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**PUBLIC ENTERPRISES AND ECONOMIC
GROWTH: STATISTICAL EVIDENCE
FROM MIXED ECONOMIES**

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I. INTRODUCTION

Do state economic enterprises promote or retard growth? Until the last decade, many policy-makers and economists agreed that public enterprises had a necessary, and sometimes indispensable, role in resource mobilization because they typically operate in areas where there exist sharp divergences between public and private costs and benefits. In addition to correcting market failures, they were also expected to support the private sector via spillover effects attributable to factors such as risk-absorption, learning-by-doing, and economies of scale. In the post-War period, almost all developing countries built public sector enterprises of significant proportions to initiate the industrialization process. The opposing view, which has gained momentum in the last decade, is skeptical of the desirability of the public firms and their ability to operate efficiently. Critics argue that due to the prevalence of bureaucratic interventions, political patronage, corruption, rent-seeking behavior, and lack of an appropriate incentive structure, public firms are inefficient and wasteful. Furthermore, reliance of these firms on government financing allegedly imperils macroeconomic stability and increases the uncertainty faced by the private sector. Macroeconomic stabilization and adjustment programs advanced by the World Bank and the IMF frequently feature such opinions (World Bank 1981, 1983; IMF, 1986; Mosley, 1988). Many Third World countries burdened by large public deficits indeed followed this advice and embarked on the dismantlement of public enterprises.

According to either viewpoint, public enterprises have a significant impact on the overall economy. Interestingly enough, to our knowledge, there do not exist any studies which measure the overall effects of public sector spillovers and/or distortions on the economy. Most of the available literature focuses on the performance of individual firms or industries, and are silent on the macroeconomic issues. The few empirical studies which address macroeconomic implications of the public enterprises, on the other hand, do not go beyond the calculation of cross-country correlation coefficients between some measure of relative importance of public sector (its output share in GDP or investment share) and a measure of macroeconomic performance (income per capita, income growth rate, gross fixed investment growth) (Nunnenkamp, 1986; Kirkpatrick, 1986). This paper is an attempt to fill this gap in the literature. It utilizes the neoclassical growth model to gauge, in the aggregate, external effects and distortions created by the public industrial sector in mixed economies.

The paper is organized as follows. Section II summarizes the alleged externalities and distortions created by public enterprises. In section III, I set up the analytical framework to derive an aggregate growth equation which links the rate of growth of industrial output to labor and capital inputs, and public sector distortions/externalities. In section IV, this growth equation is estimated for a cross-section of countries to gauge the impact of these factors on output growth. Interpretation and policy implications of the results, as

well as directions for future research, are presented in section V.

II. PUBLIC SECTOR EXTERNALITIES AND DISTORTIONS

The focus of this paper is public sector enterprises, firms that are owned by the state and produce goods and services that are sold in the market. Thus, a range of non-marketable public sector activities, such as provisioning of health, education, military services, are beyond the scope of this paper.¹ Discussions of positive and negative effects of public enterprises on economic and social welfare are abundant in the literature. This section briefly summarizes the main arguments made in favor and against these firms.²

The sources of the skepticism on public firms' efficacy are their multiple and often conflicting objectives, their proneness to political meddling, and the sluggishness of bureaucratic decision-making. A non-exhaustive list of the public sector objectives include capturing the "commanding heights" of the economy, employment generation, regional development, reducing income inequality, and technological self-reliance. These multiple goals are alleged to preclude the least-cost operation of an enterprise as well as the optimal allocation of national resources: construction of plants far away from the factor or product markets, overstaffing, spiraling wage bills, and keeping otherwise inviable companies alive by subsidies are common complaints. More importantly, mutually exclusive objectives may make it impossible to distinguish between the "good" and the "bad" performance (Jones and Mason, 1982, 30), and demolish the incentive structure required for an efficiently functioning firm. Insofar as they are not penalized or rewarded according to the market rules, there exists no incentive for the managers to minimize costs, to improve product quality, and or to keep up with technological changes.

In fact, political power may be the primary authority the managers are accountable to. A frequent criticism of public enterprises is that these firms are chronically subject to political interference. Public enterprises can serve as instruments of political agenda and patronage, and short-term political considerations dominate long-term public interests in investment, location, closure and hiring decisions. For the managers, the rational choice under these conditions would be to follow the directives of the political authority irrespective of their commercial implications.

The third source of inefficiency is the resource cost: centralized bureaucratic decision-making is a lengthy and complicated process where more attention is likely to be paid to the procedure rather than the outcome. Because many public enterprises are under the purview of higher governmental organs and firm level decisions

¹ Having made this caveat, I will use public sector and public industrial enterprises interchangeably in this paper.

² More detailed discussions can be found in Choksi (1979, pp. 5-73), Jones and Mason (1982), and World Bank (1983, pp. 75-87).

often require the approval of these authorities, management becomes even more cumbersome and inept. The manifold layers of bureaucracy and myriad of committees and conferences not only fail to respond to the changing economic conditions readily, but also tie up resources which could be made better use of elsewhere.

All of these problems, ostensibly, cause chronic public sector deficits and require continuous flow of subsidies from the Treasury and worsening fiscal crisis of the state. The outcome of this process is greater macroeconomic uncertainty resulting from budget deficits and the actual or potential inflationary environment, which may be expected to create negative external effects for the private sector.

Beneficial effects of the public enterprises, on the other hand, may take several forms. The traditional economic rationale for the public sector is that it is an answer to market failures arising from economies of scale, indivisibilities, and natural monopoly. In addition, certain circumstances pertinent especially to less-developed countries (LDC), such as imperfect information on technology, future product, factor and intermediate good markets, thin capital markets, absence of entrepreneurial skills, lack of vehicles for risk-spreading, long gestation and payback periods, and political uncertainty, constrain the formation and growth of the private industry. Public sector is suggested as one instrument to break the limitations on capital accumulation created by such conditions and initiate the industrialization process. This does not necessarily imply that the public sector supplants the private. Most LDCs created the public enterprises for pragmatic reasons with the anticipation that it will create an environment for the development of the fledgling private sector and act as the locomotive of economic growth (Jones and Mason, 1982). In this context, private industry turns out to be the direct beneficiary of the growth of public enterprises. The first, and most obvious, case is where public sector undertakes projects with social overhead capital such as ports, railways, highways, dams and energy plants. The private sector is unlikely to enter these areas without significant incentives, yet these projects are imperative for the development of the markets. Secondly, the public sector also concentrates in industries (chemicals, petrochemicals, iron and steel) producing intermediate goods, purchased primarily by the private sector. Prices of these intermediate goods are under the direct control of the government. Thus, private sector benefits from input markets from which supplies can be purchased at stable prices. Third, much of the learning-by-doing is performed in the public sector. Public sector introduces new technologies, trains managers, engineers and other professionals. Private sector does not engage in the creation of these professionals but can easily lure them with higher salaries later. In summary, by taking on these responsibilities, the public sector establishes an environment for the application of entrepreneurial skills of the private sector, and its contribution to economic growth consist not only of the goods and services it produces, but also the external effects it has on the private sector.

Although partisan argumentation is abundant in both the professional and the popular publications,

rigid adherence to either position is not prudent. Balanced treatments of the subject do not reach conclusive results regarding the alleged inefficiency of the public sector. Industry/firm comparisons the efficiency of the public and private sectors are often futile because public and private firms seldom coexist in the same industry, and do not share the same objectives even when they coexist. In situations where such comparisons can be made, the results suggest that efficiency of individual firms is explained by the market structure rather than ownership (Vickers and Yarrow, 1991; see also Kirkpatrick, 1986). Other studies concentrate on the individual public firms and their contribution to the regional/national economy. Many of these overwhelmingly conclude that public firms' performance is sub-standard and constitute a handicap to development efforts (e.g., Choksi, 1979; Nellis, 1986). On the other hand, there also exist public firms that have received enthusiastic and universal applause such as the South Korean iron and steel firm POSCO (Choksi, 1979, p. 27; Amsden, 1989, p. 292), or the Indian Swaraj tractor firm (Bhatt, 1982). Reviewing the experience of Great Britain, Italy, France, and Brazil, Vernon (1988) concludes that the success of the public sector in these countries can be explained by the autonomy of its managers from the state control.

The inherent difficulty in the interpretation of the conclusions of these studies is that the standard by which the performance of the state-owned firm should be measured does not exist. Given the multiple legitimate objectives of these firms and the lack of a consensus on such a yardstick, the verdict on the failure or success of the public sector firms remains a contentious matter.

In this paper, I leave aside the micro issues and approach the question from a macro perspective. Starting from the premise is that the public sector of each country exhibits some combination of the positive and the negative attributes of the public enterprises, I explore what, if any, general statements can be made regarding overall impact of public sector externalities and distortions on economic growth. The basic argument is that the public sector contributes to the aggregate output growth via resource mobilization—deployment of capital and labor. The total impact of the public sector may, however, fall short of or exceed this direct contribution if it has distortionary or spillover effects. The objective of this paper is to gauge these latter effects. In the rest of this paper, I present a model to formalize this idea and estimate econometrically the impact of public sector externalities and distortions on growth for a cross-section of countries.

III. THE MODEL

The neoclassical growth model utilizes the aggregate production function to explain national output growth in terms of the primary factors of production, namely labor and capital. Statistical applications estimate the growth equation to evaluate the relative contributions of labor and capital. This basic model is extended in several directions in the literature. One variation is augmentation of the production function by other inputs such as imports, education, communications, and social mobility. Another line of research

focuses on disequilibrium in LDCs and argues that growth also comes from reallocation of factors of production between modern/efficient and traditional/inefficient sectors of the economy. In this case explanatory variable list is revised to include "structural" variables such as capital inflow, size of the industrial sector, factor reallocation from agriculture to industry, and export growth.³ The third line of inquiry examines growth retarding/promoting effects of distortions created by industrialization strategies or government policies, such as taxes (Barro 1989; Rebelo, 1990), inward/outward-orientation of the economy (Feder, 1986). I adopt this endogenous growth analysis in the present paper to evaluate the external and distortionary effects of the public enterprises on economic growth.

The model is informed by findings of various surveys of mixed economies which found that the public sector activities are concentrated in the intermediate good producing industries. Consistent with this observation, the distinguishing feature of the model is that there exists a division of activity between the private and the public sectors whereby they produce the final and intermediate goods, respectively. Investigations of the structure of the public sector reveal a particular pattern of division of activity between the public and the private sectors: public sector industries concentrate in intermediate-good industries whereas private industries are located in the final-good producing industries (see e.g. Jones and Mason, 1982; World Bank 1983, 1987; Short, 1984). This observation is at the foundation of the analytical framework presented in this section.⁴ Consider a stylized economy which consists of public and private sectors producing the intermediate and final goods, respectively. The primary factors of production are labor (L) and capital (K). In addition, private firms use the public-firm-produced intermediate good as an input. Private sector is assumed to be perfectly competitive in product as well as labor and capital markets. Public sector is also competitive in factor markets, and uses marginal cost pricing in the output market. Both sectors are assumed to face the same nominal wage (W) and capital rental (R) rates.⁵ In order to simplify exposition I assume that the economy is closed.⁶

³ Empirical literature on these extensions is too voluminous to be cited fully here. The following works, however, are representative: Hagen and Havrylyshyn (1969), Robinson (1971), Humphries (1979), Chenery (1984), Feder (1986).

⁴ By the same token, the analysis does not apply to the once-socialist countries.

⁵ Appropriateness of these assumptions are disputable. Public firms, for instance, typically have greater access to credit relative to the private firms. The assumption however is retained because it simplifies exposition and the main points of this paper are not affected by its alteration.

⁶ In this context, the openness of the economy becomes of primary importance if intermediate goods can be imported as well. A model along this line can be developed to compare the welfare effects of domestic public production as opposed to importation. I have not taken this route in this paper because in most countries (especially LDCs) governments limited or prohibited the importation of import substitutes, and not buying from the public sector was simply not an option for the private sector.

The aggregate public output X is given by the Cobb-Douglas production function:

$$X = A_X K_X^\delta L_X^\phi, \quad \delta, \phi > 0 \quad (1)$$

where K_X and L_X denote the capital and labor input of public firms. A_X captures the technology which is assumed to grow at the exponential rate τ_A .

Externalities and distortions of the public sector are introduced into the model in two forms [similar to Feder's (1986) analysis of the impact of exports on growth]: spillover effects and sectoral marginal factor productivity differences. Spillover effects enter the private firm's production function directly. Assuming there are n identical private sector firms, production function of the representative firm is:

$$Y_i = A_Y K_{Y,i}^\alpha L_{Y,i}^\beta X_i^\gamma (X/n)^\theta, \quad \alpha, \beta, \gamma > 0 \quad (2)$$

where: Y_i denotes firm i 's output, and $K_{Y,i}$, $L_{Y,i}$ and X_i are its capital, labor, and public-produced intermediate inputs, respectively. Spillover effects of the public sector production are calibrated in terms of the public sector output level X and, therefore, X/n denotes the externality enjoyed or suffered by the private firm i due to public sector activities. The parameter θ measures the intensity of this externality. It may take either sign depending on whether the public sector creates positive or negative externalities.

Given the assumption of identical firms, aggregation over n firms yields total private sector output as:

$$Y = A_Y K_Y^\alpha L_Y^\beta X^{\gamma+\theta} \quad (3)$$

where Y is total private sector output and K_Y and L_Y are total privately employed capital and labor. Similar to the case of the public sector, private sector technology is assumed to grow exponentially at the rate τ_Y . By definition the value of aggregate output of the economy is identical to the value of private sector production.

Secondly, we consider the possibility of deviations between the sectoral marginal factor productivities. Let ν_j^k stand for the marginal productivity of factor k ($k = K, L$) in sector j ($j = X, Y$), and P_X and P_Y denote prices of public and private sector goods. If firms in both sectors minimize costs, then the first order conditions are:

$$\begin{aligned} \nu_X^L &\equiv \frac{\phi X}{L_X} = \frac{W}{P_X}; & \nu_X^K &\equiv \frac{\delta X}{K_X} = \frac{R}{P_X}; \\ \nu_Y^K &\equiv \frac{\alpha Y}{K_Y} = \frac{R}{P_Y}; & \nu_Y^L &\equiv \frac{\beta Y}{L_Y} = \frac{W}{P_Y}; & \gamma \frac{Y}{X} &= \frac{P_X}{P_Y} \end{aligned}$$

The last term on the second line indicates that the marginal productivity of the intermediate good is equal to the public-private relative price. These conditions imply that capital and labor's private-public marginal productivity ratios are equal to the public-private price ratio, which, in turn, is equal to the marginal productivity of intermediate good:⁷

$$\frac{\nu_Y^K}{\nu_X^K} = \frac{\nu_Y^L}{\nu_X^L} = \frac{P_X}{P_Y} = \gamma \frac{Y}{X} \quad (4)$$

The discussion in section II raises doubts about the validity of conditions (4), however. The alleged inefficiencies of the public sector, for instance, may imply that the values of marginal productivities of privately employed capital and labor are greater than their public counterparts. Recognizing this possibility, I rewrite the public sector first order conditions in a more general form where the values of marginal productivities of public capital and labor differ from rental and wage rates by a given proportion (assumed to be constant across the factors):

$$\nu_X^{*L} \equiv \frac{\phi X}{L_X} = \frac{W}{(1+\rho)P_X}; \quad \nu_X^{*K} \equiv \frac{\delta X}{K_X} = \frac{R}{(1+\rho)P_X}.$$

$\rho > 0$ implies that values of marginal factor productivities in the public sector are smaller than those in the private sector. Thus, ρ is a wedge driven between the sectoral marginal productivities of each factor of production, and private-public ratios factor marginal productivities are larger than the marginal productivity of intermediate good. First order conditions (4) are now written as:

$$\frac{\nu_Y^K}{\nu_X^{*K}} = \frac{\nu_Y^L}{\nu_X^{*L}} = (1+\rho) \frac{P_X}{P_Y} = (1+\rho) \gamma \frac{Y}{X}. \quad (5)$$

Next question is the estimation of these spillover and distortion effects. Employment and capital stock data at the sectoral levels are not available and therefore empirical tests of public sector externalities cannot be conducted by estimating sectoral production functions. It is necessary to formulate the econometric model at the aggregate level. In order to obtain the aggregate model, I first differentiate sectoral production functions (1) and (3):

$$dX = X\tau_X + \nu_X^{*K} dK_X + \nu_X^{*L} dL_X, \quad (6)$$

$$dY = Y\tau_Y + \nu_Y^K dK_Y + \nu_Y^L dL_Y + (\gamma + \theta) \frac{Y}{X} dX. \quad (7)$$

⁷ Note that in contrast to Feder (1986), the relative price P_X/P_Y here is not a constant. This follows from the assumption that X enters into the production function of Y as a direct input in addition to the externality effect.

Utilizing conditions (5), marginal productivities of publicly employed capital and labor are expressed as:

$$\nu_X^{*K} = \frac{\nu_Y^K}{(1+\rho)\gamma(Y/X)}, \quad \nu_X^{*L} = \frac{\nu_Y^L}{(1+\rho)\gamma(Y/X)}.$$

Substitution of these expressions into equation (6) yields:

$$(1+\rho)\gamma(Y/X)dX = (1+\rho)\gamma Y \tau_X + \nu_Y^K dK_X + \nu_Y^L dL_X,$$

which is used to manipulate equation (7):

$$dY = Y\tau_Y + (1+\rho)\gamma Y \tau_X + \nu_Y^K dK_Y + \nu_Y^L dL_Y + \nu_Y^K dK_X + \nu_Y^L dL_X + (\theta - \rho\gamma)\frac{Y}{X}dX. \quad (8)$$

By definition, total labor force and capital stock is the sum of labor and capital employed by the public and private firms ($L = L_Y + L_X$, $K = K_Y + K_X$). Also, letting $\tau = \tau_Y + (1+\rho)\gamma\tau_X$, equation (8) is written as:

$$dY = Y\tau + \nu_Y^K dK + \nu_Y^L dL + (\theta - \rho\gamma)\frac{Y}{X}dX. \quad (9)$$

According to this formulation, the direct contribution of the public sector to growth via mobilization of capital and labor are subsumed under the aggregate inputs K and L . The term X captures the public sector spillovers and distortions. The coefficient of $(Y/X)dX$, a composite of the externality and the marginal productivity deviation parameters θ and ρ , measures the response of final output to variations in X . If $\theta - \rho\gamma = 0$, then the final output is a function of the sum of the public and private sector employment and capital only. If positive spillover effects dominate, then the total contribution of the public sector exceeds the direct resource mobilization effect and the term $\theta - \rho\gamma$ would be positive. Conversely, if distortions and negative externalities dominate, this coefficient is expected to be negative.⁸

IV. THE ECONOMETRIC MODEL

The objective of this section is to gauge the contribution of labor, capital and public sector externality/distortions to growth by estimating a version of equation (9). Given data limitations, several transfor-

⁸ Similarities and differences between this analysis and Ram (1986) is worth mentioning. Ram utilized essentially the same framework to investigate the relationship between the government size (measured by government consumption expenditures) and aggregate output growth. The two studies differ in terms of their both dependent and independent variables, specification of the relationship between the two sectors, and specification of the final growth equation. The present study focuses on the public sector industrial output and introduces this variable into the private sector production function as an input [a possibility raised by Ram (1986, p. 193) but judged to be ad hoc and not pursued] as well as externality.

mations are required to perform this task. Two standard procedures concern the capital and labor variables. First, I substitute investment (I) for the change in capital stock. Second, it is assumed that there exists a linear relationship between the marginal productivity of labor in a given sector and the aggregate output-labor ratio (Bruno, 1968) such that:

$$\nu_Y^L = \lambda \frac{Y}{L}.$$

Letting $\pi = (\theta - \rho\gamma)$ to simplify notation, and dividing all terms by Y , equation (9) is written in growth form as:

$$\dot{Y} = \tau + \nu_Y^K \frac{I}{Y} + \lambda \dot{L} + \pi \dot{X}. \quad (10)$$

where the 'dot' indicates the percentage rate of change ($\dot{x} = dx/x$).

There still remains the problem of measurement of \dot{X} . There do not exist systematic data on public sector production levels for any country. I resolve this problem utilizing data on the share of the public enterprise output in gross domestic product (X/GDP) compiled by Short (1984) for a cross-section of countries. It is straightforward to manipulate this figure and to transform equation (10) into an estimable form. Note that:

$$\dot{X} \equiv \frac{Y}{X} \Delta \left(\frac{X}{Y} \right) + \dot{Y}.$$

where Δ denotes the level change. Substituting this expression into equation (10) I obtain:

$$\dot{Y} = \tau + \nu_Y^K \frac{I}{Y} + \lambda \dot{L} + \pi \left[\frac{Y}{X} \Delta \left(\frac{X}{Y} \right) + \dot{Y} \right].$$

Solving this equation for \dot{Y} , the final regression equation is obtained as:

$$\dot{Y} = \frac{\tau}{1-\pi} + \frac{\nu_Y^K}{1-\pi} \frac{I}{Y} + \frac{\lambda}{1-\pi} \dot{L} + \frac{\pi}{1-\pi} \frac{Y}{X} \Delta \left(\frac{X}{Y} \right) + u. \quad (11)$$

where u is the error term. Parameters τ , ν_Y^K , λ and π can be estimated by non-linear least squares.

Once written as equation (11) form, data difficulties are somewhat alleviated. Short's figures permit calculation of $(Y/X)\Delta(X/Y)$.⁹ I measure Y as the industrial output—manufacturing, construction, mining, and utilities (gas, electricity). L should be measured as the industrial labor force, but lacking data for most countries it is proxied by population. Finally, I stands for industrial sector investment. Again sectoral investment figures were not readily available and therefore I used aggregate net fixed investment as a proxy.¹⁰

⁹ Note that $\Delta(X/Y)$ is calculated as $\Delta[(X/GDP)(GDP/Y)]$.

¹⁰ Data source for investment, industrial output, population and gross domestic product for all countries except Taiwan is *World Bank Tables*. Figures for Taiwan come from *Taiwan Statistical Yearbook*.

These proxies are likely to bias the estimates of the associated coefficients and, as I note below, care must be shown in interpreting the results.

Short's figures on the variable (X/GDP) determined the layout of data points used in estimation. He provides, for each country, the average share of public sector output in the GDP over certain periods. The length of each period is variable, ranging from one to four years (but in most cases it is three or four years). Accordingly, I defined all variables (Y , GDP , L , and I) over the periods for which average X/GDP figures are available. Specifically, period j 's observations of Y , GDP , and L are obtained as annual averages of the period, i.e. letting Z stand for the relevant variable, $Z_j = \frac{1}{k} \sum_{i=1}^k Z_{i,j}$ (k is the number of years in the period), and growth rates are then calculated over these observations as $\dot{Z}_j = \frac{Z_j - Z_{j-1}}{Z_{j-1}}$. Finally, investment in period j is the sum of investment expenditures over the period: $I_j = \sum_{i=1}^k I_{i,j}$. This is the appropriate definition because the growth equation links the rate of growth of output from j to $j+1$ to the contribution of capital accumulation in period j .

The procedure described above is consistent with those used in the empirical studies of growth. Cross-sectional studies of growth typically define the data points as averages over several years in order to filter out the effects short-term fluctuations on labor and investment. The chosen length of period in these studies is usually a decade. In our sample, due to the limitations imposed by the public sector data, these intervals are much shorter. As mentioned above, most of the averages are calculated over the maximum length of four years. Thus, due to the lack of data, the present study does not accomplish as good a job in isolating the variables from business cycles as other empirical studies of growth.

The sample countries are selected among those for which more than one observation (as defined above) are available so that changes can be calculated. Attention is also paid to selecting countries for which the public sector is defined consistently. Variable X ideally measures the output of the public industrial firms. In the sample used in this paper, X is defined fairly uniformly as the output of all or the largest non-financial public enterprises.¹¹ The sample consists of seven industrialized countries and eighteen developing countries. The total number observations used in the estimation is 50, 16 for industrialized and 34 for developing countries.¹²

All regressions reported in this section are estimated by non-linear least squares. Two points have to

¹¹ Detailed description of data on individual country basis is provided in Short (1984, pp. 182-194).

¹² *DCs*: Australia (2), *Austria (3), France (3), *Germany (1), Greece (1), *Italy (3), UK (3); *LDCs*: Argentina (1), *Bolivia (1), *Botswana (1), Chile (1), *Guyana (2), India (5), Republic of Korea (1), Mali (1), Mexico (1), Pakistan (3), *Paraguay (2), Sri Lanka (2), Taiwan (2), Tanzania (2), Thailand (1), Tunisia (1), *Turkey (5), *Venezuela (2). In line with Short's data gross domestic product of countries marked by asterisk is measured at market prices, and at factor cost otherwise. The numbers in parentheses indicate the number of observations for each country.

be made regarding estimation before reporting the results. First, the averaging procedure described above implies that the larger is the number of years over which the period is defined, the smaller is the error of the variance term, and, consequently, residual errors are potentially heteroskedastic. Inspection of residuals and heteroskedasticity tests indicate that this is not a serious problem, and therefore no corrections are attempted in the estimations. Secondly, growth equation estimates typically suffer from simultaneous equations bias because the right hand side variables (e.g. investment) are often a function of the dependent variable. This problem is also encountered in the case of the present focal variable, public sector output. It may be argued that the dependent variable \dot{Y} explains \dot{X} because the intermediate good production level may be determined by the input demand of the final-good producing sector. \dot{X} would then be positively correlated with the error term u , and its estimated coefficient would be upward biased. Lacking appropriate instrumental variables, I did not attempt correcting this bias, but interpreting the results it should be kept in mind that the reported value of π is an overestimate of its actual value.

Estimates of equation (11) are reported in columns 1 and 2 of Table 1. In the first trial the coefficient π is restricted to zero in order to see whether the present sample supports conclusions of the previous studies of the basic growth model. As reported on column 1, without the public sector variable, the model explains 42 percent of the variation in industrial output growth. Both investment and labor growth turn out to be statistically significant, at the 5 and 1 percent levels, respectively. The magnitude of λ is much larger than those found in earlier studies, more than twice the figures reported in Feder (1984). The explanation probably lies in utilization of population as a proxy for the industrial labor force. Urbanization and the switch of labor from the traditional agricultural sector to the industrial sector cause industrial labor force to grow in excess population (Robinson, 1971). Thus, population proxy biases the estimate of the elasticity of industrial output with respect to labor in the upward direction.¹³ This has not been as serious a problem for other studies because their dependent variable was total output growth whereas in this paper it is the industrial output growth. Secondly, the order of the marginal productivity of capital is small relative to those obtained in comparable studies. The definition of the independent variable may explain the difference. The independent variable here is the industrial sector investment but it is proxied by total investment. Therefore, the reported figure underestimates the marginal productivity of capital in the industrial sector. As columns 2 to 4 of Table 1 show, specifications including the public sector variable did not change these two results at

¹³ Let L_T be equal to the sum of industrial (L_I) and agricultural (L_A) labor force. Then $\dot{L}_T = s\dot{L}_A + (1-s)\dot{L}_I$ where s is the share of agricultural labor force in the total. Also let $\dot{L}_T = \psi\dot{L}_A$ where $0 \leq \psi \leq 1$. Thus $\dot{L}_I = \frac{1-s\psi}{1-s}\dot{L}_T$. If $\psi = 1$ then sectoral labor forces grow at the same rate and therefore total labor force is an appropriate proxy for the industrial. However, $\psi < 1$ implies that the industrial labor force grows faster than the total and utilizing \dot{L}_T (loosely speaking, population) as a proxy yields an upward biased estimate of the output elasticity of industrial sector labor force.

all.

As reported in column (2) the addition of the public sector variable raises the explanatory power of the regression by 20 percent. The estimate of the parameter π is negative and statistically significant at the 10 percent level, which implies that the public sector output creates distortions which lower the industrial output growth rate.

So far, DCs and LDCs are pooled together under the implicit assumption that they share the same production function. Most researchers, however, suspect the plausibility of this homogeneity assumption on the basis that such a structural commonality is expected to hold at best for countries at similar states of development. In response, I divide the sample into two groups of developed and less-developed countries, and utilize intercept and slope dummies to test whether there are structural differences between them.¹⁴ The new econometric model is given by:

$$\begin{aligned} \dot{Y} = & \frac{\tau}{1-\pi} + \frac{\nu_Y^K}{1-\pi} \frac{I}{Y} + \frac{\lambda}{1-\pi} \dot{L} + \frac{\pi}{1-\pi} \frac{Y}{X} \Delta \left(\frac{X}{Y} \right) + \\ & \frac{\tau'}{1-\pi'} \cdot D_{DC} + \frac{\nu_Y^K}{1-\pi'} \frac{I}{Y} \cdot D_{DC} + \frac{\lambda'}{1-\pi'} \dot{L} \cdot D_{DC} + \frac{\pi'}{1-\pi'} \frac{Y}{X} \Delta \left(\frac{X}{Y} \right) \cdot D_{DC} + v. \end{aligned} \quad (12)$$

where D_{DC} is a dummy variable which is unity for DCs and zero for LDCs, and v is the error term. Columns (3) and (4) of Table (1) report these estimation results. Wald tests indicate that the dummies as a group are not significantly different from zero, failing to reject the hypothesis that the developed and underdeveloped countries have different structures.

The sources of growth are decomposed in Table 2 for both the full sample and the LDCs. The negative impact of the public sector distortions is 5.1 percent (0.012/0.234) of the total growth in the complete sample and 6.9 percent (0.020/0.288) in the LDC sample.

It may also be argued that the relative size of the public sector also belongs to the set of explanatory variables. The underlying argument is that the rate of growth of final output is related to the *scale* of public sector activity as well as its rate of growth. Although the present theoretical framework does not allow its inclusion, I estimated an augmented growth equation where the scale variable X/Y is added to the independent variables in order to assess the impact of this alternative specification on the parameter estimates. The new regression equation is:

$$\dot{Y} = \frac{\tau}{1-\pi} + \frac{\nu_Y^K}{1-\pi} \frac{I}{Y} + \frac{\lambda}{1-\pi} \dot{L} + \frac{\pi}{1-\pi} \frac{Y}{X} \Delta \left(\frac{X}{Y} \right) + \frac{\kappa}{1-\pi} \frac{X}{Y} + w. \quad (13)$$

¹⁴ It may be argued that even this categorization does not suffice as there are significant differences between semi-industrialized countries and non-industrialized countries. However, data limitations do not allow a finer distinction.

where the parameter κ measures the responsiveness of growth to the relative size of the public sector and w is the error term. Results of estimation are reported on column 5 of Table 1. As observed, the relative size of the public sector has a negative and statistically significant effect on growth. However, since there does not exist a theoretical structure from which the parameter κ is derived, it is difficult to interpret this result. More importantly, however, this alternative ad hoc specification does not have any significant effect on the previously reported parameter estimates. Thus, even if equation (13) is the correct specification, the conclusions reported so far are not seriously flawed.

Although these results seem to corroborate the claims of the critics of the public sector, one has to be careful in interpretation. As already mentioned, in the present formulation, the public sector contributes to growth via mobilization of factors of production (subsumed under the total labor and capital terms) and the externality and distortion effects. In drawing policy recommendations both of these channels should be kept in mind. To illustrate this point, consider the situation where the public sector capital stock is transferred to the private sector through privatization. Ignoring transactions costs, according to our calculations, this transfer boosts the industrial output growth approximately by 6.9 percent (in the LDC group), which is not an insubstantial amount.

Recent experiments with privatization, however, have shown that the private sector is often less than eager to take over the public sector firms. Given this lack of interest, an alternative policy is to suspend the operations of the public sector altogether in order to stop the budgetary drain—an action voiced by several policy-makers in the Third World such as Argentina's Menem or Turkey's Özal. Even if it is assumed that the initially public-supplied intermediate goods can be imported without much difficulty, such a move tosses away resource mobilization effect of public sector along with the unwanted distortions. If the former dominates the latter, then termination of public enterprises is a net loss to the economy. In order to assess the possibility of net loss or gain consider the following rough calculation. In our sample, the average share of public sector output in total industrial output is 30 percent. Suppose that this is the percentage of total capital employed by the public sector. Then, it is observed from the second column of Table 2 that while liquidation of public sector and removal of distortions add 6.9 percent to output growth, it also reduces output growth by approximately 10 percent ($0.30 \times 0.096 / 0.288$) due to the decumulation of capital. This loss is also an underestimate of the losses that would be incurred considering declining labor productivity arising from the lower capital stock, as well as the fact that the public sectors are traditionally more capital intensive and likely to employ more than the 30 percent of the capital stock. Although this numerical exercise is very crude, it illustrates the possible losses or triviality of gains from the liquidation.¹⁵

¹⁵ Obviously the complete listing and discussion of the items entering the cost-benefit calculus which would serve as the basis of policy choice lie outside the scope of this paper.

Another point that needs to be raised is that decisions regarding the future of the public sector enterprises should be made at the firm level, not the aggregate. Historically it is observed that public enterprises are created or acquired in a variety of ways and it would be incorrect to assume that they form a homogenous unit. Within the public sector highly "successful" firms may coexist with flops. Thus, positive and negative welfare effects of each firm should be weighed individually. Depending on the firm, the proper policy may turn out to be divestment, liquidation, privatization, or revitalization of the public enterprise.

VI. CONCLUSIONS

This paper presented and estimated aggregate growth equation to assess the externalities and distortions created by public industrial enterprises. Cross-country evidence clearly indicates that industrial output growth is negatively related to the public sector growth. Distortions and inefficiencies of public sector firms dominate any positive externalities they may have. This finding should create concern regarding the involvement of the state in industrial activities and underscore the need for policy changes regarding public enterprises. The methodology utilized in this paper, however, does not permit specific recommendations or endorsement of any particular proposal because: (i) it does not adequately measure the direct resource mobilization effect of the public sector and therefore does not yield a full account of its contribution to growth; and (ii) it does not identify the sources of externalities and distortions which are needed to make specific interventions at the firm level. The first question can be answered at the aggregate level as data become available. The second question has to be pursued at the firm level case studies.

It may also be argued that there is a conflict between maximizing welfare and maximizing growth, and that activities of public enterprises are oriented to achieve the former by employment creation, technology development, income redistribution, and so forth. This paper does not challenge the legitimacy of these objectives, or favors growth against welfare maximization. Nor does it question the potential of the public sector to achieve them. It only highlights that the alleged welfare gains of the public sector has economic costs measured in terms of growth of industrial output. It is not possible to gauge the significance of this loss as opposed to the alleged welfare gains, however. Since measures of the latter associated with the various objectives of public enterprises are not available, steepness of this tradeoff between the growth and welfare maximization remains elusive.

Finally, it should also be pointed out that the present study does not capture the probable temporal dimensions to externalities, which is desirable for a fuller assessment of the public sector. A life cycle hypothesis may be proposed for public sector enterprises: positive externalities of the public sector dominate in the early stages of development where there is little indigenous private capital and distortions take over in

the later stages after the private sector matures. Although time-series data requirements are considerable, this line of investigation may be feasible for number of developing countries.

TABLE 1: Estimates of Equations (11), (12) and (13)

	(1)	(2)	(3)	(4)	(5)
τ	0.001 (0.01)	0.048 (0.66)	0.000 (0.01)	0.110 (0.97)	0.120 (1.59)
ν_Y^K	0.037 (2.42)**	0.046 (2.21)**	0.036 (2.25)**	0.045 (1.94)*	0.061 (2.97)***
λ	1.521 (4.16)***	2.099 (3.73)***	1.547 (3.27)***	1.885 (2.77)***	1.838 (3.62)***
π		-0.438 (2.06)*		-0.499 (2.00)*	-0.359 (1.93)*
τ'			-0.050 (0.26)	-0.095 (0.63)	
$\nu_Y'^K$			-0.032 (0.37)	0.030 (0.46)	
λ'			-1.307 (0.43)	-0.786 (0.35)	
π'				0.229 (0.43)	
κ					-0.411 (2.19)**
R^2	0.42	0.51	0.42	0.52	0.56
\bar{R}^2	0.39	0.48	0.35	0.44	0.52
$d.f.$	47	46	44	42	45
$F_{1,44}^a$			0.186		
$F_{1,42}^b$				0.618	

t-ratios in parentheses. *, ** and *** indicate statistical significance at the 10, 5 and 1 percent levels (two-tailed tests).

^aNull hypothesis: $\tau' = \nu_Y'^K = \lambda' = 0$.

^bNull hypothesis: $\tau' = \nu_Y'^K = \lambda' = \pi' = 0$.

TABLE 2: Sources of Growth

	Total Sample ^a	Developing Countries ^b
Constant	0.033	0.073
I/K	0.094	0.096
\dot{L}	0.119	0.139
\dot{X}	-0.012	-0.020
\dot{Y}	0.234	0.288

Numbers may not sum totals because of rounding.

^a Based on estimates from Table 1, column 2.

^b Based on estimates from Table 1, column 4.

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