adjust the price that lower-level jurisdisctions effectively face when financing their production of public goods.

Our findings also suggest an empirically testable prediction. Countries in which lower-level governments are able to keep a larger share of wage tax revenues should have more labor-intensive public sector at that level. Conversely, changes in revenue-sharing between central-level and lower level governments should have implications for labor-intensity of the public sector at the lower level governments.

There are several ways in which our analysis could be extended. E.g., one might consider a small open economy where the rental rate of capital is exogenously given. Moreover, one could dispense with the assumption that governments are price takers on the factor markets. While this is an appropriate assumption in the case of local municipalities and individual government agencies, it is implausible for the central level of government as a whole. These extensions, as well as empirical testing of the predictions and evaluation of quantitative importance of our findings, are left for further research.

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