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PRIVATIZATION, PUBLIC DEFICIT FINANCE, AND INVESTMENT IN INFRASTRUCTURE

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ABSTRACT

Privatization, Public Deficit Finance, and Investment in Infrastructure*

The paper presents a theoretical analysis of the relationship between privatization and public deficit finance. We examine the optimal magnitude of public asset sales and the extent to which privatization can be used to reduce taxes, or, to retire public debt, for two cases. In the first, standard case, privatization proceeds are used directly to finance the public deficit, while in the second they are used in cost-reducing public investment in infrastructure. In the latter case the government gains through smaller deficits of remaining public firms, higher proceeds from profit taxation and a smaller net employment loss. We find that the second case will often be associated with lower taxes for any given number of privatizations and a greater optimal number of privatizations than the first.

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NON-TECHNICAL SUMMARY

Privatization has become the cornerstone of economic policy in several countries with either an advanced economy or in the period of transition towards one. The main argument for privatization is that it can enhance efficiency and thus improve economic welfare. Privatization has not always been undertaken for the sake of enhancing the long-run efficiency of the economy, however. In some countries privatization has either explicitly or implicitly been associated with public deficits and the size of the public debt.

This paper presents a theoretical analysis of the relationship between privatization and public finance. Using a model in which the optimal magnitude of public asset sales is endogenous, we examine the extent to which privatization can be used to reduce taxes, or, to retire public debt, for two cases. In the first, standard case, privatization proceeds are used directly to finance the public deficit, while in the second they are used in cost-reducing public investment in infrastructure. In the latter case the government gains through smaller deficits of remaining public firms, higher proceeds from profit taxation and a smaller net employment loss. Whether or not, and the extent to which, taxes can be reduced or public debt retired, and the optimal degree of privatization in each case are shown to depend on a number of interacting factors. Of particular importance are the initial conditions with regard to public debt, the labour market, the quality of infrastructure, the potential scope of the privatization programme, the corporate tax rate, and the unemployment benefit rate, also the factors that determine the effect on employment, the size of revenue proceeds, and the efficiency effects of privatization – the structure of the markets in which public firms operate, the extent of public firm inefficiency, and public firm objectives.

We find that the second case will often be associated with a lower wage tax rate for any given number of privatizations and a greater optimal number of privatizations than the first. This is more likely the sharper the reduction in firms' costs from infrastructural investment (as is likely when the quality of infrastructure is initially low), the greater the scale of the privatization programme, the greater the employment gains generated by infrastructural investment and the more monopolistic the market structure (leading to a high employment loss from privatization). It is particularly interesting to note that these circumstances are exactly those characterizing Central and East European countries. Thus our analysis suggests that the second scenario should be given more careful consideration by policy-makers in these countries.

1. INTRODUCTION

Privatisation has become the cornerstone of economic policy in several countries, with either an advanced market economy or in a period of transition towards one. The main argument advanced by proponents of privatisation is that it can enhance efficiency and thus improve economic welfare.[1] However, this does not fully reflect reality, neither in the public debate arguments over privatisation, nor in the extent to which privatisation has been actually implemented.

An important reason for this is that privatisation is not always undertaken solely, or even primarily, for the sake of enhancing long-run efficiency. In not a few countries privatisation was basically seen as a last-ditch attempt to collect state revenues when other more orthodox methods aiming to restrict spending or expand the tax-base were not forthcoming. As a number of examples clearly indicate, in both developed and less-developed countries privatisation was either explicitly or implicitly associated with the size of the public debt.

This has been true in the UK (Vickers and Yarrow, 1987) and the USA, where, as Goodman and Loveman (1991) describe in a recent article "...privatisation was a *central* piece of the Reagan's Administration efforts to reduce the size of government and balance the budget" (our emphasis). In Italy large-scale privatisation is seen by Favero et.al. (1992) as the country's only chance to reduce the soaring public debt and qualify for entry to the European Monetary Union. In Greece, whilst before the 1990 elections the New Democracy Party was advocating full-scale privatisation on efficiency grounds, after assuming office, the main argument to keep the plan alive has been that state finances are virtually bankrupt and public firms have to be sold to escape the liquidity crisis.

A similar situation is observed in Eastern European countries.

Privatisation in Hungary was speeded up partly in order to remedy the enlarging public deficit (Grosfeld and Hare, 1991). In Poland the privatisation programme was largely dictated by the inability of the state to continue subsidising ailing public firms.

Despite the above, the relationship between privatisation and public deficit finance has not as yet being subject to theoretical analysis. We believe that this has had serious implications for public policy proposals that have suffered from a number of weaknesess, among which perhaps the most important are:

(i) The use, explicitly or implicitly, of the (wrong) hypothesis that, the sale of public assets will *always* reduce the public deficit and will make possible some public debt retirement (at least if the returns to the state from holding the existing public assets are neglected, which are in any case, at least in Eastern Europe, likely to be small or negative).

(ii) The attempt to infer the desired extent of privatisation by refernce to an exogenous target level of public debt (or debt-GDP ratio).

(iii) Very importantly, the neglect of alternative scenaria of using revenue proceeds from privatisation.

These weaknesses are the result of neglecting some important factors. One such factor is that privatisation is likely to affect the unemployment rate, and therefore, the size of unemployment benefits and of taxable labour income. This is very important in determining the extent to which or whether privatisation can or cannot reduce the public deficit. Even if the latter *can* be reduced, it is unlikely that a government will be able to fully exploit this to retire public debt: to compensate for the loss of utility from the rise in unemployment the government will have, at least in part, to reduce taxes. Further, alternative scenaria of using privatisation proceeds will have different implications for unemployment and tax revenues for any given number of privatisations.

To take into account these factors we construct a model in which the optimal extent of privatisation is endogenous. We use a government objective function expressed as the expected income utility of the average citizen (voter). This allows us to endogenise, what one may call, "the politically feasible" retirement of public debt as a result of public asset selling.

We examine the extent to which privatisation can be used to reduce taxes, or, to retire public debt, for two scenaria: in the first, privatisation proceeds are simply used to finance the public deficit, whilst in the second they are used in cost-reducing public investment in infrastructure. In the latter case the government gains through smaller deficits of remaining public firms, higher proceeds from profit taxation and a smaller net employment loss. A scenario may be preferable to the government because it allows a lower tax rate even though the other scenario leads to a higher optimal number of privatisations and thus may be more attractive on social welfare grounds.

Whether or not, and the extent to which, taxes can be reduced or public debt retired, and the optimal degree of privatisation are shown to depend on a number of interacting factors. Of particular importance are the initial conditions with regard to public debt, the labour market and the wage rate, the quality of infrastructure, the potential scope of the privatisation programme, the corporate tax rate, and the unemployment benefit; also the factors that determine the effect on employment, the size of revenue proceeds, and the efficiency effects of privatisation - the structure of the markets in which public firms operate, the extent of public firm inefficiency, and public firm objectives.

Generally, privatisations will be relatively less attractive, the *higher* the public debt, the tighter the labour market (as reflected in the size of the labour supply), the greater the unemployment benefit, the smaller the anticipated profit flows of privatised firms and the larger the unemployment created by privatisations. Unemployment will depend on a number of factors: the relative efficiency of public and private firms, market structure and the exact objective of the public firms. Given the latter, unemployment will rise most when public firms are monopolies (as is usually the case in Eastern Europe) that are relatively (though not exteremely) inefficient.

The optimal extent of privatisation in our two scenaria and which of them is preferable will depend crucially, on the profitability of the privatised firms, on the corporate tax rate, on the rate of cost improvement from infrastructural investment, on the scale of the privatisation programme, and on the relative loss of employment per privatisation under each scenario. Scenario 2 will be often associated with a *lower* wage tax rate for any given number of privatisations than scenario 1, *and a higher* optimal number of privatisations. This is more likely the sharper the reduction in firms' costs from infrastructural investment (as is likely when the quality of infrastructure is initially low), the greater the scale of the privatisation programme, the greater the employment gains generated by infrastructural investment and the more monopolistic the market structure (leading to a high employment loss from privatisation). It is particularly interesting to note that these circumstances are exactly those characterising Eastern European economies. Thus our analysis suggests that scenario 2 should be given more careful consideration by policy makers in these countries.

In the next section we set out our model and in Section 3 we characterise and then compare the outcomes of our two scenaria. Conclusions and suggestions for further research are drawn in Section 4.

2. THE MODEL AND CHARACTERISATION OF EQUILIBRIUM

2.1 Basic assumptions

We consider an economy consisting of N distinct homogeneous product industries. In each industry there are m+1 firms: $m \geq 0$ private and one public.[2] Thus N is the parameter that measures the scope or potential scale of the privatisation programme, whilst if m is zero the industry is a public monopoly. We will indicate the private firms by subscript 'E' and the public by subscript 'P'.

Producing a unit of a product requires $l_E(l_P)$ units of labour if the firm is private (public). Thus, if q is a firm's output w is the wage rate and f the fixed cost of production the firm's cost function is:

$$C(q_i) = f + wl_iq_i \qquad i=E,P$$

that is, we assume that l_i is the same across industries. So the marginal and unit variable cost is, $c_i = wl_i$, $i=E,P$. For further convenience we will use c (rather than c_E) to represent the marginal cost of private firms and we will assume that $l_P \geq l_E$, so that $c \leq c_P$. Thus, public firms are less efficient than private firms.

2.2 The Nash equilibrium in a typical industry before and after privatisation

A simple and convenient way to describe a "mixed oligopoly" (an industry with private and public firms) is to assume that each private firm maximises profits whilst the public firm maximises a weighted average of profits and social surplus. Assuming a linear demand function:

$$p = \delta - Q, \quad \delta>0 \quad \text{where } Q = q_p + \sum_{s=1}^{n} q_s$$

the gross social suplus is given by $\int(\delta\text{-}Q)\ dQ = \delta Q - (1/2)Q^2$. Neglecting fixed cost, the objective of a private firm, s, $s=1,\dots,m$ is: $\max_{q_s} \Pi_s = (p-c)q_s$, whilst that of a public firm is: $\max_{q_s} \{\lambda(p-c_p)q_p + (1-\lambda)[(\delta-\frac{1}{2}Q)Q - c_pq_p - mcq_E]$, where $0 \leq \lambda \leq 1$. It can easily be shown that[3] given λ, the solution in a Nash Equilibrium (NE) is:

$$q_p = [\delta-c-(m+1)(c_p-c]/[1+\lambda(m+1)] \qquad (1)$$

$$q_E = [\lambda(\delta-c) + (c_p-c)]/[1+\lambda(m+1)] \qquad (2)$$

Thus:

$$Q = [(1+\lambda m)(\delta-c) - (c_p-c)]/[1+\lambda(m+1)] \qquad (3)$$

$$p = [\lambda(\delta+mc) + c_p]/[1+\lambda(m+1)] \qquad (4)$$

$$\Pi_p = \lambda[(\delta-c) - (m+1)(c_p-c)]^2/[1+\lambda(m+1)]^2 \qquad (5)$$

and

$$\Pi_E = [\lambda(\delta-c) + (c_p-c)]^2/[1+\lambda(m+1)]^2 \qquad (6)$$

We assume that λ is set by the government prior to quantity competition. Its value will depend on the government's objectives vis a vis public firms, and given this on the relative efficiency $(c_p - c)$ and the number of firms, m. Rather than specify these objectives, we will assume, without loss of generality, that $\lambda^* = 0$ is the value chosen by the government. It is straightforward though tedious to show that, if for distributional considerations the government gives greater weight to consumers' surplus than profits, then for appropriate values of $(c_p - c)$ and m, this *would* be the value chosen by a government that wished to maximise social welfare in the quantity competition stage.[4] Setting $\lambda = 0$ implies, from (5) above, that in each of the N industries the government has to meet a deficit of:

$$[f - \Pi_p(\lambda^*)] = f \qquad (7)$$

or, a total public enterprise deficit, of Nf.

The advantage of the above approach in modelling a "mixed oligopoly" is that we can immediately see what the NE in a typical industry will be *after* privatisation. We will use superscript "A" to describe values after privatisation. Once a firm is privatised, it maximises profit, with λ set at unity. Further, following its privatisation a firm is restructured and, as a result of this, its marginal cost falls to c. From (5) or (6), when $c_p = c$, and $\lambda = 1$, in the NE solution profits per firm will be:

$$\Pi^A = (\delta-c)^2/(2+m)^2 \qquad (8)$$

whilst from (1) or (2): $q^A = (\delta-c) / (2+m)$ (9)

Also, from (3): $Q^A = (1+m)(\delta-c)/(2+m)$ (10)

and from (4): $p^A = [\delta+(m+1)c]/(2+m)$ (11)

which is the standard Cournot-Nash symmetric equilibrium with (m+1) firms. We assume that $\Pi^A > f$.

To make the analysis interesting, we will assume that it *is* social welfare improving to privatise all public firms, account being taken of the change in the firms' objective. Measuring social welfare as the sum of consumers' surplus and profit it is straightforward to check, by comparing social welfare prior to (with $\lambda = 0$ and $c_p > c$) and after privatisation (with $\lambda = 1$ and $c_p = c$), that the increase in efficiency from privatisation could increase social welfare for appropriate values of $(c_p - c)$ and m.[5] (In the public monopoly case, m = 0, this will be so for sufficiently large $(c_p - c)$). Of course, here, we are implicitly assuming that privatisation is *necessary* for an increase in efficiency.

Note that even though it is socially optimal to privatise all public firms, we will argue below that a government subject to periodic elections may not seek to maximise social welfare as its objective in choosing the optimal number of privatisations. Hence the scale of privatisation may well fall short of the social welfare maximising level.

2.3 The Labour Market

Labour employment by firm i, i=E,P, is $l_i q_i$. Thus, in a NE, total labour demand, L_d, in the industry will be:

$$L_d = N(ml_E q_E + l_P q_P) \qquad (12)$$

Industry output in NE will be $Q = [mq_E + q_p]$. With $\lambda = 0$, $q_E = c_p\text{-}c$ and $q_p = (\delta\text{-}c) - (m+1)(c_p\text{-}c)$, where $c_p\text{-}c = w(l_p\text{-}l_E)$ and $c = wl_E$. Substituting into (12) and rearranging gives:

$$L_d = N[\delta l_p - w\xi] \qquad (13)$$

where: $$\xi = m(l_p - l_E)^2 + l_p^2 > 0 \qquad (14)$$

Thus, $(dL_d/dw) < 0$ and as we would expect labour demand falls with the wage rate. Equilibrium employment and the wage rate can be obtained from the labour market equilibrium condition $L_d = L_s$ where L_s is labour supply. We will assume for simplicity, and without affecting any of our results, that L_s is a constant indicating the number of workers supplying inelastically one unit of labour. Then w, the worker's labour income is given in equilibrium by w^* where:

$$w^* = [N\delta l_p - L_s] / N\xi\psi \qquad (15)$$

where, of course, we assume that $N\delta l_p > L_s$.

2.4 The Government Budget Constraint

Neglecting for convenience all other kinds of expenditure, we take total government expenditure to be given by:

$$G = Nf + D \qquad (16)$$

where D indicates the amount required to serve accumulated debt[6]. Thus if the value of the debt is $\bar{D}$, $D = r\bar{D}$, where r is the rate of interest. We will think of $\bar{D}$ as the value of outstanding perpetuities issued by the state in the past.

We assume that tax revenues are given by:

$$T = w\upsilon L + \tau mN(\Pi_E - f) \qquad (17)$$

where υ is the rate of wage income tax, and τ the rate of profit tax. Take-home pay is therefore $\tilde{w} = (1 - \upsilon)w$. Abstracting from money creation and bond finance, and given τ, the wage tax rate υ that will balance the budget, is given by:

$$\upsilon = [fN + D - \tau mN(\Pi_E - f)]/ wL \qquad (18)$$

The equilibrium value of υ can be obtained by substituting for w^* from (15). We can then solve for the equilibrium take - home pay $\tilde{w}^* = (1 - \upsilon^*)w^*$.

2.5 The government objective function

We assume that in deciding on the optimal number of firms to be privatised (N_E) the government maximises the expected utility from income of the average citizen (voter), that is, neglecting profit and interest income, it maximises:

$$\max_{N_E} W(N_E) = hU(b) + (1-h)\, U(w(1-\upsilon)) \qquad (19)$$

where $U(y)$ is the utility from income y, with $U'>0$, $U''\leq 0$, b is the unemployment benefit, and h is the probability of being unemployed after privatisation. That is:

$$h = \max[0, (L_s - L_d^A) / L_s] \qquad (20)$$

This is the formulation also used in Roland and Verdier (1991). Implicit in this formulation is the assumption of wage rigidity so that the wage rate remains fixed after privatisation. Alternatively, we could have assumed that the labour market always clears, i.e. $h = 0$, and the government maximises the utility of take-home pay. The formulation in (19) seems more reasonable in view of the well-known imperfections in the functioning of the labour market and the implementation of wage freezes during stabilisation programmes in several countries and, further, (19) is consistent with our hypothesis that public firms choose output by maximising social welfare.[7] Thus, L_d^A is labour employment after privatisation at the initial wage, which we assume to be the full employment wage rate before privatisation given by (15). Finally note that we assume that the unemployment benefit b is constant, untaxed, and remains strictly lower than take-home wage.

3. THE EFFECTS OF PRIVATISATION

3.1 The labour market after privatisation

Assuming that $N_E \leq N$ firms are privatised and then restructured labour demand in a typical industry after privatisation is given by:

$$L_d^A = N_E l_E q^A(1+m)+(N-N_E)[m\ l_E q_E + l_p q_p] \qquad (21)$$

Rearranging (21), noting (from (12)-(13)) that $N[ml_E q_E + l_p q_p] = N[\delta l_p - w\xi]$ $= L_s = L_d$ = total labour demand before privatisation, we get:

$$L_d^A = L_s - N_E\left\{\delta[l_p - ((1+m)/(2+m))l_E] + wl_E^2[(1+m)/(2+m)] - w\xi\right\} \qquad (22)$$

Alternatively, (21) can be written as follows:

$$L_d^A = L_s - N_E\{l_E(Q - Q^A) + q_p(l_p - l_E)\} \qquad (23)$$

where $(Q - Q^A)$ is the difference between pre- and post-privatisation industry output. It is clear from (21), given (9) and the fact that from (12)-(13), $ml_E q_E + l_p q_p = \delta l_p - w\xi$, that as shown in Figure 1, L_d^A is steeper than L_d.

Figure 1

As shown in Figure 1 two situations are possible, depending on whether the L_s line lies to the right or to the left of the intersection where $L_d^A = L_d$. If it lies to the right of this point then privatisation leads to unemployment. To see the conditions required for this outcome, recall that, at the initial wage, by assumption, $L_d = N\delta l_p - wN\xi\psi = L_s$. From (23), let:

$$\chi(w) = \{l_E(Q - Q^A) + q_p(l_p - l_E)\} \qquad (24)$$

Alternatively, using the fact that with $\lambda = 0$, $Q = \delta - c_p$, the value of q^A given by (9), the value of q_p given by (1) for $\lambda = 0$, and that at the initial wage $c_p - c = w^*(l_p - l_E)$ we get:

$$\chi(w) = q_p(l_p - l_E) + [l_E/(2+m)][q_p - w^*(l_p - l_E)] \qquad (25)$$

Thus from (23):

$$L_d^A(w^*) = L_s - \chi(w^*)N_E j \qquad (26)$$

Lemma 1: A necessary and sufficient condition for privatisation to lead to unemployment is that $\chi(w^*)$ given by (24) or (25) is positive. As (24) indicates a sufficient (but *not* a necessary) condition for this to hold is that at the initial wage $Q > Q^A$, that is, that privatisation reduces industry output. From (3), with $\lambda = 0$, and (10), the latter requires that $(\delta - c) - (c_p - c)(2+m) > 0$, that is that m and $(c_p - c)$ are not both very large, or, the public firm's market share is not very small.

Remark: Note that even if the last condition holds, and privatisation reduces industry output (and thus consumers' surplus), this is consistent with our assumption that it increases social welfare since the latter includes profit. Of course we do not want to put too much emphasis on such cases. Instead, we mainly have in mind cases where privatisation creates unemployment ($\chi(w^*) > 0$), though it does *not* reduce industry output ($Q^A \geq Q$) and it increases social welfare. This would, for example, result if $\delta = 22$, $c = l_E = 1$, $c_p = l_p = 3$, $m = 9$ ($w^* = 1$, $L_s = 21N$): then, $q_p = 1$, $Q = 19 < Q^A = 19.09$, $\chi = 1.9$ and social welfare increases. In many instances, in for example Eastern Europe, it would be reasonable to assume that $m = 0$: such (public monopoly) cases, easily satisfy the above requirement when $c_p - c$ is sufficiently large.

Since for most of our analysis we will be assuming that $\chi > 0$, we will use the convention of referring to χ as *unemployment per privatisation.*

Lemma 2: (a) Unemployment per privatisation, χ, is likely to be larger the smaller the number of firms, m, in the industry. Thus privatisation is most likely to increase unemployment when there are no previously private firms - exactly the situation in Eastern Europe. (b) When m is small, an increase in c_p relative to c will first increase unemployment per privatisation χ, and will reduce it after a sufficiently large c_p - thus privatising a public monopoly will generate more unemployment if the firm is relatively (but not too) inefficient. If m is very large, χ will continuously decrease with c_p -

in other words, privatising very inefficient public firms *with very small market share* will generate little unemployment.

This Lemma is also illustrated in Figure 2, where we have depicted χ as a function of $(c_p\text{-}c)$ for two cases: in one $m = 0$ and in the other m is large.

Figure 2

Proof: These results follow by differentiating χ, given by (24), with respect to m and c_p (or l_p, where $c_p = wl_p$). It is perhaps worthwhile noting that when public and private firms are equally efficient, i.e. $l_p = l_E$, privatisations will create unemployment. The explanation for this is that privatisations are here assumed to lead to a change in the privatised firms' objectives and a subsequent increase in λ, which results, all other things equal, to a decrease in industry output[8]. The effect of privatisation on the labour market is the subject of a recent paper by Haskel and Szymanski (1991) who use empirical evidence from the UK to confirm that privatisation leads to a reduction in employment.

3.2 The proceeds from privatisation

Equation (8) gives the gross profit flow of a privatised firm after restructuring. Let $z = (1/r)$ be the discount factor. We will take the government revenue proceeds, ρ, from privatising a public firm without any prior restructuring to be a fraction α, $0 < \alpha \leq 1$, of the capitalised value of the net expected profit flows of the privatised firm, that is:

$$\rho = (1-\tau)\alpha z(\Pi^A - f) \qquad (27)$$

where for simplicity we neglect the cost of restructuring. Remember that Π^A is greater than what the government can earn by retaining its equity in the public firm, by the assumption that privatisation is necessary to increase the efficiency of the firm[9]. This and a number of other factors will ensure that, in practice, the fraction α will be less than unity. For this reason we shall call α the *undervaluation parameter.* We mention two of these factors here.

First, this will be the case because π^A is unlikely to be known with certainty and potential bidders for the firms to be privatised are likely to be risk-averse. Thus ϱ can be thought of as the maximum that investors are prepared to pay. π^A is unlikely to be known with certainty if the cost reductions associated with restructuring are the result of a large number of production and organisational changes that make the nature, potential extent, impact and required duration of restructuring, unknown with certainty prior to the process of restructuring being complete. It seems reasonable to assume that, in practice, the more efficient and profitable has been the public firm to be privatised the smaller the magnitude of the required restructuring and, because of this, the smaller the uncertainty about the magnitude of potential cost reductions. Hence the smaller will be the variability of future profit flows. Thus: (a) the value of the parameter α is larger the more efficient (relative to the potential maximum) is the firm to be privatised, and, (b) the value of α would be higher were the firm sold after being restructured.

Secondly, α is likely to depend on other objectives of the government not explicitly taken into account here: for example, if the government wishes to maximise share ownership it is likely to deliberately underprice the firm. If, as in some Eastern European countries, the government operates a voucher scheme then essentially, assuming away uncertainty, it freely distributes shares of value equal to $(1 - \alpha)$ of the capitalised value of the firm to be privatised and receives in revenue a fraction α of that value.

3.3 The price level after privatisation

We can compare the equilibrium price in a typical industry before and after privatisation using equations (4) and (11). Under our assumption that $\lambda = 0$ we have:

$$p \gtrless p^A \quad \text{as} \quad (\delta - \bar{c}_p) - (m+1)(c_p - c) \lessgtr 0$$

Since in this paper we not concerned with issues related to the effects of privatisation on the price level we will, throughout the following discussion, make the benchmark assumption that $p \cong p^A$, that is that prices and hence aggregate output are broadly unaffected by privatisation. The condition for this is consistent with all our other assumptions (in particular, the creation of unemployment as a result of restructuring, and the increase in social welfare - due to the increase in profits). Further, this assumption is broadly consistent with empirical evidence indicating that whilst privatisation leads to a rise in productivity and losses in employment it induces higher profits rather than lower prices (see, for example, Haskel and Szymanski, 1991).

3.4 Alternative uses of privatisation proceeds

There are various approaches a government could follow in relation to the way it uses revenue proceeds from privatisation. We mention the following scenaria which we then examine in detail:

1) The government can use the revenue proceeds from privatising public firms directly to reduce the public deficit.

2) The government can use the revenue proceeds to "invest in infrastructure". This can be interpreted in various ways. Here we will think of investment in infrustructure as resulting in a reduction in the firms' costs.

3.5 Privatisations and Public Deficit Finance (Scenario 1)

If N_E firms are privatised and R_g (to be explicitly defined below) is the net gain in government spending per privatisation, the government budget constraint can be written as:

$$Nf + D + D_r - N_E R_g = w\upsilon^A L^A + CT \qquad (28)$$

where, from now on, w will indicate the benchmark pre-privatisation full - employment wage rate, L^A is employment after N_E firms are privatised, υ^A the wage tax rate after privatisation, CT are proceeds from corporate taxation, and $D_r \leq \bar{D}$ is the amount of debt retirement undertaken by the government.

We will assume for convenience that the constant tax rate on profits, τ, does not change after privatisation. Expression (28) then makes clear that, given the corporate taxe rate, and if employment does not fall very much, proceeds can be used to reduce wage taxes or to retire public debt, or both.

Below we undertake our analysis on the basis of the simplifying assumption that the government uses privatisation to reduce wage taxes, so we set $D_r = 0$. The justification for this is that the government's objective function is defined in terms of the average voter's utility from income which depends on taxation and not on the size of public debt. This allows us to determine the *maximum potential impact of privatisation on wage taxation*, which has the advantage that, if this is found to be negative, then privatisation will certainly not be undertaken. Of course, as we shall see, we will still be able to determine what we shall call the "politically feasible amount of debt retirement", once we have determined the maximum potential size of tax reduction from privatisation.

Given the above remarks, we now proceed to define more explicitly the government budget constraint in scenario 1. Government expenditure after privatisation in scenario 1 is given by G_1^A, where:

$$G_1^A = D + f(N - N_{E1}) + b(L_s - L_1^A) - \rho N_{E1} \qquad (29)$$

where L_1^A is labour employment after privatisation in scenario 1, with L^A = $\min(L_d^A, L_s)$ and N_{E1} is the number of firms to be privatised. Strictly speaking, privatisation proceeds reduce public debt and thus they reduce the deficit by $r(\bar{D} - \rho N_E)$ where $\bar{D}$ is public debt. However below, for simplicity and without loss of generality, we ignore r by setting it equal to unity. Using (26), and indicating by G_0 government expenditure prior to privatisations (given by (16)), we can rewrite (29) as follows:

$$G_1^A = G_0 - N_E(\rho + f - \chi b) \qquad (30).$$

We will use R_g to indicate the *net gain in government spending per privatisation*, that is: $R_g = \rho + f - \chi b$ (31)

χb being the amount that has to be spent on unemployment benefit per privatisation. Hence: $G_1^A = G_0 - N_{E1}R_g$ (32).

After privatisation, in scenario 1, total tax receipts are given by:

$$T_1^A = w\upsilon_1^A L_1^A + \tau(1+m)N_{E1}(\Pi^A - f) + \tau m(N - N_{E1})(\Pi_E - f) \qquad (33)$$

Again, υ_1^A must equate G_1^A and T_1^A, so that from (30) and (33) we get:

$$\upsilon_1^A(N_E) = [G_0 - N_{E1}R_g - \tau(1+m)N_{E1}(\Pi^A - f) - \tau m(N - N_{E1})(\Pi_E - f)]/wL_1^A \qquad (34)$$

By comparison to (17) we note that privatisation changes profit taxation proceeds by $\Delta CT = [(1+m)(\Pi^A - f) - m(\Pi_E - f)]\tau N_{E1}$. This is certainly non-negative when m = 0, or when privatisation does not reduce firms' profit ($\Pi^A \geq \Pi_E$). We will use β to indicate the term in square brackets and we will henceforth assume that:

$$\beta = (1+m)(\Pi^A - f) - m(\Pi_E - f) \geq 0 \qquad (33')$$

so that $\Delta CT \geq 0$. Finally, we will use R to indicate the *net financial gain per privatisation*, that is, $R = R_g + \tau\beta$, or:

$$R = \rho + f - \chi b + \tau\beta \qquad (31')$$

Thus, since $\rho = (1-\tau)\alpha z(\Pi^A - f)$, the net gain per privatisation increases with the expected post-privatisation profit (Π^A), the undervaluation parameter (α), the burden to the government deficit per public enterprise (f), and the corporate tax rate (τ); it decreases with unemployment per privatisation (χ), and the unemployment benefit.

We now can state the following results:

Proposition 1: It is sufficient (though not necessary) to engage in full - scale privatisation ($N^*_{E1} = N$) that privatisations increase labour demand at the initial full-employment wage (i.e. $\chi \leq 0$). .

Proof: This will hold if privatisation always increases the expected utility from income of the average citizen, $W(N_E)$. From the objective function (19), generally:

$$(\partial W/\partial N_E) = -(U'/L_s)[\chi(\Delta U/U') + wL^A(\partial \upsilon^A/\partial N_E)] \qquad (35)$$

where $\tilde{w} = w[1-\upsilon(N_E)]$, $\Delta U = U(\tilde{w}) - U(b) > 0$, $U' = (\partial U/\partial \tilde{w})$ and we have used the fact that $(1-h) = \min[1, (L^A_d/L_s)]$. When $\chi \leq 0$, we have that $h = 0$, so under scenario 1, $L^A_1 = L_s \leq L^A_{d1}$, and $R > 0$. Thus, from (34), $(\partial \upsilon^A_1/\partial N_{E1}) = -(R/wL_s) < 0$. Hence $(\partial W_1/\partial N_{E1})$ is everywhere positive. QED.

As already indicated (Lemma 2) a sufficient condition for $\chi \leq 0$ is that $(c_p - c)$ is large and/or the number of firms m is very large. In this case q_p is very small ($q_p < q_E$) even if the public firm is a social-welfare maximiser, and privatisation increases total industry output ($Q^A > Q$). Thus Proposition 1 suggests that the privatisation of inefficient public firms *with small market shares* is likely to be optimal. This is however a rather uninteresting case. First, even if, as we assume, such firms are viable after privatisation, they are likely to generate very small financial gains (very small R) so their effect is likely to be negligible. Second, such a case is not very realistic, given that public firms (irrespective of efficiency) are more likely to be monopolies or dominate their markets as a result of institutional barriers to competition.

We now turn to the, more interesting and realistic, case where $\chi > 0$. From Lemma 2, this is most likely to hold when there are a few or no other firms prior to privatisation or, if m is large, when public firms are not too inefficient.

Lemma 3: If $\chi > 0$, a necessary condition for the optimal number of privatisations, N^*_{E1}, to be positive is that the wage tax rate is reduced with privatisations, that is that $\upsilon^A_1(N_{E1})$ is a decreasing function.

Proof: This is again obvious from (35): if $\chi > 0$, $(\partial W_1/\partial N_{E1}) < 0$ and $N^*_{E1} = 0$ for as long as $(\partial\upsilon^A_1/\partial N_{E1}) \geq 0$. This Lemma expresses a very reasonable condition: it says that, if privatisation increases unemployment, it will only be undertaken by a government that maximises its citizens' expected utility from income, if it leads to an increase in take-home pay for those remaining in employment.

We now need therefore to characterise the function $\upsilon^A_1(N_E)$.

Lemma 4: A necessary and sufficient condition for $\upsilon^A_1(N_{E1})$ to be a continuously decreasing convex function is that:

$$\chi[G_0 - \tau mN(\Pi_E - f)] - RL_s < 0 \qquad (36).$$

Proof: From (34) it is easily seen by differentiation that:

$$(\partial\upsilon^A_1/\partial N_{E1}) = [1/w(L^A_1)^2]\{\chi[G_0 - \tau mN(\Pi_E - f)] - RL_s\} \qquad (37)$$

QED.

Note that $G_0 - \tau mN\chi(\Pi_E - f) > 0$, since from (18), this is just the proceeds from wage taxation in the initial situation. Thus, a necessary condition for (36) to hold is that $R > 0$. We postpone discussion of condition (36) untill we derive some further results.

Lemma 5: Diminishing marginal income utility $(U''<0)$ is necessary and sufficient for $W_1(N_{E1})$ to be strictly concave, for $0 \leq N_{E1} \leq N$.

Proof: Given (37), equation (35) can be rewritten as:

$$(\partial W_1/\partial N_{E1}) = -(U'/L_s)[\chi(\Delta U/U') + (\hat{R}/L^A_1)] \qquad (38)$$

where $$\hat{R} = \chi[G_0 - \tau mN(\Pi_E - f)] - RL_s \qquad (39)$$

(so condition (36) is equivalent to $\hat{R} < 0$). From (38):

$$(\partial^2 W_1/\partial N^2_{E1}) = [wU''(\partial\upsilon^A_1/\partial N_{E1})\hat{R}] \;/\; L^A_1 \qquad (40)$$

where $U'' = (\partial^2 U/\partial\bar{w}^2)$, and from Lemma 4, $\hat{R}$ and $(\partial\upsilon^A_1/\partial N_{E1})$ have the same sign. QED.

From Lemmas 3- 5 it follows immediately that:

Proposition 2: (i) A *necessary* condition for a positive N^*_{E1} to exist is that $\hat{R} < 0$ or, equivalently, taking account of (31') and (27), that:

$$\chi[G_0 - \tau mN(\Pi_E-f)] - [\alpha z(\Pi^A-f) + \bar{f} - \chi b + \tau\beta]L_s < 0 \qquad (41)$$

(ii) A *sufficient* condition for a unique positive N^*_{E1} to exist is that:

$$\hat{R} < -\chi L_s[\Delta U(0)/U'(0)] \qquad (42)$$

(iii) A *sufficient* condition for full scale privatisation to be optimal (N^*_{E1} = N) is that: $\hat{R} < -\chi L^A_1(N)[\Delta U(N)/U'(N)]$ (43)

where $[\Delta U(i)/U'(i)]$, i = 0, N, is just $(\Delta U/U')$ when $N_{E1} \cong 0, N$, respectively.

Proof: The first part is trivial, given Lemmas 3-4. Given Lemma 5 the second part requires that $(\partial W_1/\partial N_{E1}) > 0$ when $N_{E1} \cong 0$, in which case $L^A_1 = L_s$. From (38), this requires that (42) holds. Similarly, for the third part of the Proposition, which requires that $(\partial W_1/\partial N_{E1}) > 0$ when $N_{E1} \cong N$, so that $L^A_1 = L^A_1(N) = L_s - \chi N$. Note that $(\Delta U/U')$ is continuously increasing in N_E when $(\partial v^A_1/\partial N_{E1}) < 0$, i.e., when condition (36) holds. QED.

Clearly the more negative $\hat{R}$ (and hence the more negative $(\partial v^A_1/\partial N_{E1})$), the more likely that it will be optimal to engage in full-scale privatisation. An alternative way of describing the sufficient condition for that is the following:

Proposition 3: A sufficient condition for full-scale privatisation to be optimal (N^*_{E1}= N), is that: $\hat{R}\varepsilon < -\chi\bar{w}L^A_1(N)$ (44)

or, equivalently: $\varepsilon\{\chi[G_0 - \tau mN(\Pi_E-f)] - RL_s\} < \chi\bar{w}$ (45)

where ε is the elasticity of utility with respect to income.

Proof: From (38), when N_{E1}= N:

$$(\partial W/\partial N_E) = -(U/\bar{w}L_s)\{[\hat{R}\ \varepsilon/L^A_1(N)] + \chi\bar{w}\ (\Delta U)/U\} \qquad (46)$$

where $\Delta U/U$ is by definition less than unity. QED.

The determination of the optimal number of privatisations and the budget balancing tax rate (BBTR) in scenario 1 is also shown in Figure 3 (quadrants I and II). In quadrant I we depict the $W(N_E)$ function whilst in quadrant II we depict equation (39) that gives the BBTR. Given that optimal $N_E = N^*_E$, we obtain υ^* as the corresponding BBTR.

Figure 3

Figure 3 can also be used to obtain the "politically feasible amount of debt retirement" that can be undertaken by the government given the optimal degree of privatisation. To obtain this, in quadrant III we depict W as a function of υ, for given N_E and hence given L^A and h. Clearly (with $\chi > 0$) this will shift to the left as N_E decreases. To the initial values $\upsilon = \upsilon_0$ and $W = W_0$ corresponds the curve $N_E = 0$ whilst below this we have depicted the curve for $N_E = N_E^*$. The *maximum* or "politically feasible amount of debt retirement" is defined as the amount that results in a value of W equal to the initial value W_0. Thus, given $N_E = N_E^*$, it is equal to $(\upsilon' - \upsilon^*)wL^A(N_E^*)$. Note that the maximum debt retirement is proportional to $(\upsilon' - \upsilon^*)$ and *not* to $(\upsilon_0 - \upsilon^*)$: the wage tax rate *must* fall to at least υ' (independently of the size of the public debt) to compensate for the fall in utility from the reduction in employment.

3.6 Discussion and Corollaries of Propositions 2 and 3

The condition that the more negative $\hat{R}$, where $\hat{R}$ is given by (39), the larger the optimal extent of privatisation likely to be, or the larger the "politically feasible amount of debt retirement" is likely to be, suggests some interesting economic interpretations.

Corollary 1: The optimal extent of privatisation is more likely to be small the *larger* the accumulated public debt (and hence G_0), the larger the unemployment χ per privatisation, the smaller the net gains per privatisation (R), the *smaller* the number of firms (m) and the corporate tax rate τ, and the more tight the labour market (the smaller L_S). In turn, the net financial gain per privatisation (R) is smaller the smaller the expected post-privatisation profit (Π^A), the undervaluation parameter (α), the burden to the government deficit per public enterprise (f), and the corporate tax rate (τ) and the larger the unemployment per privatisation (χ), and the unemployment benefit.

The intuition behind these results is that a large accumulated debt, a tight labour market, small net finanial gains from privatisation, and a large unemployment due to privatisation, tend to generate the need for an increased tax rate as a result of privatisation, and hence to make the policy unattractive to a government that seeks to maximise the average voters' expected utility from income.

Corollary 2: The above analysis *suggests* that when the public debt is large and privatisations are expected to increase unemployment by a large amount, the government should follow a selling strategy in which public firms are sold *after* restructuring. For example, the government could, under such circumstances, allow quite a long period of time between making a credible commitment to privatise (e.g., by passing an Act of Parliament) and the actual sale date of the firm, during which time the firms' managers can restructure the firm and redirect its objectives. Such a strategy could allow the government to increase its revenue proceeds because, as explained above, it could result in a higher value of the undervaluation parameter α. Actually, α could increase even without any major restructuring if, during the period between the commitment to privatise and putting the firm up for sale, the adoption of commercial objectives allows potential investors to become better informed about the relative extent to which the firm's observed lack of profitability is the result of genuine inefficiency or of pursuing social objectives.

A scheme that involves restructuring and gradual selling of the major enterprises in Eastern Europe has been proposed by Blanchard and Layard (1991) and is under implementation in Poland[10]. In this scheme ownership of these enterprises is first transferred to holding companies (or, investment trusts) whose shares are given as gifts to all citizens, with the government retaining a minority shareholding (30 per cent in Poland) in the enterprises. The holding companies are given control over the enterprises and are responsible for appointing efficient management and oversee its performance and for the restructuring of the enterprises over a period of ten years - during which time shares in the enterprises and the holding companies are to be tradeable.

Corollary 3: From condition (44), given that $\hat{R} < 0$ the likelihood of full-scale privatisation being optimal, that is, $N^*_{E1} = N$, is greater the greater is the elasticity of utility with respect to income (ε) and the smaller the value of $\tilde{w}$. The value of $\tilde{w}$ will be small when L_s is large (and the latter makes it more likely that $N^*_{E1} > 0$), whilst ε is likely to be large exactly when $\tilde{w}$ is small. The implication is that, all other things equal, (and, in particular, given the values of α, z, ρ, χ, b, and G_0), the poorer the country in per capita terms to start with the more likely that it will be optimal to privatise all public firms.

3.7 Privatisations and Investment in Infrastructure (Scenario 2)

As already indicated, scenario 2 involves investing the revenue proceeds from privatisation in infrastructure. This should create a positive externality that affects the performance of the economy in a number of ways.

(i) It could reduce production costs in both private and public enterprises, for example, by improving means of transportation and/or communication.

(ii) It could increase the country's quality of human capital.

(iii) Capital accumulation externalities improve the growth rate of the economy as the booming recent literature on endogenous growth has effectively demonstrated.

In the present paper we only examine the case where the investment in infrastructure lowers costs, and, in particular, the fixed cost (f). We assume that the reduction in f depends on the level of investment which in turn depends on the privatisation proceeds, which are proportional to the number of firms privatised. More specifically we will assume that, given ρ (the government revenue proceeds from privatising a public firm), the fixed cost is given by :

$$f = g(\rho N_E) \qquad (47)$$

where g is a continuous, twice-differentiable and monotonically decreasing function, with:

$$g(0) = f \text{ and } \lim_{N_E \to \infty} g(\rho N_E) = 0,\ g'(\rho N_E) < 0 \text{ and } g''(\rho N_E) > 0 \qquad (47').$$

In (47'), the first two terminal conditions say that fixed cost will remain as at present with no additional investment in infrastructure and will asymptotically vanish as positive externalities accumulate. The first derivative condition implies monotonic improvement and convexity is compatible with diminishing returns.

Thus, whilst in the present scenario privatisation does not reduce the public deficit directly, it reduces it indirectly by reducing the fixed cost of public enterprises (f). There two more ways in which using privatisation proceeds to invest in infrastructure will indirectly reduce public deficits. First, it is reasonable to assume that in scenario 2 infrastructural investment leads to an additional labour demand, and hence a saving in unemployment benefit. This we assume to be equal to η per privatisation, $\eta \geq 0$. Thus *the net labour employment change per privatisation* in scenario 2 is $(\chi - \eta)$, so that $L^A_{d2} = L_s - (\chi-\eta)N_{E2}$.

Second, the reduction in costs as a result of infrastructural investment increases the profits of *all* firms relative to scenario 1: thus there is also an increase in tax proceeds from profits, relative to scenario 1.

Before we proceed to the solution in scenario 2 we prove a general proposition that will be useful below:

Proposition 4: A privatisation scheme Pareto-dominates any other involving more firms to be privatised and a higher tax rate on labour income.

Proof: Use subscript 1 and 2, respectively, to represent our two scenarios and let (N_{E1}, υ_1^A) and (N_{E2}, υ_2^A) denote the number of firms to be privatised and the associated tax rates. We assume $N_{E1} \leq N_{E2}$ and $\upsilon_1^A \leq \upsilon_2^A$ with at least one of them holding as strict inequality. The difference in welfare is:

$$W_1 - W_2 = -(h_1 - h_2)[U(\tilde{w}_1) - U(b)] + (1 - h_2)[U(\tilde{w}_1) - U(\tilde{w}_2)]$$

But, $(h_1 - h_2) = (N_{E1} - N_{E2})\chi/L_s \leq 0$ and $\tilde{w}_1 \geq \tilde{w}_2$ so $U(\tilde{w}_1) \geq U(\tilde{w}_2)$, therefore, under our assumptions, $W_1 > W_2$. QED.

Let us now turn to a characterisation of the solution in scenario 2. When N_{E2} firms are privatised, government spending G_2^A will be given by:

$$G_2^A = D + b(L_s - L_2^A) + (N - N_{E2})g(\rho N_{E2}) \qquad (48)$$

which, after some manipulation, reduces to:

$$G_2^A = G_0 - R_g N_{E2} - S(N_{E2}) \qquad (49)$$

where R_g is given by (31) and:

$$S(N_{E2}) = (N - N_{E2})[f - g(\rho N_{E2})] - \rho N_{E2} + b\eta N_{E2} \qquad (50)$$

By comparing to (32) we note that for any given privatisations N_E, $G_2^A = G_1^A - S(N_{E2})$ where $S(N_{E2}) \gtrless 0$. $b\eta N_{E2}$ is the saving in unemployment benefit due to the smaller loss in employment as a result of infrustructural investment.

In scenario 2, tax receipts are given by:

$$T_2^A = w\upsilon_2^A L_2^A + \tau(1+m)N_{E2}(\Pi^A - g) + \tau m(N - N_{E2})(\Pi_E - g)$$

or:

$$T_2^A = w\upsilon_2^A L_2^A + \tau(1+m)N_{E2}(\Pi^A - f) + \tau m(N - N_{E2})(\Pi_E - f) + \tau(f-g)(mN + N_{E2})$$

Equality of G_2^A and T_2^A implies, after some manipulation, that:

$$\upsilon_2^A = [G_0 - \tau mN(\Pi_E - f) - RN_{E2} - \tau(f-g)(mN + N_{E2}) - S(N_{E2})]/wL_2^A \qquad (51)$$

where R, the net financial gain per privatisation in scenario 1, is given by (31'), and, for simplicity, we have ceased writing g as a function of ρN_{E2}.

The term $\tau(f\text{-}g)(mN+N_{E2})$ represents the increase in proceeds from profit taxation relative to scenario 1. Later we compare in more detail υ_2^A to υ_1^A.

Again, the optimal number of firms to be privatised is given by the first-order condition $(\partial W/\partial N_E) = 0$, where $(\partial W/\partial N_E)$ is given by (35), which we rewrite incorporating the fact that now unemployment per privatisation is $(\chi\text{-}\eta)$: $(\partial W/\partial N_E) = -(U'/L_s)[(\chi\text{-}\eta)(\Delta U/U') + wL^A(\partial\upsilon^A/\partial N_E)]$ (35')

It is clear that Proposition 1, concerning full-scale privatisation, is now more likely to hold:

Proposition 1': For as long as the net loss in employment is non - positive, $(\chi - \eta) \leq 0$, it will be optimal to engage in full-scale privatisation ($N_{E2} = N$), in scenario 2.

Proof: When $\chi - \eta \leq 0$, $h = 0$, so under scenario 2, $L_2^A = L_s \leq L_{d2}^A$ Thus, from (51), $(\partial\upsilon_2^A/\partial N_{E2}) = -[R+\tau(f\text{-}g)+S'(N_{E2})]/wL_s = \{[(\chi\text{-}\eta)b - \tau\beta - \tau(f\text{-}g) - g - \varrho g'(N\text{-}N_{E2})]/wL_s\} < 0$, for $0 \leq N_{E2} \leq N$, since by assumption $g' < 0$ and $\beta > 0$. Hence $(\partial W_1/\partial N_{E1})$ is everywhere positive. QED.

As in scenario 1, when $\chi\text{-}\eta > 0$, it is necessary for a non-negative optimal number of privatisations to have that $(\partial\upsilon/\partial N_E) < 0$. Differentiating (51) we obtain: $\text{sign } (\partial\upsilon_2^A/\partial N_{E2}) = \text{sign } \Phi(N_{E2})$

with

$$\Phi(N_{E2}) = \varrho g'[N\text{-}N_{E2} + \tau(mN+N_{E2})]L_2^A + \Gamma - [f - g]\Lambda \qquad (52)$$

where: $\Gamma = (\chi\text{-}\eta)[G_0\text{-}\tau mN(\Pi_E\text{-}f)] - L_s[\tau\beta + g - (\chi\text{-}\eta)b)]$

$\Lambda = \tau L_s + (\chi\text{-}\eta)N(\tau m+1) > 0$

and, by assumption, $g' < 0$, $\beta > 0$ (given by (33')), and $(\chi\text{-}\eta) > 0$.

Also: $$\Phi(N_{E2}) = w(L_2^A)^2\ (\partial\upsilon_2^A/\partial N_{E2}) \qquad (53)$$

and therefore, from (35'):

$$(\partial W_2/\partial N_{E2}) = -(U'/L_s)[(\chi\text{-}\eta)(\Delta U/U') + \Phi(N_{E2})/L_2^A] \qquad (54)$$

Obviously, a *necessary* condition for $N_{E2}^* > 0$ is that for at least some $N_{E2} > 0$, $\Phi(N_{E2}) < 0$. Finaly we have the following:

Proposition 5: (i) A sufficient (though not necessary) condition for $W(N_E)$ to be strictly concave for $0 \le N_E \le N$ is that the marginal utility of income is diminishing, $U'' < 0$. (ii) A *sufficient* condition for a unique positive N^*_{E2} to exist is that:

$$\Phi(0) < -(\chi-\eta)L_s[\Delta U(0)/U'(0)] \qquad (42')$$

(iii) A *sufficient* condition for full scale privatisation to be optimal ($N^*_{E2} = N$) is that:

$$\Phi(N) < -(\chi-\eta)L^A_2(N)[\Delta U(N)/U'(N)] \qquad (43')$$

where $[\Delta U(i)/U'(i)]$, $i = 0, N$, is just $(\Delta U/U')$ when $N_{E2} = 0, N$, respectively.

Proof: The first part of the Proposition follows from the fact that:

$$(\partial^2 W_2/\partial N^2_{E2}) = \{[\Phi(N_{E2})wU''(\partial\upsilon^A_2/\partial N_{E2})/L^A_2] - U'\varrho[g''K(N_{E2}) - 2g'(1-\tau)]\}/L_s$$

where $K(N_{E2}) = N - N_{E2} + \tau(mN+N_{E2}) > 0$, our assumptions about the function $g(N_E)$ and the fact that sign $(\partial\upsilon^A/\partial N_E)$ = sign $\Phi(N_E)$. The rest of the proposition then follows directly from inspection of (54). QED.

Clearly, the more negative is Φ for any given N_E (and hence the more negative $(\partial\upsilon^A_2/\partial N_{E2})$), the more likely that it will be optimal to engage in full-scale privatisation, in scenario 2. What is required for $\Phi(N_{E2}) < 0$? From (52), it is clear that, ceteris paribus, $\Phi(N_{E2})$ is more negative:

(i) The more negative g', that is the greater the reduction in cost induced by any given infrustructural investment (or the more convex the function $g(.)$ is). This, in turn, is likely to be true in practice when the existing infrastructure is very inadequate or of low quality, as is to a large extent the case in the Eastern European countries.

(ii) The greater the potential scale of the privatisation programme, i.e., the greater is N.

(iii) The smaller the existing public debt, and hence, the smaller G_0; the less tight the labour market (i.e., the greater L_s); the greater the profit tax rate (τ); and the greater the revenue generated from privatisation (ϱ).

3.8 Comparison of scenaria 1 and 2

We now move to compare the solutions in scenaria 1 and 2. We start by comparing the optimal extent of privatisation in the two scenaria using Propositions 2 and 5, and, in particular, comparing $\hat{R}$, given by (31'), and $\Phi(N_{E2})$, given by (52). Such a comparison is important from a normative point of view, given our basic hypothesis that privatisation increases social welfare. For ease of comparison we rewrite here $\Phi(N_{E2})$ as:

$$\Phi(N_{E2}) = \hat{R} - \eta\hat{G} + L_s(\rho+f-g-\eta b) + \rho g'[N-N_{E2}+\tau(mN+N_{E2})]\hat{L}_2 - [f-g]\Lambda \quad (52')$$

where $\hat{G} = G_0 - \tau mN(\Pi_E - f) > 0$, and $\Lambda = \tau L_s + (\chi-\eta)N(\tau m+1) > 0$. This makes clear that Φ may well be negative even when $\hat{R} \geq 0$.

Proposition 6: The optimal scale of privatisation is more likely to be greater in scenario 2 than in scenario 1 ($N^*_{E2} > N^*_{E1}$), in the following cases:

(i) The more negative is g' for any given N_E, that is the greater the reduction in cost from infrustructural investment. As already indicated, this is likely to be true in practice when the existing infrastructure is of low quality.

(ii) The greater is the potential scale of the privatisation programme, i.e., the greater is N. This is particularly interesting in that it holds also when m = 0 (the public firms are monopolies): a very high value of N, with m = 0, is exactly the case that characterises Eastern European economies. The intuition is that the greater is N the greater the benefit from the reduction in the cost of the remaining public enterprises due to the infrastructural investment and the greater the potential gain from corporate profit taxation on the increased profit resulting from this investment.

(iii) The larger are the gains in employment from infrastructural investment, ie., the larger η, relative to the employment losses from privatisation (χ).

(iv) The greater is the profit tax rate (τ).

When revenue proceeds from privatisation (ρ) are relatively small, the existing public debt, and hence $\bar{G}_0$, is high, and χ is high, but infrastructural investment has a large impact on costs, so g' is large, and N and η are large, it may well be the case that $N^*_{E2} > 0$, whilst $N^*_{E1} = 0$.

Proof: These results follow immediately by comparing $\hat{R}$ and $\Phi(N_{E2})$ and Propositions 2 and 5.

Whilst the above Proposition establishes that in many circumstances, scenario 2 will lead to a larger optimal degree of privatisation than scenario 1, it does not establish that scenario 2 will also be *preferable* to scenario 1. For this we need to compare the welfare function $W(N_E)$ under the two scenaria.

From Proposition 4, for any given extent of privatisation, a scenario will Pareto-dominate another if the latter involves a higher tax rate on wage income. The tax rates in the two scenaria are given by (34) and (51) respectively. For easier comparison we rewrite (34) here as follows:

$$\upsilon^A_1 = [G_0 - \tau mN(\Pi_E\text{-}f) - RN_{E1}]/wL^A_1 \qquad (34')$$

Given that, with $\eta \geq 0$, $L^A_2 \leq L^A_1$ for any given N_E, comparing (34') to (51) we obtain:

Proposition 7: It is *sufficient* for scenario 2 to be preferable to scenario 1, that is for $W_2(N_E) \geq W_1(N_E)$, for any given N_E, $0 \leq N_E \leq N$, that:

$$\Omega(N_E) = (N - N_E)(f\text{-}g) + \tau(f\text{-}g)(mN + N_E) + b\eta N_E - \rho N_E \geq 0 \qquad (55)$$

where condition (55) guarantees that $\upsilon^A_2(N_E) \leq \upsilon^A_1(N_E)$, for any given N_E, $0 \leq N_E \leq N$, and (0) = 0 since when $N_E = 0$, $f = g(\rho N_E)$.

Proof: It follows immediately by comparing (34') to (51), and Proposition 4. Note that even if (55) does not hold, we could still have $\upsilon^A_2(N_E) \leq \upsilon^A_1(N_E)$, and hence $W_2(N_E) \geq W_1(N_E)$, if η is sufficiently large so that L^A_2 is sufficiently smaller than L^A_1, for any given N_E, $0 \leq N_E \leq N$. Figure 4 illustrates a case in which $0 < N^*_{E1} < N^*_{E2} < N$, and $W_2(N_E) > W_1(N_E)$, for any given N_E, $0 \le N_E \le N$.

Figure 4

Corollaries: (i) The greater the (absolute) values of g', η, N, b and τ the more likely that $W_2(N_E) \ge W_1(N_E)$, for any given N_E, $0 \le N_E \le N$.

Proof: Differentiating (N_E) we find that it is an increasing function iff:

$$-\varrho g'[N-N_{E2}+\tau(mN+N_{E2})] + b\eta - (1-\tau)(f-g) - \varrho > 0 \qquad (56)$$

where $g' < 0$. Thus the greater the (absolute) values of g', η, N, b and τ the more likely that (N_E) will be increasing in N_E and hence the more likely that (55) will hold for any given N_E, $0 \le N_E \le N$.

Note that, given that g' is decreasing in N_E in absolute value, and that (f-g) is increasing, (56) is most likely to hold when $N_E = 0$, in which case it requires that:

$$-\varrho g'[N(1+\tau m)] + b\eta - \varrho > 0 \qquad (56')$$

which will certainly hold if $g'N(1+\tau m) \le -1$, or, it will hold for sufficiently large g' and/or N, and/or $b\eta$.

(ii) If it is optimal to privatise all firms in both scenaria, that is $N^*_{E1} = N^*_{E2} = N$, it is sufficient for scenario 2 to be preferable to scenario 1, i.e., $W_2(N^*_{E2}) > W_1(N^*_{E1})$, that $\tau[f-g(\varrho N)](m + 1) + b\eta - \varrho \ge 0$. This follows immediately by substituting in (55) N for N_E.

(iii) It is possible that whilst scenario 1 is preferable to 2, that is $W_2(N_E) < W_1(N_E)$ for all N_E, $0 \le N_E \le N$, optimal privatisation is greater in 2 than in 1, $N^*_{E2} > N^*_{E1}$. In this case scenario 1 will be chosen even though 2 may well be preferable on social welfare grounds. We illustrate this case in Figure 5.

Figure 5

Proof: Assume that $-\varrho g'[N(1+\tau m)] + b\eta - \varrho \le 0$, ie. (56') does not hold. It follows from the first corollary above that $W_2(N_E) < W_1(N_E)$ for all N_E, $0 \le N_E \le N$. On the other hand, from (52'), when $N_{E2} = 0$ and $L_2^A = L_s$, f = g, and thus:

$$\Phi(0) = \hat{R} - \eta\hat{G} - L_S[\eta b - \varrho g'N(\tau m+1) - \varrho] \qquad (52'')$$

which could be negative, so the condition (given by (42')) required for a positive N^*_{E2} is satisfied, even though $[\eta b - \varrho g'N(\tau m+1) - \varrho] < 0$ - so (56') does not hold. Now consider $\Phi(N)$ when η is close to χ. From (52'), $\Phi(N)$ is then: $\Phi(N) \cong \Phi(0) + (1-\tau)L_S(f-g)$, which, with $\Phi(0) < 0$, could also be negative if τ is quite large. But, from (43'), with η close to χ this is all that is required for $N^*_{E2} = N$. On the other hand, if χ is large, from (43) the condition required for $N^*_{E1} = N$ may not hold. QED.

4. CONCLUSIONS

A number of issues concerning the optimal scale of privatisation and its effects on public deficit finance have been discussed in this paper. We have assumed that privatisation proceeds can be used in two alternative ways: (i) to directly repay public debt or reduce taxes; (ii) to increase public investment in infrastructure that will be cost-reducing and employment-enhancing. We have shown that the effects of the above schemes on public finance and on social welfare will be quite different depending on the financial situation of the government, conditions in the labour market, the initial quality of infrastructure, the potential scope of the privatisation programme, the corporate tax rate, the size of the unemployment benefit, the size of revenue proceeds, the structure of the markets in which public firms operate, the extent of public firm inefficiency, and public firm objectives.

In many cases the use of privatisation proceeds to finance public investment in infrastructure will be associated with a lower wage tax rate for any given number of privatisations and a higher optimal number of privatisations than using such proceeds to directly repay public debt. This is more likely to be the case the sharper the reduction in firms' costs from infrastructural investment (as is likely when the quality of infrastructure is initially low), the greater the scale of the privatisation programme, the greater the employment gains generated by infrastructural investment and the more monopolistic the market structure (leading to a high employment loss from privatisation) - suggesting that this option should be given more careful consideration by policy makers in Central and Eastern European countries.

Additional research is clearly needed in this area. Our subsequent research is focusing on modelling the effect of alternative ways of using privatisation proceeds in an infinite horizon overlapping generations model. Results from this are consistent to those reported above. Further, we are using the basic model developed here to investigate the welfare aspects of specific privatisation schemes that include free distribution of shares to employees or the citizenry. Such schemes are now widely practised in Central and Eastern European countries.

Footnotes

1. For recent extensive analyses of the arguments for and against privatisations, see D. Bos (1991) and Vickers and Yarrow (1987).
2. We could easily include a "capital good producing sector supplying an intermediate product to the m industries that can be interpreted as "consumer good industries". This we have done in an earlier version of this paper (see, Christodoulakis and Katsoulacos, 1992, available from the authors on request) in which we assumed that the capital good producing sector is a public monopoly that supplies at marginal cost to the m consumer good industries. However, the addition of an extra sector makes the analysis more cumbersome without altering or adding to our analysis or results, so in this version we have decided to exclude it.
3. See, for example, Katsoulacos, 1991 for all the details that can be sent the interested reader on request.
4. See, Katsoulacos, 1991 for all the details.
5. Which is consistent with the parameter configuration required for $\lambda^* = 0$.
6. Alternatively, and more generally, we could have written λ^* as a function of $(c_P - c)$ and m and the deficit/surplus of the public entrprises as $B = B(\lambda^*(c_P\text{-}c,m))$. Of course, normally $\lambda^* < 1$: indeed it would be difficult to rationalise the existence of a public firm if $\lambda^* = 1$, even though this could be used to maximise social welfare (see De Fraja and Delbono, 1989; or, Katsoulacos, 1991). Using this more general specification does not affect any of our conclusions as long as we maintain the assumption that privatisations lead to an increase in the efficiency and profit of the privatised firms. On the other hand, setting $\lambda^* = 0$ simplifies enormously the expressions and thus the exposition of our results.

7. As noted by Roland and Verdier (1991, p. 5); see also the evidence provided in Haskel and Szymanski. Note that the objective function that we adopt should not be too dissimilar in its implications from Haskel and Szymanski's (1991), who use a weighted average of consumer surplus, profit and unemployment. Further, this objective function is clealry not inconsistent with our assumption that public firms (run by the government) choose their output by maximising (static) social welfare since this choice also leads to maximisation of employment.

8. Note that in deriving these results we assume that changes in m or l_p do not affect λ^* which remains zero. This is not unreasonable if we restrict ourselves to not very large variations in m (using m = 0 as our benchmark) and l_p ($\geq l_E$).

9. In our case the return to public asset holding is negative but this is just a simplifying assumption: all that we need is that the present value of this return is less than $\hat{\Pi}$ because privatisation leads to some increase in efficiency that would not otherwise take place.

10. See Blanchard and Layard (1991) p. 17.

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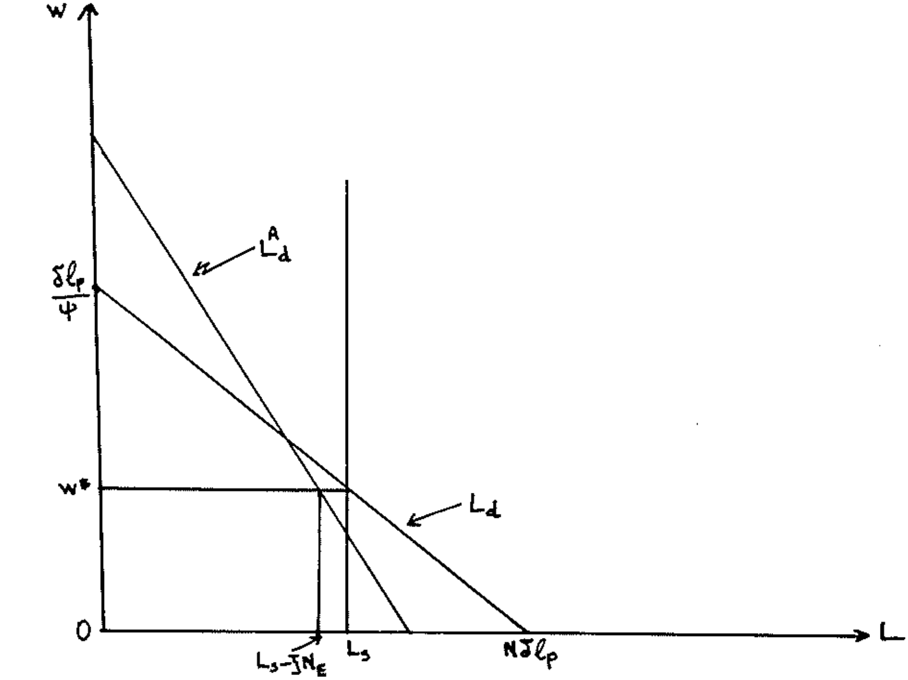

Figure 1: The Labour Market.

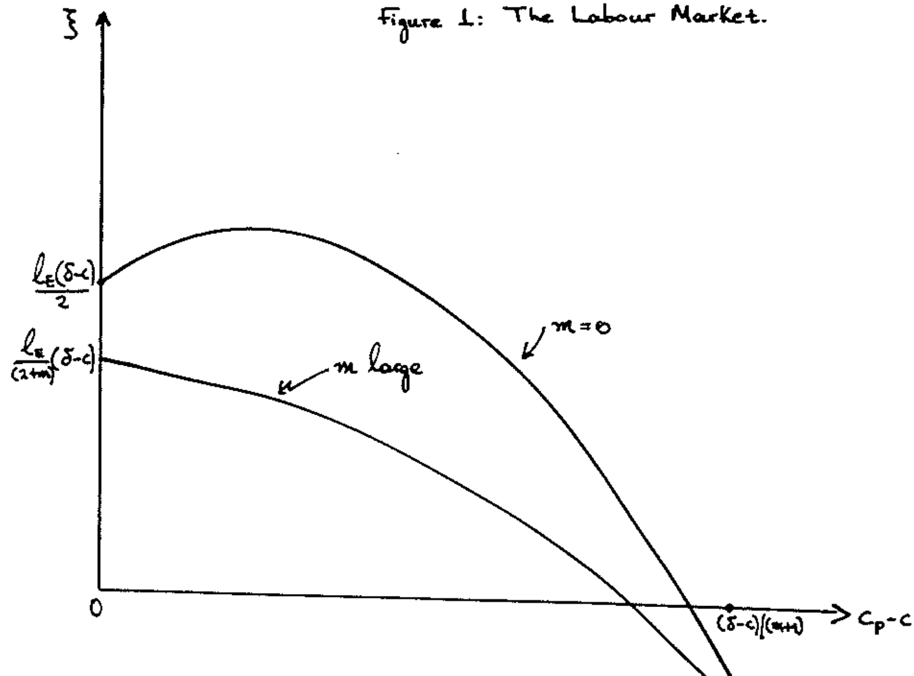

Figure 2: Unemployment per privatisation

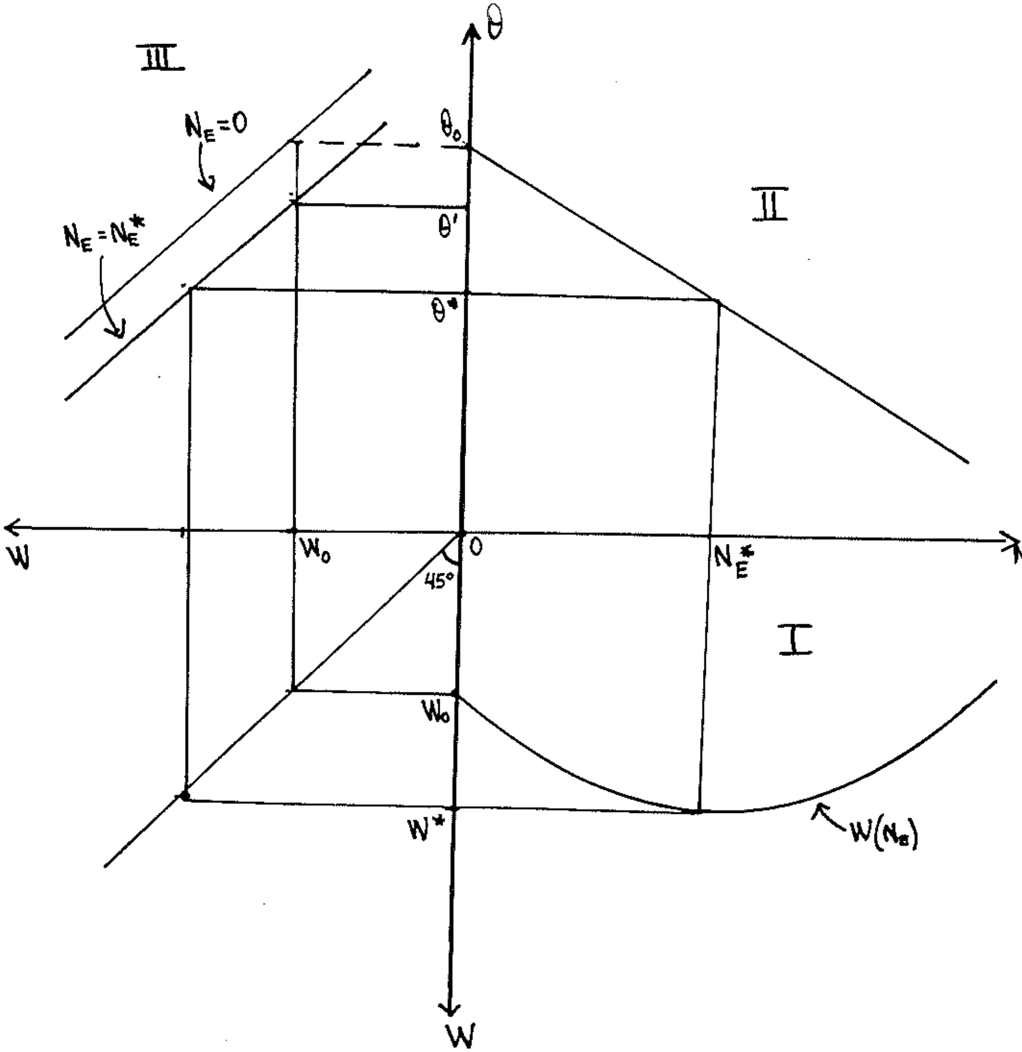

Figure 3: Maximum debt retirement = $(\theta' - \theta^*) w L^A(N_E^*)$.

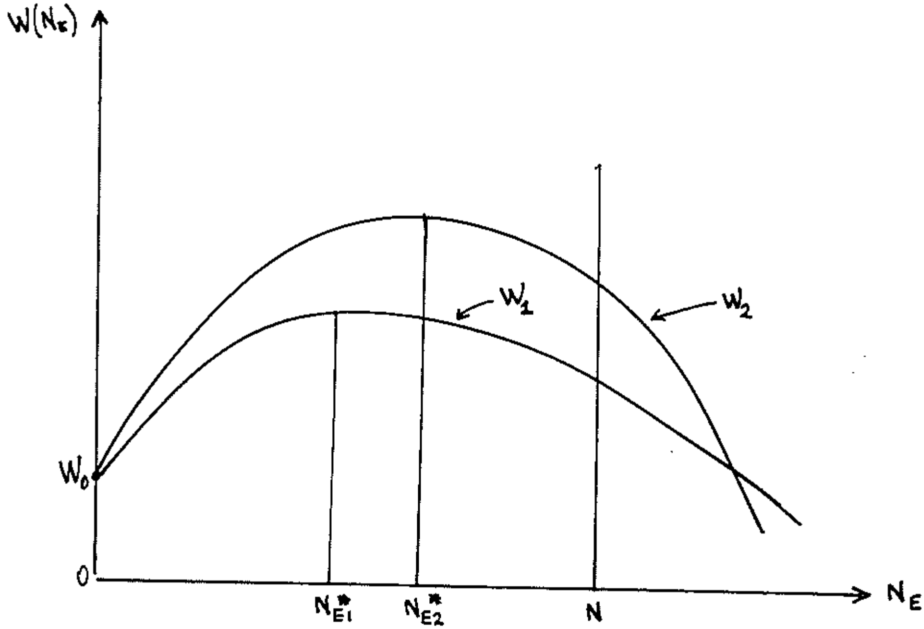

Figure 4

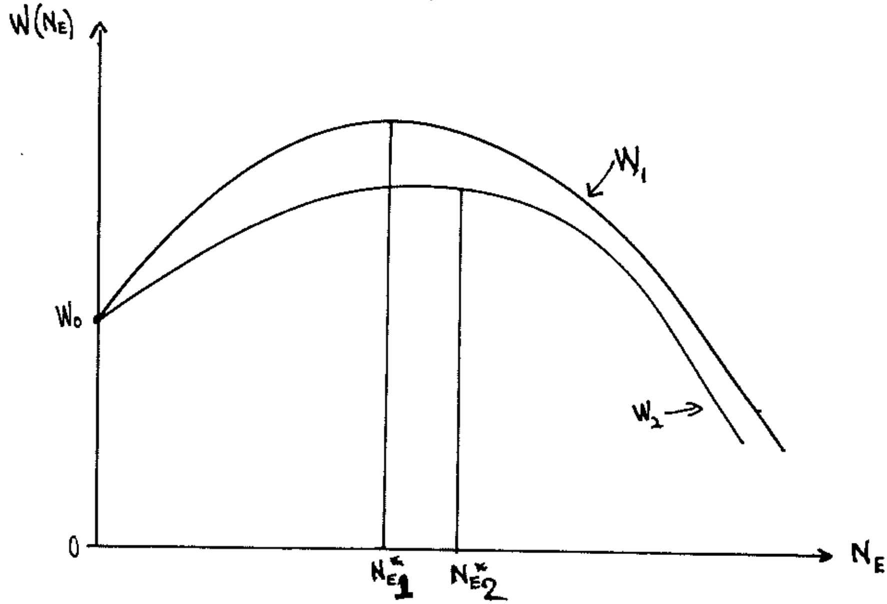

Figure 5