Why is the Public Sector More Labor-Intensive?  
A Distortionary Tax Argument

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Abstract

Government-run entities are often more labor-intensive than private companies, even with identical production technologies. This need not imply slack in the public sector, but may be a rational response to its wage tax advantage over private firms. A tax-induced cost advantage of public production precludes production efficiency and reduces welfare when labor supply is constant. With an elastic labor supply, a wage tax advantage of the public sector may improve welfare if it allows for a higher net wage. This would counteract the distortion of labor supply arising from wage taxation.

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1 Introduction

Around the world, the large-scale privatization and outsourcing programs of governments over the past 20 years typically went along with substantial reductions of labor input in the newly privatized firms or sectors (for a survey see Megginson and Netter 2001). This stylized fact documents that production in the public sector is often more labor-intensive than production in the private sector. Quite typically, this observation is interpreted as evidence that, under government-ownership, overmanning and slack working practices prevail, inefficiencies that private firms could not afford under the pressure of the marketplace. Government-run enterprises or services often are thought to absorb substantial portions of the state budget without generating commensurate contributions to social welfare. Lack of competition and incentives, X-inefficiency, a soft budget constraint, and the failure to properly price inputs and outputs result in significant misallocations of resources. Moreover, political influence, infiltration by unions, or the deliberate use of employment in the public sector as a redistributive device augment the tendency towards hiring too many staff to government entities. While from everyday experience we would not dismiss the inefficiency hypothesis for the public sector entirely, we propose in this paper a different explanation why private firms have leaner workforces than state-run firms: They operate under a different tax structure with respect to factor inputs.

Consider an economy where all government expenses are financed out of a wage tax. If workers hired by a private firm in this economy should earn a certain net wage, the employing firm faces a higher labor cost (namely, the gross wage) out of which the tax goes to the government. If the employing unit is state-owned and its recruiting staff fully sees through the government’s budgeting, 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

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1 For a survey on state-ownership and privatization in the Western world, see the edited volume by Toninelli (2000). In a study on 63 privatizations, Dewenter and Malatesta (2001) report a significant decline in labor intensity after privatization. In a study on 218 privatizations in Mexico, La Porta and López-de-Silanes (1999) found that output on average increased by 54.3% while employment declined by almost half, which indicates a substantial increase in labor productivity. An opposite effect seems to be indicated by Megginson et al. (1994): for their sample of 18 countries they find that privatization on average was followed by a rise in employment. However, this effect is largely driven by changes in output or production programs after privatization and only sets in in the medium term.
firm and will, *ceteris paribus* and optimally, hire a larger workforce than a private firm that produces the same level of output with identical technology. Put differently, if the production of a good or service that has so far been operated by the government is outsourced to the private sector, then it will become less labor-intensive even if and though the public sector organized it efficiently (i.e., in a cost-minimizing way).

This argument remains valid in the presence of other factor taxes as long as labor is the relatively most highly taxed factor as is generally the case in Europe. Also observe that the argument does not presuppose — but does not exclude either — that public firms and government entities actually possess a tax advantage over private firms via special tax regulations; differences in labor intensities of private and public firms are fully driven by the fact that, upon consolidation of all budgets, the government *de facto* does never pay any taxes at all.

This simple tax-argument may be questioned for several reasons. First, as it stands we adopted a strict *ceteris-paribus* clause of constant factor prices and tax rates — which might, however, be inappropriate: an economy where one sector is government-operated differs from an otherwise identical economy where this sector is run privately with respect to factor allocations, factor prices, output in other sectors, factor supplies, budgetary needs, and tax rates.

Second, the public sector is nowhere a monolithic actor that perfectly sees through its consolidated budget. Rather, public production is typically spread over different ministries, agencies or departments, each of them being small relative to the whole government. The same applies for federal economies when public production takes place on a lower level. Only that fraction of the total tax burden on labor is irrelevant as labor cost that accrues (or is perceived to accrue) to the employing jurisdiction itself.²

We capture these aspects by analyzing a two-sector economy in a general-equilibrium setting. One of the sectors is always privately organized (such that its labor costs correspond to gross wages) while the other sector can be either privately-run or government-controlled. The output of this sector is provided to citizens free of charge by the government, and it is financed by a wage tax that distorts labor supply. We call the economy

²There is indeed 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.
a private economy if the sector that produces the government-provided good is privately run, and a mixed economy otherwise. In a mixed economy, the government recognizes that a fraction of the wage taxes which it pays for its employees will return to its own budget and, thus, does not constitute a genuine factor cost. For a monolithic government with a fully consolidated budget that recycling fraction would be one while with more fragmented governments, recruitment decisions will be based on fractions that typically lie well below one. As a first main result we show that in the general equilibrium of a mixed economy the labor intensity in the government sector is higher the larger the fraction of tax revenues that returns (or is perceived to return) to the employing government units. Consequently, the labor intensity in the production of government-provided goods is higher in a mixed than in a private economy.

These results do not require that tax or social security laws actually stipulate a factual tax advantage of government employers over private employers. However, the existence of such preferential tax treatment of hiring by the state would augment the effect we are depicting. In many countries and instances, special tax rules apply to government-run entities (often to the dismay of private competitors). In some cases (e.g., corporate income taxes, property taxes) these rules favor factors other than labor, in other cases (e.g., VAT) the effect on relative factor prices is unclear. However, in some countries (e.g., in Germany, Italy, and Austria), civil servants are fully or partly exempt from social security taxes (old-age income, unemployment, or health insurance; see, e.g., Cardona, 2002). To the extent to which it relies on civil servants as its personnel, the government enjoys a labor cost advantage over the private sector which might translate into a higher labor intensity.

Provided that due to taxation the public and the private sector face different relative labor costs, a mixed economy with a public and a private sector at first sight looks like a non-optimal arrangement relative to a fully privatized economy. After all, different factor price ratios and, hence, different marginal rates of factor substitution in the private and the public sector distort the mixed economy away from production efficiency. However, under certain circumstances it may be worthwhile to encounter this inefficiency. A comparison between a mixed and a private economy reveals that the equilibrium net wage may (but

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3 If the fraction of wage taxes that is recycled to the own budget approaches zero, the government agency is in fact in the same position as a private firm.

---
need not) be higher in the former than in the latter. If labor supply is increasing in the net wage, a mixed economy will then operate with a larger labor supply than the private economy. This may enable it to produce a higher level of output than the private economy, despite the deadweight loss caused by an inefficient intersectoral allocation of resources.

Hence, society may face a trade-off between production efficiency (realized in the private economy) and smaller tax distortions (best realized in the mixed economy). We identify conditions (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 a private economy and, thereby, to entertain one sector in the economy with a labor intensity that would appear inefficiently high under market conditions.

At this point, we would like to emphasize one distinctive feature of our model: production will always be organized efficiently (i.e., in a cost-minimizing way), regardless of whether a sector is outsourced or government operated. Thus, the increase in labor intensity that a sector encounters when moving from private hands to the government is not due to governmental waste or slack but merely a consequence of the government’s tax advantage. Consequently, the (potential) inefficiency in a mixed economy does not stem from a poor factor allocation within the sector under government ownership but is rather induced by tax wedges between public and private sectors.

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

An extensive literature discusses why private firms are more productive than public enterprises (see Shleifer, 1998, for a survey). However, as observed in Mintz et al. (2000), taxation is a largely overlooked issue in this debate. If taxation plays a role, then the focus is mainly on differential tax treatment of the public and the private sector and the differences in factor costs and price ratios that it implies.
Our focus is not so much on differential tax rules for public and private production but more on the organization of public production by a government which partly, if not fully, sees through its budgetary branches. This relates our paper to an earlier literature on public production and optimal taxation (see, e.g., Stiglitz and Dasgupta, 1971; Dasgupta and Stiglitz, 1972; Diamond and Mirrlees, 1971, 1976; Naito, 1999) which routinely assumes a monolithic government with a complete understanding of the economy. This literature established that, while in a mixed economy where the government has access to an unlimited set of tax instruments production efficiency is desirable,\(^4\) some deviation from an intersectorially efficient factor allocation is typically optimal if the range of tax instruments is limited. While we make a similar observation, our approach differs. Rather than presupposing a grand social planner, we ask how governmental units, be they municipalities, ministries or other agencies, behave in the labor market when they are price-takers. Moreover, instead of aiming at a second- or third-best tax structure, we take an empirically plausible, but generally non-optimal tax structure (that entails a relatively high and distortionary tax on labor) as given and analyze the best arrangement of production under this regime.

In this respect, our paper relates to a recent strand of the literature that investigates the optimal role and size of the public sector in general equilibrium models with (non-optimal) distortionary taxes. E.g., Huizinga and Nielsen (2001) investigate the optimal boundary between public and private production 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.\(^5\) 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, outsourcing from the government sector generally goes along with

\(^4\)More precisely, if the government can set a profit tax of 100 per cent and choose all commodity taxes optimally, then public production should be organized in a way such that shadow price ratios for factors equal the marginal rates of substitution for production and consumption in the private sector of the economy.

\(^5\)Huizinga and Nielsen (2001) focus on capital income taxation (which distorts private investment decisions) and predict over-capitalization of the public sector. This is at odds with reality (see also Gordon, 2003) but replacing capital by labor taxation would render the model’s forecasts compatible with reality.
a decrease in the use of the taxed factor. For a simpler economy, our paper comes to quite similar conclusions — but 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 employ the same production technologies.

Pirttilä and Tuomala (2005) present a model where the government aims to transfer resources from high- to low-skilled workers. To reduce the need to use distortionary income taxation for redistributive purposes, it may be welfare-enhancing for the government to employ more low-skilled workers and fewer high-skilled workers than cost minimization would actually require. The resulting beneficial inefficiency of production arises from the redistributive motive of the government; such a motivation is absent from our analysis where the government’s only purpose is to provide society with a certain amount of a consumption good.

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. If 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, nationalization of industries at some point gets cheaper than financing government purchases through distortionary taxation. This result rests on an in-built inefficiency in the government sector. By contrast, the inefficiency in our model is an intersectoral one: For efficiency, sectors should not face different factor price ratios – but in a mixed economy with one sector being private and the other public they do in the presence of non-uniform factor taxation.

Gordon (2003) suggests that public firms may be more labor-intensive than private ones when the government hires workers that would otherwise be unemployed, or hires unskilled workers to drive up their equilibrium wage. We assume that factor markets are competitive, a condition under which the model developed by Gordon (2003) would not generate any positive role for public ownership. Our model allows such a role since we endogenize labor supply which may then be distorted by taxation; with exogenous labor supply, a private economy is optimal also in our model.
3 The Model

3.1 Production

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. 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 $F^i_{LL}F^i_{KK} - (F^i_{KL})^2 \geq 0$ for all $(L_i, K_i) \in \mathbb{R}_{++}^2$.

The supply of capital is fixed at some level $\bar{K}$. Full employment of capital therefore requires that

$$K_1 + K_2 = \bar{K} \quad (1)$$

always holds. We denote the rental price of capital by $r$ and the gross wage by $w$. Private employers pay a fraction $t$ of wages to the government as a wage tax. Workers, thus, earn a net wage of $w(1 - t)$ per unit of labor supply.

Sector 2 is always privately run and operates in a profit-maximizing way. 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):

$$F^2_L(L_2, K_2) = w \quad (2)$$

$$F^2_K(L_2, K_2) = r \quad (3)$$

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 exogenously given level $\bar{F}_1$ of output:

$$F^1(L_1, K_1) \geq \bar{F}_1. \quad (4)$$

We assume that production in sector 1 is organized in a cost-minimizing manner. This is a prerequisite for profit maximization and therefore appears to be an appropriate

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6We perceive of $F^1$ as being politically determined; we do not attempt to derive an optimal output level of sector 1.
hypothesis if the sector is in private hands. Assuming cost efficiency in the public sector might be more controversial, given ample evidence for governmental slack. By requiring cost efficiency we deliberately rule out all reasons for outsourcing that might arise from an inefficient organization of the public sector.

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

\[
\min_{L_1, K_1} \{ rK_1 + wL_1 | F^1(L_1, K_1) \geq \bar{F}^1 \}.
\]  \hfill (5)

To assess labor costs, the private firm uses the gross, tax-inclusive wage rate. The FOCs for cost efficiency are given by:

\[
\frac{F^1_L(L_1, K_1)}{F^1_K(L_1, K_1)} = \frac{w}{r}
\]

and the output requirement (4).

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

\[
\min_{L_1, K_1} \{ rK_1 + w(1 - t)L_1 | F^1(L_1, K_1) \geq \bar{F}^1 \}.
\]  \hfill (6)

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 the organizers of production 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:

\[
\frac{F^1_L(L_1, K_1)}{F^1_K(L_1, K_1)} = \frac{w(1 - t)}{r}
\]

and, again, the output requirement (4).

Generalizing (5) and (6), we introduce a parameter \(\alpha \in [0, 1]\) to measure the extent to which the government has, or its authorities that recruit staff into government services perceive the government to have, a tax-induced cost advantage over the private sector: \(\alpha = 1\) means that public sector recruiters fully see through the accounting mechanisms
of the consolidated government budget while $\alpha = 0$ means that wage taxes are fully part of labor costs to the hiring government agency; this would be equivalent to outsourcing the production of good 1 to the private sector. Variable $\alpha$ may also reflect the degree to which employees in government-run entities are exempt from taxes or contributions that are collected in the private sector.

With some leap of faith in the existence of aggregate production functions, one might also interpret $\alpha$ as the fraction of sector 1 that is government-operated. Such an interpretation might, e.g., be appropriate for the case of public transport when only parts of the network are operated through private companies. However, this interpretation requires that production in sector 1 can 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 $\alpha$ might also give rise to an interpretation in terms of a federalist structure. Suppose, e.g., that sector 1 is run by local municipalities. Then $(1 - \alpha)$ might be viewed 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 $\alpha$ 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 $\alpha$, the cost minimization procedure can be written as:

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

(7)

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

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

(8)

Denote the solutions to (7) by $K_1(\alpha)$ and $L_1(\alpha)$. Similarly, we might index all other variables by $\alpha$. From a mathematical perspective, the advantage from using continuous $\alpha$ rather than a dichotomous $\alpha \in \{0, 1\}$ lies in making the whole problem differentiable.

Equation (8) together with the output constraint immediately implies that labor input in sector 1 is higher and consequently capital input is lower the larger is $\alpha$, meaning that the labor intensity is ceteris paribus higher when sector 1 is government-owned rather than when it is outsourced. Below we will show that this pattern also emerges in a general equilibrium.
3.2 Households and Labor Market

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:

\[
L_1 + L_2 = L_S[w(1 - t)].
\]

3.3 Government

Our model is closed by the government budget constraint. Fiscal needs arise from the fact that good 1 is provided to the citizens free of (direct) charge:

- We assume that if sector 1 is privately-run, the government purchases 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 costs 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

\[
rK_1(0) + w(1 - t)L_1(0) = twL_2(0).
\]

- If production of good 1 takes place in the government sector with a full tax advantage, the costs of production amount to \( rK_1(1) + w(1 - t)L_1(1) \) from (6). Tax revenues
only come from labor employed in sector 2 (since workers in sector 1 are paid their 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 \( \alpha \), 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 \( r = F^2_K \) and \( L_2 = L_S - L_1 \),

\[ F^2_K \cdot K_1(\alpha) + w \cdot (L_1(\alpha) - tL_S) = 0. \] (9)

### 3.4 Reduced Form

Summarizing (1) to (4), and incorporating (8) and (9), the equilibrium of the economy can be characterized by the following system of equations:

\[
F^1_L(L_1, K_1) \cdot F^2_K \left( L_S[w(1 - t)] - L_1, \bar{K} - K_1 \right) - F^1_K(L_1, K_1) \cdot w \cdot (1 - \alpha t) = 0 \quad (10)
\]

\[ F^1(L_1, K_1) - \bar{F}^1 = 0 \quad (11) \]

\[
F^2_L \left( L_S[w(1 - t)] - L_1, \bar{K} - K_1 \right) - w = 0 \quad (12)
\]

\[
F^2_K \left( L_S[w(1 - t)] - L_1, \bar{K} - K_1 \right) \cdot K_1 + w \cdot (L_1 - tL_S[w(1 - t)]) = 0. \quad (13)
\]

Equation (10) is the cost-efficiency condition for the production of good 1, equation (11) is the minimal-output requirement for that good, equation (12) is the condition for profit-maximizing labor input in the production of good 2, and equation (13) is the government budget constraint. Equations (10) through (13) 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 \( \alpha \).
Observe that an efficient allocation of factors of production requires that the marginal rates of factor substitution are equalized across sectors:

\[
\frac{F_1^L}{F_1^K} = \frac{F_2^L}{F_2^K}. \tag{14}
\]

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

We will henceforth assume that labor and capital are gross complements in both sectors: \(F_{iLK}(L_i, K_i) \geq 0\) for \(i = 1, 2\). This assumption, which is in accordance with empirical evidence on labor demand at least for skilled labor (see Borjas, 2004, ch. 4), facilitates the technical analysis without being strictly necessary. We derive comparative statics of (10) to (13) with respect to the tax advantage \(\alpha\) of the government sector and first consider the case of a variable labor supply. In the Appendix, we prove

**Proposition 1** Suppose that labor supply is strictly increasing in the net wage, \(L'_S[w(1-t)] > 0\), 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 increases and capital input decreases upon an increase in \(\alpha\). The effects on the equilibrium gross wage and the tax rate are generally ambiguous.

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:

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

This is in harmony with stylized facts on labor supply elasticities. Moreover, if this condition were not satisfied, an increase in \(t\) would *ceteris paribus* reduce wage tax revenue \(twL_S[w(1-t)]\).

\(^7\)One could also nationalize sector 2 to obtain production efficiency. However, this would define away the problem we are interested in.
Next consider the case of a fixed labor supply. Setting $L'_S = 0$ in equations (24) to (27) in the proof of Proposition 1 immediately leads to

**Proposition 2** Suppose that labor supply is constant, $L'_S = 0$, and that the equilibrium exhibits Hicksian stability. Then labor input in sector 1 increases and capital input decreases upon an increase in $\alpha$. The higher $\alpha$, the higher the gross wage, while the effect of $\alpha$ on the equilibrium tax rate is generally unclear.

Propositions 1 and 2 imply that labor input in sector 1 is higher and capital input is lower if the sector is government-run rather than if it is privately-run. Hence, the partial effect that, if anything else is equal, tax-favored public production is more labor-intensive than production of the same output in the private sector, generalizes to a general-equilibrium comparison.

Propositions 1 and 2 furthermore imply that the effect of a change in $\alpha$ on the net wage $w(1-t)$ is generally unclear. This observation will play an important role in our discussion below.

## 5 Welfare Analysis

### 5.1 The Potential Trade-off

There is a potential trade-off when it comes to choose how production in sector 1 should be organized. Only if the sector is privately-run ($\alpha = 0$), production efficiency in the sense of (14) will be achieved, meaning that the available inputs 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 the net wage $w(1-t)$ and, thus, labor supply are higher when a government agency with some labor tax advantage ($\alpha > 0$) operates production in sector 1 it may be possible to augment output in sector 2 in spite of an intersectorially inefficient factor allocation.

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

Figure 1 goes here.
Figure 1 depicts production possibilities for $\alpha = 0$ (fully private 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 goes here.

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. 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.

### 5.2 Fixed Labor Supply

From Propositions 1 and 2 and equation (21), it is unclear whether a case as in Figure 2 can at all emerge. As it requires an increase in labor supply, we can definitely rule it out whenever labor supply is exogenous. Hence,

**Proposition 3** If labor supply is fixed ($L_S' \equiv 0$), then fully outsourcing the production of sector 1 (i.e., $\alpha = 0$) is optimal.

**Proof:** Both capital and labor are in fixed supply. Efficiency requires (14) to hold, which will only happen if $\alpha = 0$.

With a variable labor supply (and an increasing net wage), we need to weigh the two elements in the trade-off between intersectoral efficiency and a larger factor supply. Welfare analysis, thus, gets a bit more involved.
5.3 Variable Labor Supply

Underlying our model is a representative household with preferences over the consumption of goods 1 and 2 and leisure. Let us represent these preferences by a standard quasi-concave 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

\[ c_2 \leq y + w(1 - t)L_S \] (15)

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:

\[ w(1 - t)U_2 - U_3 = 0. \] (16)

Taking into account that output of good 1 is exogenously fixed, a change in \( \alpha \) will then lead to an increase in utility if and only if

\[ \frac{dU}{d\alpha} = U_2 \cdot \frac{dc_2}{d\alpha} - U_3 \cdot \frac{dL_S}{d\alpha} = U_2 \cdot \left( \frac{dc_2}{d\alpha} - w(1 - t) \cdot \frac{dL_S}{d\alpha} \right) > 0 \]

where we used (16). Hence, we have to check for conditions such that\(^8\)

\[ \frac{dc_2}{d\alpha} > w(1 - t) \cdot \frac{dL_S}{d\alpha} \] (17)

In an equilibrium, consumption of good 2 equals production of that good, i.e., \( c_2 = F^2(K_2, L_2) \). If we vary \( \alpha \), output in sector 2 is affected as follows:

\[ \frac{dF^2}{d\alpha} = F^2_L \cdot \frac{dL_2}{d\alpha} - F^2_K \cdot \frac{dK_1}{d\alpha} \]

\[ = \left( \frac{F^2_K F^1_L}{F^2_K} - F^2_L \right) \frac{dL_1}{d\alpha} + F^2_L \frac{dL_S}{d\alpha} = w \left( \frac{dL_S}{d\alpha} - \alpha t \cdot \frac{dL_1}{d\alpha} \right) \]

\[ = w \left( \frac{dL_S}{d\alpha} - \alpha t \cdot \frac{dL_1}{d\alpha} \right). \] (18)

\(^8\)Observe that this line of reasoning does neither involve nor require any analysis of how the separate components of the household’s income (wage and interest income and profits) are affected. Our arguments are purely based on a utility assessment of the changes in the consumption of good 2 and labor supply in the general equilibrium of the economy. Production feasibility, changes in the interest rate and capital income are, thus, always implicitly but properly accounted for.
Here we invoked \( \frac{dK_1}{d\alpha} = -(1-\alpha t)(F_2^2/F_2^2)(dL_1/d\alpha) \). If labor supply is fixed \( (dL_S = 0) \), then output in sector 2 decreases whenever the government runs production of good 1. This is intuitive: For \( \alpha \neq 0 \), the factor allocation will be inefficient. With a fixed output \( \bar{F}^{1} \) and fixed supplies of both factors, output in sector 2 cannot but decline (as shown in Proposition 3). A negative impact of \( \alpha \) on labor supply would acerbate this effect; only with a positive impact on labor supply can the effect be turned around.

Plugging (18) into (17), we find that welfare improves with an increase in \( \alpha \) if and only if:

\[
\frac{w \left( \frac{dL_S}{d\alpha} - \alpha \frac{dL_1}{d\alpha} \right)}{\frac{dL_1}{d\alpha}} > \frac{w(1-t)}{\frac{dL_S}{d\alpha}} \frac{dL_S}{d\alpha} > \alpha \frac{dL_1}{d\alpha}
\]

(19)

Condition (19) provides a simple requirement for an increase in \( \alpha \) to be welfare-improving: The effect of such a change on labor supply must exceed \( \alpha \) times the effect on labor intake in sector 1. This condition links the increase in the labor supply to the tax wedge and the distortion in the factor mix which arises from the tax advantage of the public sector. The left-hand side of (19) is the increase in the total labor supply as a result of the public sector tax advantage, corresponding to an increase in the size of the Edgeworth box. The right-hand side of (19) relates to the distortion inside the Edgeworth box. The distortion in the allocative efficiency caused by a change in the demand for labor in sector 1 is increasing in the tax advantage of the public sector, measured by \( \alpha \). Therefore, a higher tax wedge requires a proportionally larger increase in the aggregate labor supply in order to improve welfare.

An immediate consequence of this observation is that, starting from a fully private economy \( (\alpha = 0) \), an increase in \( \alpha \) 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.

Observe that (19) can equivalently be written as

\[
\frac{d[w(1-t)]}{d\alpha} > \frac{\alpha}{L'_S} \frac{dL_1}{d\alpha}
\]

(20)

Given that \( dL_1/d\alpha > 0 \) is plausible from Proposition 1, condition (20) conveys that a welfare improvement is possible only if the net wage increases – and increases sufficiently sharply – upon an increase in \( \alpha \) (or, conversely, if outsourcing production of good 1 from the government into the private sector 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 outsource production in sector 1: The LHS in (20) is always larger than zero. We sum this up in

**Proposition 4** Full outsourcing of the production in sector 1 can never be optimal if it leads to a decrease in net wages.

Increasing $\alpha$ is welfare-improving if it leads 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, $F_2L = w$. It may then not be optimal to achieve production efficiency. Violations of condition (14) can be induced by giving sector 1 a tax advantage over sector 2, which in our framework is tantamount 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.

Proposition 4 states conditions such that full outsourcing ($\alpha = 0$) is not optimal. This does, however, not imply that a monolithic social planner with $\alpha = 1$ should take over production of sector 1. Rather, intermediate values of $\alpha$ might dominate the polar cases. As outlined above, one way to think of such intermediate values is in terms of partial outsourcing or of a mixed personnel structure (both civil servants and normal employees). Under the latter interpretation, 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 argument in favor of a federal structure in which lower-level governments receive a certain fraction of (centrally administered) wage tax revenues. This gives them a potentially welfare-improving tax advantage over the private sector. As a 100%-tax advantage ($\alpha = 1$) will, in general, 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.
5.4 The Role of the Labor Supply Elasticity

The crucial question arising from Proposition 4 is, of course, whether the net wage does at all (and then sufficiently steeply) increase in response to increases in $\alpha$. From Proposition 1 this is not clear.

To gain further insights on this question, combine (26) and (27), where we use $\beta$ as defined in (23) in the Appendix:

\[
\frac{d[w(1-t)]}{d\alpha} = (1-t) \cdot \frac{dw}{d\alpha} - w \cdot \frac{dt}{d\alpha} = -\beta \cdot w \cdot \left(-2(1-t)L_S F^1_L F^2_K F^2_{LL} + (L_S - L_1) \cdot [F^1_K F^2_{LL} - F^1_L F^1_{K L}] \right.
\]

\[+ F^1_K \cdot [w - F^2_{KL} K_1] - F^1_L \cdot [F^2_K - K_1 F^2_{KK}]) \right)
\]

\[= -\beta \cdot w \cdot \left(-2(1-\alpha t) \cdot \eta^S \cdot L_S F^2_{LL} F^1_K + (L_S - L_1) \cdot (F^1_K F^2_{LL} - F^1_L F^1_{K L}) \quad \text{if } \eta^S \text{ is negative) \right)
\]

\[+ w \cdot \left(\alpha t F^1_F + K_1 \cdot \left[F^1_{K KL} F^1_{K LL} - F^1_{K KL} F^1_{F KL}ight]\right) \right). \quad (21)
\]

To arrive at the final line of (21), we made use of $F^1_K w - F^1_L F^2_K = F^1_K \cdot [w - r F^1_L / F^1_K] = F^1_K w \alpha t$ which stems from (2), (3), and (7).

Combining (20) and (21), one sees opposing forces at work: For a welfare improvement, (21) must, according to (20), exceed $(dL_1/d\alpha) \cdot (\alpha / L_S)$ which is positive whenever $dL_1/d\alpha > 0$. Expression (21) is smaller and, thus, more likely to be negative if labor supply elasticity is higher (the cofactor of $\eta^S$ is negative). Thus, for high values of $\eta^S$, (20) cannot be satisfied. On the other hand, if $\eta^S$ is getting very small, the RHS of (20) exceeds all bounds, making it again impossible for the condition to hold.\footnote{This point could already be seen from (19): if the elasticity of labor supply is too small then (19) cannot hold as its LHS approaches zero, while its RHS does not.}

This observation renders general results for an optimal value of $\alpha$ unobtainable. It is, however, easy to see that full outsourcing is never optimal whenever the labor supply elasticity is low but positive. From (20), an increase in the net wage suffices to make deviations from $\alpha = 0$ worthwhile. From (21), this will happen in the case of positive, but small labor-supply elasticities. We summarize:

**Proposition 5** Fully outsourcing the production in sector 1 ($\alpha = 0$) can never be optimal if the labor supply elasticity is positive but small.
It is important to recall that none of our observations hinges on the assumption that only labor is taxed. Without qualitatively affecting any of our results we could allow for taxes on capital as long as they are lower than taxes on labor and as long as they alone do not suffice to cover the financial needs of the government. The crucial element is that the tax structure we impose is not an optimal one for the economy. This generates a bias in favor of having two differently taxed sectors (i.e., a mixed economy) and a distorted production structure. In line with the earlier literature on optimal taxation and public production, full optimality in our set-up — apart from running a perfectly planned economy — could be reached by leaving both sectors in private hands and taxing only (inelastically supplied) capital. We consider the assumption that the economy operates under a sub-optimal tax structure not being too far-fetched; in that case, some intersectoral distortions may be worthwhile.

6 Conclusion

In this paper, we analyze the relationship between public production and taxation from a general-equilibrium perspective. Several publicly provided goods and services, like hospitals, schools, and public transportation, can be produced privately even if they are ultimately financed by the government. Empirical evidence suggests that outsourcing such activities tends to result in a leaner workforce and increases the capital intensity in their production. This is often viewed as evidence of slack in public production. We argue that this need not be the case. In a consolidated government budget, the government “pays taxes to itself”. As a consequence, the government sector has a cost advantage over the private sector for the factor that is taxed relatively more heavily. As – in our model, but also in most countries – labor is taxed more heavily than capital, the government would then optimally organize production in a more labor-intensive way than a private firm. Observing a different factor mix in private and public production need, thus, 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 trade-off in deciding whether to outsource government activities or not.
On the one hand, different factor prices faced by public and private entities distort allocative efficiency. 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 certain circumstances, result in a decrease in equilibrium net wages and, thus a reduction in labor supply. If the reduction in production possibilities associated with this is 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 with smaller production possibilities. Given that these effects are driven by changes in labor supply, we argue that full outsourcing is never optimal with positive but low labor supply elasticities, as in Europe.

For public production that takes place at lower-level jurisdictions in federations our analysis also suggests an efficiency argument for the otherwise puzzling phenomenon of fiscal churning where the central government collects a share of tax revenues and returns it as lump-sum transfers to all lower-level jurisdictions, and not just to poorer ones. We identify that, even though full outsourcing would not be generally efficient, giving the public sector a full tax advantage could be inefficient as well. Fiscal churning can then be understood as an attempt to influence the price that lower-level jurisdictions effectively face when financing their production activities.

There are several ways in which our analysis could be extended. 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 in 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. E.g., one could assume that public managers directly maximize social welfare in a mixed economy, thereby taking labor supply decisions and private sector behavior as given. These extensions, as well as empirical testing of the predictions and evaluation of quantitative importance of our findings, are left for further research.
Appendix: Proof of Proposition 1

**Proof:** Differentiating (10) to (13) with respect to $\alpha$ yields the following system of equations:

\[
\begin{pmatrix}
a_1 & a_2 & a_3 & a_4 \\
b_1 & b_2 & 0 & 0 \\
c_1 & c_2 & c_3 & c_4 \\
d_1 & d_2 & d_3 & d_4
\end{pmatrix}
\begin{pmatrix}
dL_1 \\
dK_1 \\
dw \\
dt
\end{pmatrix}
= \begin{pmatrix}
-wtF^1_K \\
0 \\
0 \\
0
\end{pmatrix}
\cdot d\alpha
\tag{22}
\]

with

\[
a_1 = F^1_{LL}F^2_K - F^1_LF^2_{KL} - F^1_{KL}w(1 - \alpha t) < 0
\]

\[
a_2 = F^1_{KL}F^2_K - F^1_LF^2_{KK} - F^1_{KK}w(1 - \alpha t)
\]

\[
a_3 = (1 - t)F^1_LF^2_{KL}L'_S - F^1_K(1 - \alpha t)
\]

\[
a_4 = -wF^1_LF^2_{KL}L'_S + F^1_Kw\alpha
\]

\[
b_1 = -F^1_L \\
b_2 = -F^1_K < 0 \\
c_1 = -F^2_{LL} \\
c_2 = -F^2_{LK} \\
c_3 = F^2_{LL}L'_S(1 - t) - 1 < 0
\]

\[
c_4 = -F^2_{LL}L'_S w \\
d_1 = w - K_1F^2_{KL} \\
d_2 = F^2_K - K_1F^2_{KK} \\
d_3 = -tL_S + L_1 - wtL'_S(1 - t) + K_1F^2_{KL}L'_S(1 - t) \\
d_4 = -wL_S + w^2tL'_S - K_1F^2_{KL}L'_S w.
\]

Denote the matrix on the LHS of (22) 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), $A$ must then be negative semi-definite (see Takayama, 1985, pp. 313ff). In particular, $\det A > 0$ — which we will henceforth assume. For sake of abbreviation define:

\[
\beta := \frac{wtF^1_K}{\det A} > 0,
\tag{23}
\]
where the positive sign prevails when $A$ is stable. Now apply Cramer’s Rule to (22):

\[
\begin{align*}
\frac{dL_1}{d\alpha} &= \beta \cdot (c_3d_4 - c_4d_3) \cdot F_K^1 \\
&= \beta \cdot w \cdot (L_S - L'_S) \cdot \left[ -F_{LL}^2(L_S - L_1) + K_1F_{KL}^2 \right] \cdot F_K^1 \\
&= \beta \cdot w \cdot \left( L_S \cdot \left[ 1 - \eta^S \cdot \frac{t}{1-t} \right] + L'_S \cdot \left[ -F_{LL}^2(L_S - L_1) + K_1F_{KL}^2 \right] \right) \cdot F_K^1 \\
\frac{dK_1}{d\alpha} &= -\beta \cdot (c_3d_4 - c_4d_3) \cdot F_L^1 = -\frac{F_L^1}{F_K^1} \cdot \frac{dL_1}{d\alpha} \\
\frac{dw}{d\alpha} &= -\beta \cdot (b_2(c_4d_1 - c_1d_4) + b_1(c_2d_4 - c_4d_2)) \\
&= -\beta \cdot w \cdot \left( L'_S \cdot \left[ \Gamma - F_{LL}^1F_K^2F_{KL}^2 \right] + L_S \cdot \left[ F_K^1F_{LL}^2 - F_L^1F_{KL}^2 \right] \right) \\
\frac{dt}{d\alpha} &= -\beta \cdot (b_2(c_4d_1 - c_1d_4) + b_1(c_3d_2 - c_2d_3)) \\
&= -\beta \cdot \left( (1-t)L'_S \cdot \left[ \Gamma + F_{LL}^1F_K^2F_{KL}^2 \right] + (L_1 - tL_S) \cdot \left[ F_K^1F_{LL}^2 - F_L^1F_{KL}^2 \right] \\
&\quad - F_{KL}^1 \cdot \left( w - K_1F_{KL}^2 \right) + F_L^1 \cdot \left( F_K^2 - K_1F_{KK}^2 \right) \right).
\end{align*}
\]

where we defined:

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

which is of ambiguous sign. Given the assumptions mentioned in the proposition, the signs of (24) and (25) turn out as asserted, while the signs of (26) and (27) remain unclear in general.

References


Figure 1
Figure 2