

# Intermediate Industry Monopolies: Long-Run Implications of Private and Public Ownership

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## **Abstract**

We use an infinitely lived agent model in which an intermediate good is provided either by a public or a private monopolist to study the effects of privatization on steady state levels of income. We allow for public sector inefficiencies(x-inefficiency) which shift down the intermediate goods technology as well as bureaucratic inefficiencies which decrease the amount of tax revenue which will actually be allocated to public investment. We solve the model numerically for reasonable parameter values. The results of the model indicate that the benefits of this type of privatizations depend crucially on the size of the relative inefficiency of public firms and the amount of public investment. Furthermore, the gains from privatization are found to be strongly related to the balance sheet of the public firm that is privatized. Privatization of public firms which run deficits (surpluses) typically generate increases (decreases) in steady state consumption.

JEL codes: L33; L43; O25; O43

# 1 Introduction

Since the 1980's, many countries have turned to the privatization of state owned enterprises (SOEs), and the ownership of many intermediate-industry monopolies in areas like electricity, telecommunications, and others, has been transferred from the government to private entrepreneurs (World Bank's Bureaucrats in Business Report (1995)). While such policies have often been the subject of heated debates and popular discontent, most economists agree that privatizations of non-public goods industries are beneficial whenever market competition is introduced simultaneously, for a more competitive economy is thought to be superior to a less competitive one (see Armstrong and Sappington (2006) for a detailed discussion). When market competition does not emerge as part of the privatization process, potential outcomes of privatization are more controversial.

Whether an economy is better off with a private or a public intermediate-industry monopoly is likely to depend on three key characteristics: 1. Whether private firms operate more efficiently than public firms. 2. Whether the pricing distortions introduced by private monopolies are corrected (or reduced) by public monopolies subject to governmental guidelines. 3. Whether the SOEs to be privatized constitute a source of income for financially constrained governments or an expense burden that diverts public resources from other, more beneficial uses (see Sheshinski and Lopez-Calva (2003) for a review of these issues). In this paper, we gather all three of these characteristics in a general equilibrium model and study the conditions under which private ownership of intermediate industry monopolies is

preferred to public ownership. We restrict our analysis to the case of non-public goods.

The questions that we focus on are often encountered by policy makers but rarely answered in the macroeconomic literature. We ask: Is it possible for welfare to be higher with a public intermediate goods monopoly than with a private one? Is this possible even though public firms are less efficient than private firms? How big is the welfare loss (or gain) when a public monopoly is in place? Is the average government investing too much or too little on their SOE's? If so, how much can be gained by choosing the right policy?

In order to answer these questions we use a model of an aggregate economy where final goods are produced competitively and an intermediate input is required for the production of final goods. We then calibrate this model based on reasonable parameters and compare the steady-state welfare levels of an economy with a public intermediate industry monopoly to those of an alternative economy where a private intermediate industry monopoly is in place. Throughout this exercise, the production process of a private firm is assumed to be more efficient (or at least as efficient) than the production process of a public firm, and the financial deficit (or surplus) generated by any SOE is transferred directly to the central government. In addition, the government indirectly determines the pricing decisions of public monopolies by choosing the amount of physical capital available for public firm use.

The available macroeconomic literature with a general equilibrium approach to privatization is scarce. Apart from the literature on privatization in the context of the post-Soviet reforms in Eastern Europe, which includes for example Aghion and Blanchard (1994), Alexeev and Kaganovich (2001), Blanchard (1997), Castanheira and Roland (2000) and Roland

(2000), we are not aware of many other theoretical macroeconomic papers on privatization in mixed market economies. This post-Soviet privatization literature, however, does not look at the privatizations of intermediate sectors, but rather at a whole-scale privatization of (almost) all productive activity.

Two closely related papers are Schmitz (2001), who finds sizeable effects of privatization on aggregate income and Gylfason, Herbertsson and Zoega (2001), who show that privatization has large growth effects. Schmitz does not consider the issue of monopoly power and Gylfason, Herbertsson and Zoega model public and private goods as perfect substitutes in consumption and do not focus on the role of government production in intermediate goods. In another related paper, Glomm and Méndez (2004) use a similar theoretical model to study the economic impact of privatizing a intermediate public monopoly. They study how the benefits from privatization vary from a competitive to a noncompetitive environment and how this difference changes as the elasticity of substitution for the intermediate good in the aggregate production function changes. They ignore any issues related to inefficiencies, SOE's deficits, or the potential welfare impacts of privatization.

The single issue regarding state divestitures that has captured significant attention is that of the relative productive efficiency of public and private firms. Several empirical studies have reported evidence that private firms operate with greater efficiency than public firms (Domberger and Piggott (1994), Price and Weyman-Jones (1996), Newberry (1997)). Most of these studies, however, failed to distinguish between competitive industries and non-competitive industries. When such a distinction is made, the evidence is less definite and

the case for the privatization of intermediate industry monopolies weakens. Authors like LaPorta and Lopez-de-Silanes (1999) and Bourbakri and Cosset (1998), for example, report significant gains in the productive efficiency of privatized firms in competitive industries but only small gains for firms in non-competitive industries. Others like Vickers and Yarrow (1991) report no efficiency advantages for either private or public ownership under non-competitive conditions.

The following section presents the theoretical framework of the model. Section 3 presents the equilibrium solution of the model and the numerical calibration of the model to the typical, base-case economy. Section 4 then uses the model to answer our questions regarding privatization and, finally, the last section of the paper offers a summary of our conclusions and a tentative list of issues pending for future research.

## 2 Theoretical Set-up

The economy is populated by a large number of individuals, which is normalized to one. The individual lives forever and is endowed with  $k_0$  units of capital at time zero and with one unit of labor in each period. At each point in time, he supplies labor and capital inelastically. The before-tax wage rate is  $w_t$ . The before-tax rental price of capital is  $q_t$ .

The individual's lifetime utility function takes the form

$$\sum_{t=0}^{\infty} \beta^t \left( \frac{c_t^{1-\sigma}}{1-\sigma} \right), \quad (0 < \beta < 1, \quad \sigma > 0), \quad (1)$$

where  $\beta$  is a discount factor,  $c_t$  represents consumption of final goods at time  $t$  and  $1/\sigma$  is

the elasticity of inter-temporal substitution. Every period the individual divides his total income between consumption at period  $t$ ,  $c_t$  and investment at period  $t$ ,  $i_t$ . In addition, it is assumed that capital depreciates at the rate  $\delta$  regardless of the specific use to which it is put.

Two goods are produced in this economy: a final good  $Y_t$  is used for consumption and investment in physical capital, and an intermediate good  $E_t$  is used completely in the production of final goods. In this sense, the role of  $E_t$  is similar to the role of many intermediate goods like electricity, internet, telecommunications, gas, or general energy that are used in almost all production processes. For simplicity, we assume that this intermediate good is not consumed directly by the individuals.

The final good is produced competitively by a large number of firms that use the same constant returns to scale technology, which is given by

$$Y_t = A(\theta K_{F,t}^\rho + (1 - \theta) E_t^\rho)^{\frac{\alpha}{\rho}} N_{F,t}^{1-\alpha}. \quad (2)$$

Here  $K_{F,t}$  and  $N_{F,t}$  represent the amount of capital and labor used in the production of final goods at time  $t$  respectively,  $A$  is a constant measuring total factor productivity and  $\rho$  and  $\alpha$  are constants that measure the degree of substitutability and the marginal products of the factors in the production function.

Since the technology exhibits constant returns to scale, we can assume that there is one firm and that  $Y_t$  is aggregate output. The representative final goods firm's problem can be

expressed as

$$\underset{\{K_{F,t}, N_{F,t}, E\}}{\text{Max}} A(\theta K_{F,t}^\rho + (1 - \theta) E_t^\rho)^{\frac{\alpha}{\rho}} N_{F,t}^{1-\alpha} - q_t K_{F,t} - r_t E_t - w_t N_{F,t}, \quad (3)$$

given  $q_t$ ,  $r_t$ , and  $w_t$ .

Where  $r_t$  represents the price per unit of intermediate good  $E$  at time  $t$ , and the firm takes input prices  $q_t$  and  $w_t$  as given.

The intermediate good  $E$  is produced using the constant returns to scale technology

$$E_t = BK_{I,t}^\gamma N_{I,t}^{1-\gamma}, \quad (4)$$

where  $K_{I,t}$  and  $N_{I,t}$  represent the total units of capital and labor used in the production of intermediate goods at time  $t$  respectively,  $\gamma$  is a positive constant, and  $B$  is a number that represents the productive efficiency of the firm.

The assumption about constant returns to scale in the intermediate industry allows us to capture different possibilities regarding the nature of competition in this market. One possibility is that the monopolistic power is imposed by laws that prevent an otherwise competitive industry; in that case, the production function in (4) can be thought as the representative production technology. Another possibility is that the monopolistic condition is the result of fixed start-up costs to the firm; in that case, the production function in (4) would need to include a fixed cost as well. This last term, however, if sufficiently small would not influence any marginal decisions. Schmitz (2001) also assumes constant returns

to scale in the investment good sector.

Using this basic framework, we construct two alternative models: one with a private intermediate monopoly and another one with a public intermediate monopoly. The private monopolist hires both labor and capital from their respective markets. The private monopolist's problem can then be written as

$$\begin{aligned}
 & \underset{\{N_I, K_I\}}{\text{Max}} \quad r(E_t) \cdot E_t - w_t N_I - q_t K_I, & (5) \\
 & \text{s.t.} \quad E_t = K_{I,t}^\gamma N_{I,t}^{1-\gamma}, \\
 & \text{given } r(E_t), w_t, q_t.
 \end{aligned}$$

Here the inverse demand function  $r(E_t)$  corresponds to the representative final good firm's input demand function resulting from its maximization problem as stated by (3) and the constant  $B$  is set to one to indicate full efficiency in the private sector.

For the case of a public monopoly, if  $B < 1$  ( $B > 1$ ), the public sector monopoly is less (more) efficient than the private sector monopoly. The lower productive efficiency of public firms (often referred to as X-inefficiency) can be explained by the lack of managerial incentives, the mix of political interests into the objective function, the lack of clear monitoring efforts by the government, and others (See for example Kay and Thompson (1986), Vickers and Yarrow (1991), or Plane (1992)). Here any such sort of inefficiency is summarized by the constant  $B$ .

Any profits generated by the public and the private monopolies are defined by  $\pi_g$  and

$\pi_p$  respectively. For the private monopoly case, we assume that profits  $\pi_p$  are distributed equally among the individuals. For the public monopoly case, we assume that profits  $\pi_g$  are collected by the government and used in the same way as any other type of revenue.

The government in these economies taxes labor and capital income at the common rate  $\tau$ ; this tax rate is exogenous and assumed to be constant over time. The government has only two types of expenditures: government transfers  $T$  and, for the case of an intermediate public monopoly, government investment in public physical capital ( $\tilde{K}_I$ ).

Specifically, for the public monopoly case, we assume that a fraction  $\Psi$  of  $\pi_g$  is used for investments in the capital of the public firm. We allow for  $\Psi$  to be greater than one as long as the government budget is balanced and the transfers  $T$  are not negative<sup>1</sup>. We do not allow  $\Psi$  to be less than zero, since this would amount to selling the public capital (a form of privatization).

Public investments are further subject to bureaucratic degradation; that is, for each unit of funds allocated to investment only a fraction  $b$  of these funds is actually added to the capital stock. The constant  $b$  is introduced to capture the effects of corruption, red-tape, and political inferences that are more likely to be present in public enterprises. Both  $b$  and  $B$  are treated as exogenous variables. In principle, productive and bureaucratic inefficiency are separate phenomena; interestingly, as will be shown afterwards, the effects of changes in  $b$  and  $B$  are not identical in our model.

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<sup>1</sup>This is equivalent to assume that a fraction of total government revenue is invested and the other fraction used for Transfers. We choose to model public investment in this way because it facilitates the analysis of SOE deficits as opposed to fiscal deficits.

The equation of motion of public capital and the government's balanced budget condition can then be described as follows:

$$\tilde{K}_{I,t} = (1 - \delta)\tilde{K}_{I,t-1} + b \cdot \Psi \cdot \pi_{g,t-1} ; \quad (6)$$

$$\tau(q_t k_t + w_t) + \pi_{g,t} = \Psi \pi_{g,t} + T_t. \quad (7)$$

The assumption of a government balanced budget implies that public investment is financed entirely with current government revenues. Having a balanced government budget constraint also allows us to isolate and study the effect of SOE's deficits (surpluses) on the economy. An SOE is said to have a deficit if net revenues cannot cover operating expenses plus investment. By this definition, the case of  $\Psi > 1$  ( $\Psi < 1$ ) corresponds to a deficit (surplus) on the SOE balance and thus, to a reduction (increase) on the public funds available for other purposes. Similarly, the case of  $\Psi = 1$  corresponds to a balanced SOE budget.

The public monopolist takes the level of capital available for the production of intermediate goods as determined by government policies and hires labor from the labor market. Thus, given equations 6 and 7, the public monopolist problem can be written as

$$\begin{aligned} & \underset{\{N_I\}}{Max} \ r(E_t) \cdot E_t - w_t N_I, & (8) \\ & \text{s.t. } E_t = B \cdot \tilde{K}_{I,t} N_{I,t}^{1-\gamma}, \\ & \text{given } r(E_t), \tilde{K}_{I,t}, w_t, q_t, B. \end{aligned}$$

The inverse demand function  $r(E_t)$  in equation (8) is exactly the same as before.

While the objective function of public sector enterprises is by no means uncontroversial, we assume that the public firm's objective is to maximize profits. Such an assumption might not be too far away from actual behavior since, as pointed out by Ramamurty (1991), accounting practices, executive management and performance measures for state-owned enterprises often resemble those of private firms. Additionally, this assumption provides a convenient comparison to the case of a private monopoly, where profit maximization is more natural.

The individual's utility maximization problem can be expressed as

$$\begin{aligned}
 & \underset{\{c_t, i_t\}}{\text{Max}} \quad \sum_{t=0}^{\infty} \beta^t \left( \frac{c_t^{1-\sigma}}{1-\sigma} \right) & (9) \\
 & \text{s.t.} \quad \sum_{t=0}^{\infty} p_t \{ (1-\tau)(q_t k_t + w_t) + T_t + \pi_{p,t} \} = \sum_{t=0}^{\infty} p_t (c_t + i_t) \\
 & \text{and } k_{t+1} = i_t + (1-\delta)k_t \\
 & \text{given } T_t, \pi_{p,t}, w_t, q_t, p_t, \tau, \text{ and } k_0.
 \end{aligned}$$

Here  $p_t$  represents the price of a unit of consumption at time  $t$  relative to a unit of consumption at time  $t+1$  and  $\pi_{p,t} = 0$  for the public monopoly case.

Finally, in equilibrium the capital and labor markets must clear, that is to say, at all times it must be true that  $N_{F,t} + N_{I,t} = 1$  and that  $K_t = K_{F,t} + K_{I,t}$ ; where  $K_{I,t}$  enters the equation only for the private monopoly case.

The corresponding equilibrium for these two alternative economies is defined as a sequence  $(c_t, K_t, E_t, Y_t, q_t, r_t, w_t, T_t, \pi_{p,t})_{t=0}^{\infty}$ , such that:

- the individuals solve their utility maximization problem as given by (9),
- the final good firms solve their profit maximization problem as given by (3),
- the intermediate monopolist solves his maximization problem as given by (5) and (8) respectively
- the government budget is balanced in all periods, and
- all markets clear.

### 3 Solution of the models

Throughout the rest of the paper, we will focus on steady states and drop time subscripts whenever possible without the risk of confusion. We chose a value of  $\rho$  that is arbitrarily close to zero, such that the production function described by equation (2) can be approximated by the simpler Cobb-Douglas technology  $Y_t = AK_{F,t}^{\alpha} E_t^{\varphi} N_{F,t}^{1-\alpha-\varphi}$ . There are three reasons that support our choice for  $\rho$ . First, as reported in cross-country studies by Megginson et al. (1994) and Boubarki and Cosset (1998), the levels of employment of the privatized industries (absolute and relative to total employment) do not change much after privatization. In our model, the only value of  $\rho$  that generates this result is zero. Second, although the empirical evidence about the value of the parameter  $\rho$  at the industry level is mixed (authors

like Prywes (1986), for example, find values varying from -24 to 12 across different US industries); empirical studies at the macroeconomic level often find values that are closer to zero. Kemfert (1998) and Chang (1994), for example, estimate  $\rho$  to be -0.5 and -0.14 for Germany and Taiwan respectively. Third, as shown by Glomm and Méndez (2004), when the value of  $\rho$  moves away from zero the changes in the output difference of the public and private monopoly cases is very small.

With this in mind, after solving the consumer's dynamic utility maximization problem and the final good firm's profit maximization problem we obtain the Euler equation for the consumer and the first order conditions for the firm. These equilibrium conditions are stated in equations 10-13 respectively.

$$\left(\frac{C_{t+1}}{C_t}\right)^\sigma = \beta(q_{t+1}(1-t) + (1-\delta)) \quad (10)$$

$$q = A\alpha K_F^{\alpha-1} E^\varphi N_F^{1-\alpha-\varphi} \quad (11)$$

$$r = A\varphi K_F^\alpha E^{\varphi-1} N_F^{1-\alpha-\varphi} \quad (12)$$

$$w = A(1-\alpha-\varphi)K_F^\alpha E^\varphi N_F^{-\alpha-\varphi} \quad (13)$$

Similarly, equations (14) and (15) show the profit maximizing conditions for the private monopoly.

$$w = A\varphi^2(1 - \gamma)K_F^\alpha K_I^{\varphi\gamma} N_I^{(1-\gamma)\varphi-1} N_F^{1-\alpha-\varphi} \quad (14)$$

$$q = A\varphi^2\gamma K_F^\alpha K_I^{\varphi\gamma-1} N_I^{(1-\gamma)\varphi} N_F^{1-\alpha-\varphi} \quad (15)$$

Equation (16) shows the public monopoly's optimal amount of labor:

$$w = A\varphi^2 B^\varphi (1 - \gamma) K_F^\alpha \tilde{K}_I^{\varphi\gamma} N_I^{(1-\gamma)\varphi-1} N_F^{1-\alpha-\varphi} \quad (16)$$

In both cases, the equilibrium system of equations can be solved to obtain a closed form solution for the steady state equilibrium <sup>2</sup> but the analytical comparison of the alternative models does not allow us to reach definitive conclusions regarding the gains from privatization. Whether the private monopoly economy outperforms the public monopoly one depends on the value of the key parameters studied here; namely,  $B$ ,  $b$  and  $\Psi$ . Thus, in order to obtain tangible results, a numerical exercise was conducted.

### 3.1 Numerical Simulation: Base-case scenario

We first choose reasonable numerical values for all parameters in the model. The values of the exogenous parameters for our base case simulations are shown in Table 1. Setting  $A = 1$  is simply a normalization. The values for the capital's share of income and the rate of time preference are standard (See Gollin (2002)), and the values of  $\tau = 0.2$  and

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<sup>2</sup>Closed form solutions of these systems of equations together with the solutions for the most relevant variables in the model are available upon request

$\delta = 0.1$  correspond to the government's share of GDP in relative poor countries and capital depreciation respectively.

The value for the parameter  $\gamma$  (the share of capital in the value of the intermediate input) was chosen to match the empirical observations about the role of capital in the production of several intermediate goods. In the case of Britain, for example, Bishop and Thompson (1992) reported capital to constitute 40.2% of total inputs used in the production of electricity, 44.4% in the production of gas, and 46.7% for the telecommunication industry. Values of  $\gamma \in (0.3, 0.5)$  were also used without much change in the results.

**Table 1.** Base Case Parameters

Preference Parameters:	$\beta = 0.96$
Consumption Goods Technology Parameters:	$A = 1$ $\alpha = 0.3$ $\varphi = 0.15$ $\rho = 0$ $\delta = 0.1$
Intermediate Goods Technology Parameters:	$B = 0.8$ $\gamma = 0.4$
Government Parameters	$\tau = 0.2$ $b = 0.7$ $\Psi = 1.05$

In turn, the parameter  $\varphi$ , which measures the income share of the intermediate good E, was set to match the actual share of SOE's output to GDP as reported by the World Bank's Bureaucrats in Business report (1995). Since before the 1990s it was common for the government to control the production of intermediate goods like public utilities and telecommunications, this is a logical approximation. The average estimate of this ratio for

developing economies, as reported in the World Bank's Bureaucrats in Business (BB) report (1995) was close to 10% during the period 1978-1991. The value of  $\varphi$  that matches this result after accounting for all inefficiencies is 0.15.

With respect to the value of  $B$ , our base case choice is inspired by several empirical studies. Using a sample of 79 firms in over 21 developing countries, Boubakri and Cosset (1998) estimate a 14% gain in the sales-efficiency<sup>3</sup> of noncompetitive firms. In a similar study Megginson et al (1994) reported a 3% gain for the same measure. Others like La Porta and Lopez-De-Silanes (1999) report a cost per unit decrease of 34% in the noncompetitive Mexican privatizations. All of these authors report much greater income-efficiency<sup>4</sup> gains for all privatizations, but do not report them for the noncompetitive sector only. We chose a value of  $B = 0.8$  as our base case, but analyze a wider range of values in what follows. A similar approach is taken for the values of  $b$ . Although some evidence about the investment costs associated with slow, cumbersome or corrupt bureaucracies is available (see for example Guash and Hahn (1998) or Brunetti et al. (1998)), it is difficult to pin down an exact number for  $b$ . We then explore values of  $b$  between 0.5 and 0.9, which we think cover most cases.

Finally, the parameter  $\Psi$  measures the flow of resources from the central government to the state owned enterprises. The actual value of these transfers varies greatly across developing regions of the world. According to the Bureaucrats in Business report (1995) the average flow of resources from the central government to all SOE's as a percentage of

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<sup>3</sup>Sales efficiency is defined as Real Sales/Employees

<sup>4</sup>Income-efficiency is defined as Net Income/Employees

GDP averaged 1.4% in Asia, -1.6% in Latin America and 0.7% for Africa. We use a base case value of  $\Psi = 1.05$  (resulting in a resource flow of 1.3% of GDP) but use many other values throughout the analysis.

Table 2 shows some facts about the importance and performance of SOEs in Africa, Asia and Latin America as well as the corresponding numbers from the base case simulation of our model for the public monopoly case. The statistics are derived from the World Bank's Bureaucrats in Business (1995) data set, which provides valuable information about the role of SOEs in the economic activity of over 50 developing countries during the years 1978-1991.

**Table 2.** SOEs Performance

	Asia	Latin America	Africa	Base Model
SOE/ GDP	8.3%	9.6%	13.9%	9.9%
INV/GDP	5.8%	3.5%	5.5%	10%
EMP (%)	2.9%	2.6%	20.6%	2.4%
FLOW ( % GDP)	1.4%	-1.6%	0.7%	1.3%
BAL (%GDP)	-3.1%	-0.5%	-2.9%	-2.6%

Table 2 shows four statistics from this data set. These statistics are the ratio of total SOEs economic product to total GDP (SOE/GDP), the ratio of SOE's investment to total GDP (INV/GDP), the share of SOE's employment to total employment (EMP), the net flow of resources from the central government to all SOEs (FLOW), and total SOE Balance before transfers (BAL)<sup>5</sup>.

According to the data, Asia and Latin America exhibit several similarities, while African

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<sup>5</sup>BAL is defined as total SOE revenues minus wages, factor rentals, depreciation and net capital expenditures.

countries showed much higher values for the share of SOE employment and production. Interestingly, Asia and Latin America have also followed very different policies regarding privatization resulting in very different growth patterns. We will return to this issue later in the paper.

As shown in Table 2, our base case model is able to replicate the average statistics from the BB data set<sup>6</sup> and, thus, it provides a good departure point for comparative policy analysis. The parameters  $B$ ,  $b$  and  $\Psi$  may represent some of the most important sources of variation in public policies. In the next section we study variations on these and other parameters in order to answer the policy questions we had initially posted; namely: Is it possible for welfare to be higher with a public intermediate goods monopoly than with a private one? Is this possible even though public firms are less efficient than private firms? How big is the welfare loss (or gain) when a public monopoly is in place? Is the average government investing too much or too little on their SOE's? If so, how much can be gained by choosing the right policy?

## 4 Policy Experiments

### 4.1 The General Comparison of Public and Private Ownership

In this section we will address the following questions: Is it possible for the average economy to be better off with a public intermediate goods monopoly? Is this possible even though public firms are less efficient than private firms?

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<sup>6</sup>If the data is restricted to pre-1985 years (before privatization policies became wide spread), the data value for INV/GDP becomes approximately 7%; which is much closer to our base case of 10%.

A natural starting point is to determine whether a public monopoly from a typical (base-case scenario) economy that suffers from a  $x$ -degree level of inefficiency can match welfare levels achieved by the private monopoly system. Table 3 addresses this issue for many possible values of productive inefficiency  $B$  and bureaucratic inefficiency  $b$ . For different values of  $b$ , the columns in Table 3 show the ratio of the total output generated by the public monopoly economy to the one generated by the private monopoly one ( $Y_{pub}/Y_{pv}$ ) and the ratio of the steady state consumption levels for the two alternative models ( $C_{pub}/C_{pv}$ ). Throughout this section, we use consumption levels as a measure of welfare. The values corresponding to the base case scenario are in bold font.

$B$	$b=0.5$		$b=0.7$		$b=0.9$	
	$Y_{pub}/Y_{pv}$	$C_{pub}/C_{pv}$	$Y_{pub}/Y_{pv}$	$C_{pub}/C_{pv}$	$Y_{pub}/Y_{pv}$	$C_{pub}/C_{pv}$
0.1	0.740	0.608	0.764	0.628	0.782	0.643
0.2	0.871	0.716	0.899	0.739	0.920	0.756
0.3	0.958	0.787	0.989	0.812	1.012	0.831
0.4	1.025	0.842	1.058	0.869	1.083	0.889
0.5	1.080	0.887	1.114	0.915	1.141	0.937
0.6	1.127	0.926	1.163	0.955	1.191	0.978
0.7	1.168	0.960	1.206	0.991	1.235	1.014
0.8	1.206	0.990	<b>1.244</b>	<b>1.022</b>	1.274	1.046
0.9	1.239	1.018	1.279	1.051	1.309	1.076
1	1.270	1.043	1.311	1.077	1.342	1.103

**$Y_{priv}$**  = Total Output in the private monopoly case  
 **$Y_{pub}$**  = Total Output in the public monopoly case  
 **$C_{pub}$**  = Consumption under the public monopoly case  
 **$C_{priv}$**  = Consumption under the private monopoly case

The results from Table 3 provide a clear message: the public monopoly economy can generate higher output and consumption levels than the private one even though it exhibits

significant productive inefficiencies. In fact, as long as the productive efficiency of public firms remained above 80% ( $B > 0.8$ ), the public monopoly economy generated higher income and consumption levels than the private one for all scenarios in Table 3. This result emerges when the investments levels in the public monopoly exceed those of the private monopoly by more than what is needed to compensate for productive inefficiencies; that is to say, when the welfare loss due to productive inefficiencies is smaller than the gain obtained by correcting the monopoly pricing distortion. It is only when productive efficiency falls below 70%-80 % that the situation is reversed and the consumption gains from privatization become positive ( $C_{pub}/C_{pv} < 1$ ).

Besides its base-case value, the bureaucratic efficiency parameter  $b$  was also assumed to take a low value ( $b=0.5$ ) and a high value ( $b=0.9$ ). Changing the level of bureaucratic efficiency had a similar but less severe impact than the one obtained by changing the productive efficiency parameter; in fact, the results are almost unaltered across the columns in Table 3. Nonetheless, higher levels of bureaucratic efficiency yielded higher consumption levels in the public monopoly case and, thus, smaller gains from privatization for all levels of  $B$ .

So far, however, we have assumed a value for the public investment parameter ( $\Psi = 1.05$ ) that best represented the data from the average economy and used it as our "base case" value. A priori, there is no reason to assume this is the optimal value. Next, we look for evidence of over-investment or under-investment in SOE's physical capital.

## 4.2 The Growth-Maximizing Funding Level for SOEs

In this section we address the following questions: Does the typical economy invest too much or too little in their SOE's? How much can be gained by choosing the optimal policy?

Table 4 presents the results of our numerical simulation when the parameter  $\Psi$  is allowed to vary. The simulations are done under three alternative scenarios: a low productivity case ( $B=0.7, b=0.5$ ), our initial base case ( $B=0.8, b=0.7$ ), and a high productivity case ( $B=0.9, b=0.9$ ). Under the low productivity scenario, the private monopoly always generates a higher consumption level. Under the high productivity scenario, the public monopoly always generates a higher consumption level. Under the base case scenario, the relative consumption levels depend crucially on the public investment parameter ( $\Psi$ ). In all three scenarios, increasing public investment always increased output but, due to decreasing marginal returns of capital, such an increase in output ultimately comes at the expense of lower transfers and lower consumption levels.

With respect to the optimal value of ( $\Psi$ ), the results from Table 4 suggest that the gains from privatization processes of intermediate monopolies are strongly related to the balance sheet of the public firm in question. In all relevant columns from Table 4, as the deficits in the intermediate public monopoly firm increase (and values of  $\Psi$  go beyond 1), the consumption levels in the public monopoly economy go below the ones generated by the private intermediate monopoly economy. In other words, privatizations of deficitary SOEs tends to be associated with welfare gains and privatizations of non-deficitary SOEs

are associated with welfare losses under most scenarios considered in this paper.

<b>Table 4. Changes in Public Investment (<math>\Psi</math>)</b>						
$\Psi$	B= 0.7, b=0.5		B=0.8, b=0.7		B=0.9, b=0.9	
	$Y_{pub}/Y_{pv}$	$C_{pub}/C_{pv}$	$Y_{pub}/Y_{pv}$	$C_{pub}/C_{pv}$	$Y_{pub}/Y_{pv}$	$C_{pub}/C_{pv}$
0.1	0.937	0.915	0.9980	0.9745	1.050	1.025
0.2	1.000	0.960	1.0650	1.0226	1.120	1.076
0.4	1.067	0.989	1.1365	1.0541	1.196	1.109
<b>0.6</b>	1.108	<b>0.992</b>	1.1806	<b>1.0565</b>	1.245	<b>1.111</b>
0.8	1.138	0.982	1.2128	1.0458	1.276	1.100
1	1.163	0.964	1.2385	1.0275	1.303	1.081
1.2	1.183	0.942	1.2598	1.0041	1.325	1.056
1.4	1.200	0.917	1.2782	0.9770	1.345	1.028
1.6	1.215	0.889	1.2943	0.9471	1.362	0.996
1.8	1.228	0.859	1.3086	0.9149	1.377	0.962
<b><math>Y_{priv}</math></b> = Total Output in the private monopoly case						
<b><math>Y_{pub}</math></b> = Total Output in the public monopoly case						
<b><math>C_{pub}</math></b> = Consumption under the public monopoly case						
<b><math>C_{priv}</math></b> = Consumption under the private monopoly case						

Given any level of productive inefficiency, the optimal value of ( $\Psi$ ) is that one that maximizes the overall level of consumption in the economy. In Table 4, this value corresponds to  $\Psi = 0.6$ ; a value that is much lower than the base-case value. We interpret this as evidence that that government from the average economy is over-investing on its SOEs. By comparing the optimal policy of  $\Psi = 0.6$  to the base-case policy of  $\Psi = 1.05$ , an increase in consumption of about 9% is obtained.

Going back to Table 2, we are able to relate these results to the observations of the statistics from the different regions of the world. According to the data presented in Table 2, the average Latin American country is the most likely to have non-deficitary SOEs (they are the only region with a negative average for FLOW); whereas the average Asian country is the least likely. Thus, for a common level of productive and bureaucratic efficiencies, our

results would suggest that Latin American countries would benefit less from privatizations than Asian countries would. This conclusion is subject to the caveat that the efficiency levels of public Latin American firms could be very different from the respective levels of Asian public firms.

In general, as mentioned in the preceding sections, the available evidence does not show an indication for severe SOEs deficits for any developing region and points only to medium or low levels of public inefficiencies. In such a scenario of low inefficiency and low deficits, the results of our model would predict small (if any) gains from privatization whenever privatization is not followed by increased competition.

### **4.3 Comparing Public and Private Ownership under the Growth-Maximizing Public Funding Level**

If policy ( $\Psi$ ) is chosen optimally, when does inefficiency justify privatization? In order to answer this question, we set the value of  $\Psi$  to its optimal value ( $\Psi = 0.6$ ) and leave all other parameters unchanged. Table 5 then presents the results of the simulations for different parameters of inefficiency  $B$  and  $b$ . As shown, if the level of public investment is chosen optimally and monopoly pricing distortions are eliminated, then an intermediate goods public monopoly can sustain considerable productivity inefficiencies and still be considered superior to an intermediate private monopoly.

In the low bureaucratic efficiency scenario ( $b=0.5$ ), the public monopoly economy generates higher consumption levels than the private monopoly economy as long as the productive efficiency of the public firm does not fall below 80% of the private efficiency benchmark. This

number decreases to 70% and 60% for the medium and high bureaucratic efficiency scenarios respectively. Thus, the results in Table 5 suggest that when public investment decisions are chosen optimally, privatizations generate higher consumption levels only when  $B$  is low (high levels of inefficiency).

<b>Table 5. Changes in Productive Efficiency under optimal policy</b>						
$B$	b=0.5		b=0.7		b=0.9	
	$Y_{pub}/Y_{pv}$	$C_{pub}/C_{pv}$	$Y_{pub}/Y_{pv}$	$C_{pub}/C_{pv}$	$Y_{pub}/Y_{pv}$	$C_{pub}/C_{pv}$
0.1	0.702	0.628	0.725	0.648	0.742	0.664
0.2	0.826	0.739	0.853	0.763	0.873	0.781
0.3	0.908	0.813	0.938	0.839	0.960	0.859
0.4	0.972	0.870	1.003	0.898	1.027	0.919
0.5	1.024	0.916	1.057	0.946	1.082	0.968
0.6	1.069	0.956	1.103	0.987	1.129	<b>1.011</b>
0.7	1.108	0.992	1.144	<b>1.023</b>	1.171	1.048
0.8	1.143	<b>1.023</b>	1.180	1.056	1.208	1.081
0.9	1.175	1.052	1.213	1.086	1.242	1.111
1	1.205	1.078	1.243	1.113	1.273	1.139

$Y_{priv}$  = Total Output in the private monopoly case  
 $Y_{pub}$  = Total Output in the public monopoly case  
 $C_{pub}$  = Consumption under the public monopoly case  
 $C_{priv}$  = Consumption under the private monopoly case

## 5 Conclusions

In this paper we have addressed the issue of how x-inefficiency and bureaucratic inefficiency influence the welfare implications of the privatization of intermediate goods industries. We have focused on steady state analysis. Issues that might be interesting to pursue in the future are:

- (i) The desirability of any fiscal policy reform depends crucially on what is going on along the entire transition and not only in the steady state. In order to study the welfare

consequences of large scale privatizations it will thus be useful to study the transitional dynamics of privatization.

(ii) In this paper the output of the industry to be privatized was only an intermediate good in the production of the final consumption good. Most examples mentioned in this paper such as electricity and phone service also serve as final consumption goods. We leave this generalization to future work.

(iii) The role of the government in this paper has been very simple in that the government only has two functions, to run the SOEs and to carry out transfers programs. In this model the cost of using tax revenue to prop up inefficient public sector enterprises might be relatively small, since the cost of propping up these enterprises is only lost transfer payments. The cost of running public sector enterprises with a tax financed deficit might be substantially higher if financing these deficits comes at the expense of productive government expenditures such as infrastructure investments.

(iv) Finally, governments typically have different wage compensation schemes than the private sector. Large scale privatization then might have substantial distributional consequences.

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