Choosing the extent of private participation in public services: A computable general equilibrium perspective

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Abstract:
What determines the propensity to reduce or widen the extent of public ownership? Why has there been a tendency to privatise and concede public utilities during the nineties? The answers to these questions depend both on macroeconomic and microeconomic considerations. And correct answers could also help to avoid or prevent inefficient reversals and frustrations that jeopardize reform processes. An alternative perspective, that combines micro and macro arguments, is given by general equilibrium models. The objective of this paper is to explore the rationality of the decision of choosing the implicit "technologies" of private and public operators of utilities in an economy that has fiscal budget and trade balance in equilibrium. The simulations confirm that the choice of the technology to be used for servicing infrastructure depends on deep parameters of efficiency and costs. The model shows that there are plausible scenarios where the selection is not unique.

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1. Introduction.

What determines the propensity to reduce or widen the extent of public ownership? Why has there been a tendency to privatise and concede public utilities during the nineties?

The answers to these questions depend both on macroeconomic and microeconomic considerations. And correct answers could also help to avoid or prevent inefficient reversals and frustrations that jeopardize reform processes.

On the microeconomic side, there are two prominent theories[1]. One, emphasizes the role of public ownership to resolve contractual problems and to influence the decisions of the firms in certain sensitive issues for the politicians; it is easier to control the decisions of the firm (on employment levels, for example) when the company is under public ownership. The other focuses on the self exclusion of private sector under government opportunism; if taxes and regulations are too unstable and endogenous, risk of arbitrariness discourages private investments, and public ownership is the only possibility.

Macro considerations have been concentrated in the need of controlling public deficits, obtaining revenues from privatisations and concessions, fostering growth through efficiency enhancements and obtaining price reductions via competitive environments.

One additional point to consider is the all-or-nothing character of the choice. That is, are there gains of having private operators coexisting and competing with a public enterprise?

There are two aspects to take into account:

[1] According to Esfahani and Ardakani (2004).

1) Efficiency gains given the reciprocal benchmarking, though in this case it is difficult to say why not benchmarking private operators and why a mix public/private is better.
2) Gains due to harder competition, though a similar observation applies and competition could prevail between private operators. In fact, having only private operators could alleviate potential problems of moral hazard of public sector being involved simultaneously in operation and regulation.

2. The general equilibrium approach.

An alternative perspective, that combines micro and macro arguments, is given by general equilibrium models. This perspective has not been fully explored, and there are only a few examples –e.g. Chisari, Estache and Romero (1999). Beyond short term increases in revenue for the governments, efficiency gains for the economy could justify higher presence of private sector.

General equilibrium gives a framework of consistency that impedes counting gains more than once, obliges to represent budget constraints of all agents –including transfers- and gives net welfare results after taking into account changes in relative prices and factor rewards. In fact, changes in factor rewards could change expected gains of privatisations and government activity…or not. And it is in the last case when arguments in favour of private operation are stronger.

In this paper the objective is to explore the rationality of the decision of choosing the implicit "technologies" of private and public operators of utilities in an economy that has fiscal budget and trade balance in equilibrium.

We do not consider neither asymmetries of information nor political opportunism. They are certainly important elements to take into account, but it seems to be also relevant to focus on the core of the workings of the economy. What happens with relative prices and factor rewards after the privatisation or concession, net welfares gains and their distribution –even or not- the sensitivity of the decision to changes in fundamental parameters, like the cost of capital, deserve deeper examination.

In broad terms, we will assume that the extreme cases of public and private operation have the following differences:

- Public enterprises show lower efficiency levels in the use of intermediate inputs and employment.
- This inefficiency implies that public enterprises must be subsidized, and therefore, that taxes or prices of utilities services must be higher.
- This inefficiency is also present in the investment process: one unit of investment produces more units of capital installed under private operation (or less units of investments are needed to compose one unit of capital).
- However the share of imported intermediate inputs is higher in the case of private operators, since new investments and methods are complementary of inputs and services provided by the rest of the world.
- Capital reward of private operators in determined basically by its cost of opportunity in the rest of the world.

Given these elements, the typical choice will involve:

- Taking into account that evidence tends to confirm that under public hands inefficiencies are higher, that more resources will be necessary to operate utilities diverting them from other (valuable) activities, and that subsidies will have to be covered with taxes or higher prices and that this creates further inefficiencies in the allocation of resources.
- Realizing that though private operators are more efficient, productivity of capital in the rest of the world becomes a relevant benchmark as the minimum required reward for private capital, and that potential transfer of dividends abroad could put pressure on trade balance. The economy will enjoy higher efficiency and performance standards, but at the cost of having to devote more resources to export markets.

So the basic comparison can be reduced to the minimum cost choice between contributing to exports with local effort and consumption sacrifice or accepting inefficiencies and costs of misallocation of resources due to subsidisation. The intention is trying to give general equilibrium hints to the answers posed at the beginning of this paper and to consider thresholds for the cost of capital and public funds full costs that explain rational choices.

There are some provisos to take into consideration. The results must be examined both under full employment and unemployment; in the last case, the results will depend on the rule of indexation of wages. Under unemployment, efficiency gains will be more important for obtaining increases in scales of operation that will influence positively welfare.

Asymmetries of information are not part of the model. It is true that they a cornerstone of regulatory economics, but at this stages the differences of dealing with them under public or private operation will only add confusion to the results. In fact, especially under high-powered regimes, the capacity and willingness to deal with asymmetries of information will be probably higher under private hands and that would be a reason for recommending private ownership or operation. But, what of the costs?

3. Basic analytical structure.

The analysis is based on a standard CGE model with regulation and service obligations (see Box 1). So the economy must choose between: 1) a local technology provided by the public enterprises, or 2) an updated –probably capital intensive-technology that uses mobile capital.

A fundamental difference of these technologies is that while capital is considered a sunk cost for public enterprises, it is not for private operators, though these conditions can be relaxed. The idea is to compare the on going model –the public enterprises technology- with a new one, more demanding in terms of capital investments.

BOX 1: Regulatory Regimes and Service Obligations in a CGE

Service obligation is interpreted as the passive adjustment of services supply to demand in the regulated sector. This assumption prevents need to rely on rationing which is quite realistic in the context of modern infrastructure reforms. If this assumption were not included, we would need to accept some form of rationing of customers (households or firms), and this will make any model much more complicated and ad-hoc.

Most regulatory regimes establish explicitly this obligation in the contract, and its violation has not only direct economic costs but also hinders on the reputation of the firm. Service obligation increases costs to the firm (real and expected) and is compensated with the tariff and, very often, with the commitment by the regulator of protecting incumbents by legally blocking the entry of new competitors. A temporary "no entry" condition is, in fact, a second important characteristics of modern infrastructure reforms, which guarantees a return on assets, when perceived commercial risk levels could be aggravated by the concern for entry and become a participation constraint for the private sector.

With the Service Obligation hypothesis, there are two possible cases. In the first case, there is enough installed capacity to cover the necessities of clients and the main issue is for the firm to get a subsidy to cover the difference between marginal cost and regulated price. In the second case, the capacity is insufficient and additional investment is needed. This second option (with constant marginal costs) is used exceptionally when demand becomes too high. For the first option, we assume that the subsidy is paid by the shareholders of the firm in the case of the price-cap regime. With this strategy, existence of equilibrium can be shown using the proofs already available for the standard general equilibrium models with taxes. The price-cap or the rate-of-return regulation can be interpreted as special mark-up rules that are in fact taxes for which the revenue accrues to (or is extracted from) the owners of the firms.

To simplify, it may be useful to complement the discussion with a graphic beginning with the model of alternative technology. In fact, Graph 1 shows the case of an alternative technology when demand (D_a) is low enough as to have excess of installed capacity. P_R and q_R denote the tariff in terms of the numeraire and the production level in the regulated sector, respectively. MC represents the marginal cost of the existing technology (the increasing segment) and an alternative technology (the constant marginal cost section of the curve), and $1/\mu$ stands for the benchmark regulated price.

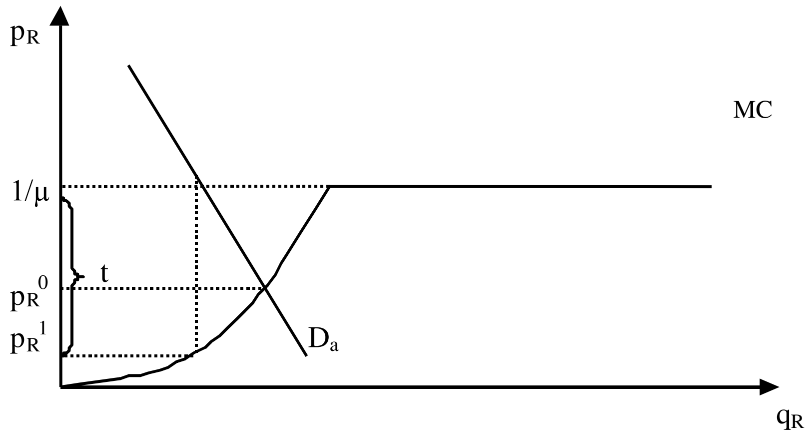
Given D_a, p_R should fall to p_R^0. However, a tax t is imposed (mark-up) to compensate owners of capital so that $p_R^1(1+t) = p_R^* = 1/\mu$.

"Tax" revenue is transferred from customers to shareholders of the regulated firm. This t could be negative as it is shown in Graph 2, that it is a subsidy s. If an alternative technology does not exist, the firm will continue operating if the additional units (A) marginal costs are covered (triangle S). Since the obligation of service was established in the original contract between the regulators and shareholders, we assume that the shareholders cover the excess of costs –implicitly in the form of a subsidy to the operative management of the firm. This internal subsidy s is depicted in the figure below; in this case s is computed so that net price to customers equals the price-cap settled at level p_R.

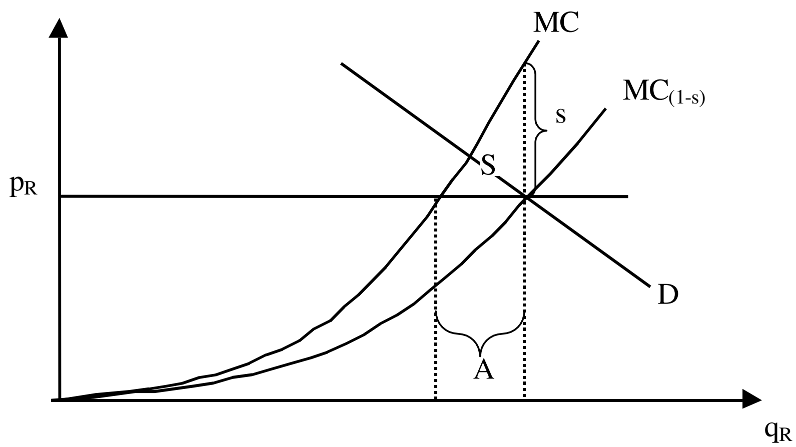
In summary, Graph 2 shows the case of an internal subsidy, funded with a tax on the shareholders of the regulated firm. When shareholders are foreign, this subsidy will be accompanied by an inflow of capital that reduces the need of trade surplus. Graph 2 also illustrates the case when the firm has the alternative of importing international capital. The incremental cost of the new technology is given by w^*A/μ, where w^* is the foreign factor reward and μ its average productivity. The firm will compare this cost with S, to choose the method for servicing the market. However, this will have consequences on the current account; if the firm covers the deficit with the existing technology there will be an inflow of capital (though temporary); instead if the alternative technology is employed, the additional reward of foreign factors will impose a burden.

The literature on existence of equilibrium with taxes –see Shoven and Whalley (1973) and Ginsburgh and Keyzer (1997)- can be used in this case with minor adaptations.

Graph 1: Non-operative price-cap



Graph 2: Subsidy and alternative technology



Source: Chisari, Estache, Lambardi y Romero (2003).

To simulate the model we will use a Social Accounting Matrix of reduced dimensions that captures the main characteristics of a developing economy, in terms of share of public services in GDP.

There is a basic structure that will be specialized to consider the public and private technologies. For the sake of presentation, the public technology is discussed first.

Each sector uses two different factors: one mobile, labor, and one non mobile, specific capital[2]. There are four domestic sectors of production (activities): I={1,2,N,R}, two of them are tradable sectors, T={1,2}, and the rest are producers of goods and

[2] A summary of the main characteristics of these models can be found in Bhagwati *et al*. (2000).

services that are not tradable; sector N produces services and sector R represents sectors under regulation.

Each activity produces only one commodity represented by J={1,2,N,R}. We assume that the utility and production functions correspond to the traditional neoclassical version. However, production sectors are related through input-output transactions, which play an important role in understanding the net impact of regulation on the economy. Prices of tradable goods are determined by the rest of the world[3], and domestic agents also import consumption goods that are imperfect substitutes of local production. In this version, it is assumed that imported goods are not used for production.

The analytical representation of the aggregated regulated sector in this section deserves more attention. Though it is natural to think that the production function of that sector should exhibit some economies of scale or sub-additivity, we will assume that there are not non-convexities once specific capital is installed. This is a simplification with obvious theoretical costs, but it also contributes to concentrate our effort in determining the impact of regulatory mechanisms and not on the properties of the production set[4]. The public technology works with installed capital. The alternative technology gives some hints on the long run effects; in that case, we assume constant returns to scale.

Domestic household.

We assume that there is an only domestic agent that makes the decision on the consumption plan and receives all factor rewards (except for the regulated firm) and profits. So, we will not be paying attention to personal income distribution matters, though we can analyze factor distribution. This agent collects also all taxes and grants subsidies. Net welfare of this household will therefore represent social welfare.

The domestic agent maximizes the utility function $u(c_1, c_2, c_N, c_R, m)$ subject to:

[3] The "small country assumption" in terms of Kehoe and Kehoe (1994).

[4] Dierker et al (1985) present an analysis of the existence of equilibrium when there are special pricing rules.

<1> $$\sum_{T} p_T c_T + p_R c_R + p_N c_N + p_m m = w\overline{L} + \sum_{I/\{R\}} r_I \overline{K}_I + \theta\pi^*_R + \theta t p_R G(L_R, K_R)$$

where θ is the share of domestic agents in profits of the regulated sector π^*_R and the last term corresponds to the compensatory transfer from domestic customers (t > 0) or to the firm from its shareholders (t < 0). Under public ownership, $\theta = 1$. In both cases, under price cap, t is computed so that $p_R = 1/\mu(1+t)$. From utility maximization, we obtain the familiar first order conditions:

<2> $$u'_{c_T} / u'_m = p_T / p_m$$

<3> $$u'_R / u'_m = p_R / p_m$$

<4> $$u'_N / u'_m = p_N / p_m$$

c_T is consumption of domestic tradable goods, c_R is the consumption of goods and services under regulation and m are imports (a good produced abroad but not domestically) and p_T, p_R and p_m are their respective prices. w is the wage rate and r_I is the rate of return on capital in each sector. $\overline{L}$ and $\overline{K}$ represent the domestic agent endowments of labor and capital.

Domestic Production Sectors

F, H and *G* are the production function of the tradable, non-tradable and regulated sectors, respectively. We assume constant returns to scales in all cases. As we mentioned, this is a simplification that helps to avoid problems of existence of equilibrium. However, in this version, once capital is sunk, it does not seem to be unrealistic.

a. Tradable Sectors

There is one firm that maximizes profits in each tradable sector. The net price for the firm is the price to consumers less the cost of intermediate inputs..

<5> $$\pi_T = \left[p_T - \sum_{J \neq T} a_{J,T} p_J - a_{R,T} p_R - a_{N,T} p_N \right] F_T(L_T, K_T) - wL_T - \sum_{T} r_T K_T$$

for every T=1,2. Notice that firms observe the incentive given by the net price after intermediate inputs costs. The maximum profit conditions are:

<6> $$\left[p_T - \sum_{J \neq T} a_{J,T} p_J - a_{R,T} p_R - a_{N,T} p_N \right] F_L = w$$

<7> $$\left[p_T - \sum_{J \neq T} a_{J,T} p_J - a_{R,T} p_R - a_{N,T} p_N\right] F_K = r_T$$

In both cases, the value of marginal product (corrected for intermediate costs) is equalized to the reward of the factor. Notice that we are not assuming export or import taxes but they can be introduced easily as ad valorem taxes.

b. Non-tradable Sector

Services and other non tradable goods are produced using labor and capital. Capital is specialized and non mobile. Equation (8) corresponds to profits definition, and equations (9) and (10) to optimization conditions:

<8> $$\pi_N = \left[p_N - \sum_T a_{T,N} p_T - a_{R,N} p_R\right] H(L_N, K_N) - wL_N - r_N K_N$$

<9> $$\left[p_N - \sum_T a_{T,N} p_T - a_{R,N} p_R\right] H_L = w$$

<10> $$\left[p_N - \sum_T a_{T,N} p_T - a_{R,N} p_R\right] H_N = r_N$$

c. Public utilities or regulated sector

As we mentioned above, the regulated firm is treated as a neoclassical firm. There is no entry and service obligations are established. Net price is obtained as the difference between the regulated price and intermediate cost.

<11> $$\pi_R = \left[p_R - \sum_T a_{T,R} p_T - a_{N,R} p_N\right] G(L_R, K_R) - wL_R$$

Notice that in this expression K_R is given. The total rate of return of this sector is $r_R = \pi_R / K_R$. The optimal condition for profits is:

<12> $$\left[p_R - \sum_T a_{T,R} p_T - b_{N,R} p_N\right] G_L = w$$

$a_{R,T}$ and $a_{T,R}$ are input-output coefficients used to represent also technical gains due to privatization. A reduction in $a_{T,R}$ is an improvement of efficiency internal to the public service firms, which reduces the requirement of intermediate inputs per unit of product. $a_{R,T}$ is a reduction of the requirement of regulated input per unit of tradable output (due to a better performance of private operators).

Rest of the world.

a. Production sectors.

The rest of the world produces substitutes for our exports and import goods, using a factor of production F. Equations (19) to (22) give an alternative technology available for foreign owners to fulfill their obligation of services, using mobile capital.

<13> $\pi^*_m = p_m \alpha(F_m) - w^* F_m$

<14> $\pi^*_T = p_T \beta_T(F_T) - w^* F_T$

<15> $p_m \alpha' = w^*$

<16> $p_T \beta'_T = w^*$

<17> $m^s = \alpha(F_m)$

<18> $x^s = \beta_T(F_T)$

In the case of α' and β'_T constants, international terms of trade will be given by $p_T / p_m = \alpha / \beta_T$ (small economy assumption).

π^*_m and π^*_T represent profits in the rest of the world industries that produce import goods and perfect substitutes of tradable goods. w^*, the numeraire, is the wage rate of the only factor used abroad.

F_m and F_T are factor quantities employed in the corresponding industries. The production functions: $\alpha(F_m)$ and $\beta_T(F_T)$ give the total supply in equations **<16>, <17>** and **<18>.**

b. Households

Consumers in the rest of the world receive the rents of foreign factors, including capital installed in the regulated sector as well as profits in that sector. It maximizes a utility function $v(x_T, m^*)$ that depends on the consumption of our tradable goods and of import goods. Their budget condition is:

<19> $$p_m m^* + p_T x_T = w^* \overline{F} + (1-\theta)\pi_R + \pi_m^* + \sum_T \pi_T^* + tp_R G(L_R, K_R)$$

Foreign agent receives profits and capital return of the regulated sector, as well as the wage rate (cost of capital) F and the proceedings of the mark-up factor. X_T are exports that are domestic tradable goods bought by the foreign agent. The last term in equation **<19>** stands for the endogenous mark-up (positive) or internal subsidy (negative) computed as the difference between the benchmark tariff 1/μ (as seen by customers) and P_R

Market equilibrium conditions

Equations (20) to (27) represent the equilibrium conditions for factors used domestically, and (28) is the equilibrium condition for the foreign factor. Equations (25) to (27) correspond to equilibrium in markets for goods: regulated, non regulated and imports.

<20> $$\overline{L} = L_1 + L_2 + L_R + L_N$$

<21> $$\overline{K}_T = K_T \qquad (T = 1,2)$$

<22> $$\overline{K}_N = K_N$$

<23> $$\overline{F} = F_m + \sum_T F_T$$

<24> $$G(L_R, K_R) + q_R = \sum_T a_{R,T} F_T(L_T, K_T) + a_{R,N} H(L_N, K_N) + c_R$$

<25> $$F_T(L_T, K_T) + x_T^s = a_{T,R} G(L_R, K_R) + a_{T,N} H(L_N, K_N) + c_T + x_T$$

<26> $$H(L_N, K_N) = \sum_T a_{N,T} F_T(L_T, K_T) + a_{N,R} G(L_R, K_R) + c_N$$

<27> $$m^s = m + m^*$$

Trade balance

We can now see how the relation between the mark-up factor (and its mechanism of adjustment) and the trade balance arises in the model. From <1>:

$$p_R c_R + \sum_{I/\{R\}} p_I c_I + p^* m = w\overline{L} + \sum_{I/\{R\}} r_I \overline{K}_I + \theta\pi_R + \theta t P_R G(L_R, K_R)$$

and since:

$$p_R c_R + \sum_{I/\{R\}} p_I c_I + px = w\overline{L} + \sum_{I/\{R\}} r_I \overline{K}_I + \pi_R + tP_R G(L_R, K_R)$$

<28> $$px - p^* m = (1-\theta)[\pi_R + tp_R G(L_R, K_R)]$$

The left hand side is the trade balance and the right hand is the foreign share in regulated sector profits.[5]

This equation shows the link between the regulatory regime and the trade account. However this presentation is too restricted. In fact, domestic ownership is not sufficient to break the dilemma; domestic agents could reveal preference for foreign assets or goods, and put pressure on the trade balance anyhow. On the other hand, foreign ownership is not necessarily a source of stress on trade surplus, for example if profits are reinvested in the country.

A more general model should include more elaboration on the domestic and foreign agents portfolio and investment decisions.

4. The Social Accounting Matrix.

To keep the model within conceptual explorations, we constructed a small SAM that reflects acceptable proportions for a developing economy with relevant state owned enterprises participation.

The SAM represents an initial condition with prevalence of the state companies' technology. More than ever, this is a theoretical exploration using numbers, in the sense of Piggott and the model is a special case of the general system presented above.

Table 1 presents the SAM. The rows show markets and the columns budgetary constraints. Notice that the subsidy granted to the public utilities in government hands is represented as a positive entry of $12973 in the corresponding column. H, PU, RW and G stand for Household, Public Utility and Rest of the World and Government, and L, K and FF for labor, specific capital and mobile capital respectively. M1 and M2 represent imports; in this version we do not have imports of intermediate goods to be used by industries.

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[5] The trade balance must compensate the current account result. Notice that it is not influenced by entrance and exit of capital "in the same period": the net impact is: - $r_R K_R$.

TABLE 1: A SAM for modeling alternative technologies

	Agriculture	Industry	Services	P.U. (old)	P.U. (new)	H	G	RW	Total
Agriculture	26,931	-18,422	-377	-163	-2	-2,058		-5,909	0
Industry	-4,479	100,285	-16,549	-4,533	-48	-55,760		-18,916	0
Services	-2,407	-18,658	168,206	-6,381	-67	-140,693			0
P.U. (old)	-605	-5,955	-5,424	23,778		-11,794			0
P.U. (new)	-7	-72	-66		285	-140			0
L	-4,832	-22,636	-64,477	-25,675	-68	117,688			0
K	-14,600	-34,542	-81,313	0	0	130,455			0
FF					-100			100	0
Subsidy				12,973			-12,973		0
Tax						-12,973	12,973		0
M1						-732		732	0
M2						-23,993		23,993	0
Total	0	0	0	0	0	0	0	0	0

The state companies technology produces slightly more than 1% of total sales of infrastructure services ($285 of $24063), and receives a subsidy from the government of about 35% of total costs. This subsidy is financed with a tax on the household's income.

5. Alternative technologies and model solutions.

The first solution involves computing the initial subsidy that maintains the state owned company working at its observed levels however its inefficiency. Service obligations are met with the installed technology, less efficient in use of intermediate inputs and labor than the imported one.

For the initial benchmark calibration we assume that L_R is used in fixed coefficients in the domestic estate company, so that instead of (12) we have the non negativity condition:

$$\sum a_{T,R} p_T + b_{N,R} p_N + a_{L,R} w - s \geq 0 \,.$$

The subsidy s is computed initially so that the excess of costs of the state owned enterprise are compensated and its production is equal to observed quantities. That is, s is determined to replicate given productions of the estate owned enterprise and of the private owned company; for example, if 70% of total production is obtained from the state owned company, and the rest from the alternative technology, s is computed to match those observed levels of production. The subsidy is financed with taxes on households income; this first simulation assumes therefore that taxes do not create costs of distortion.

The alternative technology exhibits constant returns to scale, and uses domestic intermediate inputs and mobile capital to produce the regulated good or service. For this technology we also assume fixed coefficients in this presentation, and the price is fixed at its cost of production:

$$\sum a^{*}_{T,R}\, p_T + b^{*}_{N,R} p_N + a^{*}_{L,R} w^{*} = p^{*}_{R},$$

where the *) stands for the input coefficients of the mobile capital technology, and p^{*}_{R} is the price of the infrastructure service when produced with the imported standards.

It is assumed that the rate of profit is given at the level of the cost of opportunity of capital in the rest of the world, and that capital in the regulated sector is no longer sunk. It is an implicit cost-plus mechanism with a minimum rate of return given by the international productivity of capital. In this case K_R becomes a variable to be determined; it will be included in equation (11) in the definition of profits, with a cost given by w^{*}. The variable will also enter in equation (23), since it is part of the uses of capital of the rest of the world. The trade balance equilibrium condition becomes simply:

$$p_T\, x - p_m\, m = \pi_R + w^{*} K_R.$$

Given the initial subsidy s, the simulations explore the effects of assuming reductions in w^{*}. Changes in w^{*} are compensated in order not to change relative prices of exports and imports. The model chooses the less costly between the internal cost of the subsidy and the alternative technology, to maximize welfare of the domestic household.

Table 2 shows the results of three simulations. The first two explore a threshold for the cost of mobile capital: which is the level of w^{*} such that the local public technology is substituted by the new imported technology? The first scenario contemplates full substitution and the second, only partial. Initially we calibrate the model so that 99% of the total production of utilities is provided using the old technology and only one percent with the new mobile capital; full substitution occurs when those percentages are reverted (we do not take 100% to avoid potential computational problems). It can be seen that a reduction of approximately 12% in the rate of return of the rest of the world capital leads to a full replacement, and about the half of that reduction is needed to replace half of the share. Both simulations take as given the initial subsidy for the state owned enterprise.

However, it can be argued that the subsidies is conditional to the "international price" of the service. In fact, though the public service cannot be imported, mobile capital can be internalised to produce domestically. Therefore, the cost of one unit of service produced with the new technology puts an implicit cap on the domestic price of services. In that case, a reduction of w^* could be followed by further reductions in s, unless there is a quota or explicit ban to imports.

The subsidy s is an implicit rent of a sunk factor, and this explains why admitting that it is endogenous could not lead to a substitution of the technology.

That is why we consider the third simulation. Instead of reducing w^* we consider reductions in the subsidy s for a given level of the cost of mobile capital. Notice that in this case, the old and public technology is fully substituted when the subsidy is reduced 15%.

The results of reductions in the cost of mobile capital and in subsidies given to old public companies are shown as gains both in GDP and in households´ welfare. The latter is computed as the Equivalent Variation. When the new technology is fully adopted, households enjoy welfare levels that are equivalent to initial income increases of 5.6% and 5%.

It can be seen however that the new technology adoption is demanding for the trade balance and requires additional export effort by the economy; this effort is equivalent to w^*K_R since we assume that we are in a stationary state, so that initial entry of capital $+K_R$ is compensated in the same period with an outflow $-K_R$; when the reimbursement of the principal encompasses several periods, the stress on the forthcoming trade balances will be higher and the net effect will depend also on the gains obtained with the initial inflows and the uses given to those funds.

Table 2 also alerts on potential conflicts. Nominal and real wages fell in all scenarios; this is due to the need of rewarding mobile capital. Since labour is not mobile it must face -directly or indirectly- the costs of "purchasing" the new technology.

It is important to remember that these simulations have been performed using non distortionary taxation and so we should expect faster substitution when taxes on subsets of goods are not charged, or when the tax structure is not even.

TABLE 2: Results of simulations

	Simulation 1: Foreign Capital Price Reduction until domestic production is replaced	Simulation 2: Foreign Capital Price Reduction until **half** domestic production is replaced	Simulation 3: Domestic subsidy reduction until domestic production is replaced
GDP (% variation)	**7.2**	**3.8**	**7.1**
Agriculture	4.5	2.3	4.8
Industry	11.3	5.8	11.6
Services	6.6	3.4	6.5
Public Utilities	3.5	2.4	2.5
Old Tech. Participation in Public utilities production (benchmark 99%)	1%	50%	1%
New Tech. Participation in Public utilities production (benchmark 1%)	99%	50%	99%
RPI (% variation)	**-3.0**	**-1.6**	**-3.2**
Agriculture	0.4	0.2	0.4
Industry	1.1	0.6	0.9
Services	-4.0	-2.2	-4.8
Public Utilities	-8.8	-4.7	-4.4
Exports (% variation)	**44.3**	**23.1**	**48.5**
Imports (% variation)	**5.6**	**2.8**	**5.0**
Household Welfare (% variation)	**5.6**	**2.8**	**5**
Foreign Capital Price (% variation)	**-11.6**	**-6.2**	**0**
Domestic Subsidy (% variation)	**-**	**-**	**-15.4**
Rate of Return (% variation)	**6.1**	**3.1**	**5.2**
Agriculture	5.4	2.8	5.6
Industry	15.7	8	15.2
Services	2.2	1	0.8
Wages (% variation)	**-11.7**	**-6.3**	**-12.6**

6. Lessons from the exercises.

The simulations confirm that the choice of the technology to be used for servicing infrastructure depends on deep parameters of efficiency and costs.

It does not say why state owned companies could be more inefficient than private ones, but given those inefficiencies that create costs in terms of resources and distortions, the choice of the technology is not necessarily determined; it depends on the magnitude of waste and on the costs in the allocation of resources relative to the price of mobile capital (and implicitly on the export effort of the country).

The model shows that there are plausible scenarios where the selection is not unique.

We have left aside additional characteristics related to the technologies that could favour one or the other. For example, corruption and passive deficit could lead to hyperinflation in a context of state owned enterprises, or chronic misallocation of resources reduce investments and destroy the base of capital of government companies. Also, we have not considered potential constraints on less developing countries exports, that could also increase significantly the cost of raising foreign currency to honour the payment of dividends to mobile capital.

We have not considered the possibility of using domestic capital to produce the service of infrastructure; the idea was to consider extreme cases that could give a confirmation of the basic intuition, and to check that that intuition was not rejected by general equilibrium effects.

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