

# Tracing the Privatization Movement in the U.K. and the U.S.: An Attempt to Address The Question of Industry Productivity

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## I. INTRODUCTION

Throughout the Reagan Administration, the dictum was: “regarding government, the less the better.” A corollary to this may be interpreted as the private sector routinely offers higher-quality goods and services at lower costs and with greater efficiency. The Administration had structured this thinking into formal policy on several occasions. Privatization has come to the United States.

Privatization—the transfer of federal properties and activities to the private sector and also the reduction in the role of government as the creator of markets and controller of private industry production—is not a new economic phenomenon. The United States is experiencing a renewed interest in the systematic examination of the boundaries between public and private deliveries of goods and services. This interest has been stimulated in part by the concern that the federal government has become too large, too expensive and too intrusive into our lives. The interest might also reflect the belief that new arrangements between the government and private sector might improve productivity and efficiency while offering greater opportunities and satisfaction for the people being served.

The United States, however, is not unique in its renewed interest in privatization. Privatization policies are currently in progress the world over—in Europe, the Americas, Japan and numerous developing and newly industrialized countries. Even countries organized on socialist principles, including the Soviet Union and the People’s Republic of China, have taken measures that seem to move in the direction of loosening the ties that bind their enterprises to the apparatus of government. (Vickers and Yarrow, 1988) Privatization would seem to be high on the political agenda of various countries throughout the world.

Although the worldwide trend toward privatization has accelerated dramatically in the past few years, the unquestioned “champion” for sweeping privatization is Great Britain. Prime Minister Margaret Thatcher’s government has made the sale of government commercial entities one of the principal themes of her administration. This paper will provide a brief overview of some of these developments both in Britain and in the United States to provide a basis for the proposed empirical research.

This interest in privatization is not new to the world, nor to the study of economics for that matter. In the *Wealth of Nations* Adam Smith addressed the economic consequences of privatization when he argued that:

“In every great monarchy in Europe, the sale of crown lands would produce a very large sum of money, which, if applied to the payment of public debts, would deliver from mortgage a greater revenue than any which those lands have ever afforded the crown. . . . When the crown lands had become private property, they would, in the course of a few years, become well improved and well cultivated.”

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Smith's view of the private vs. public ownership issue has not gone uncontested. Marx, in his critique of private ownership of the means of production, and others have constructed contexts where public management may perform better in terms of economic efficiency and overall productivity than private management. It is the question of productivity that this paper will ultimately address. (Vickers and Yarrow)

### *Techniques of Privatization*

There are basically three techniques employed for the privatization of the delivery of goods and services. The first method is by simply selling the government's assets. Examples of these sales include British Petroleum and Jaguar in Britain and Conrail and the National Cooperative Bank in the U.S.

The second technique is contracting out, whereby the government enters into contracts with private firms to provide goods and services demanded by the public or used by the government. This method may result in greater cost savings because the process is open to competition among the vendors. Contracting has been encouraged since 1955 in the U.S., when President Eisenhower approved a policy that "the Federal government will not start or carry on any commercial activity to provide a service or product for its own use if such a product or service can be procured from private enterprise through ordinary business channels."\*\*

The third main form of privatization, which has been questioned as a true mechanism of privatization is the use of vouchers, under which the government distributes purchasing power to eligible consumers. These consumers must then in turn, spend the funds received on designated goods or services. For example, housing vouchers provide low-income families with the means to obtain better housing in the rental market. Food stamps provide purchasing power to lower income families, enabling them to buy more or better food than their incomes would otherwise allow.

User fees have been classified as a method of privatization, although they do not involve the transfer of government functions, but resemble privatization in that they place the burden of paying for the services on those who are gaining benefits from their usage, rather than on the taxpayers in general. Also, deregulation of industry has been considered a form of privatization in its ability to curb government involvement and place heavier emphasis on the private sector.

All of the above methods of achieving privatization have been utilized to varying degrees at each of the local, state and federal levels of government in the United States. From the contracting out of garbage collection in San Francisco to the deregulation of express mail collection by the U.S. Postal Service, attempts at the privatizing of service provision have gained momentum in the last 15 years. Although much more might have been attempted in recent years at the federal level, there is growing interest in privatization, both in the divestiture of federal government assets to the private sector and in the more aggressive use of contracting.\*\*

### *The United States' Experience*

Contracting out in the United States has been employed often as the privatization technique most widely used at the state and local levels. Throughout the U.S., government bodies, principally in response to pressures from taxpayers for greater efficiency, have been relying on the private sector to get the jobs done.

On the federal level, the 1987 sale of Conrail marked the first major privatization initiative to come to fruition. This was later followed by the sale of loans by the Department of Education and the Farmers Home Administration. Even during the period when no highly visible privatization activities were taking place, use was being made of the contracting out procedures, most notably by the Defense Department.

In the fiscal 1988 budget, the Office of Management and Budget proposed a number of privatization initiatives. These included the sale of five power-marketing administrations, two oil fields owned by the Department of Energy, excess property owned by the General Services Administration, the Federal Housing Administration's rural housing insurance fund, auction of the unassigned radio frequency

spectrum, termination of federal crop insurance, sale of federal helium equipment assets, sale of Export-Import Bank loans, and Amtrak. The budget also included proposals for additional contracting out by the federal government.\*\*

The President's Commission on Privatization was established on September 2, 1987 "to review the appropriate division of responsibilities between the federal government and the private sector," and to identify those government programs that are not properly the responsibility of the federal government or that can be performed more efficiently by the private sector.\*\*

The Commission reviewed a broad spectrum of government activities which included the following: low-income housing, housing finance, federal loan programs, air traffic control and other FAA programs, educational choice, the Postal Service, contracting out with regard to military commissaries and prisons, federal asset sales (Amtrak; naval petroleum reserves), and other programs (Medicare; international development programs; urban mass transit). In all of these representative areas, the Commission found potential for improved efficiency, quality of service, or both, to be derived from increased private sector participation in the provision of services.

### *The British Experience*

Examining the U.K. experience with privatization must be done from a different perspective since it involves nationalized industries for the most part. The general principle underlying the management of state-owned industry in Britain has been a desire to combine public accountability with managerial autonomy in day-to-day decision making. There were many who felt that state ownership would create greater equality among individuals, that removal of profits would give a substantial advantage to consumers, and that the elimination of competition would reduce the extreme fluctuations of the business cycle. State ownership would also eradicate activities that were viewed as wasteful and extravagant, such as advertising. In the words of Harold Wilson, state ownership was later seen as a way to "render accountable to the public the power of those increasingly anonymous, unidentifiable, often faceless, more often soulless corporations, national and multinational."

At the national level, Britain has adopted three main forms of public ownership. The first involves organization of the industry as a department of state under the direct control of a minister of the Crown. In this situation, the minister is responsible to the Parliament for the day-to-day running of the industry. The second type of ownership involves a sole, or majority, state shareholding in an otherwise normal commercial company. The third, and by far the most important type of state-owned enterprise has been the public corporation. The aim of this institutional innovation was to combine freedom for management from Government supervision of the daily operations with public control of the broader policies of the enterprises. Table 1 shows a list of the major public corporations in 1979.

However, public ownership is most frequently criticized on the ground that it typically fails to establish efficient incentive structures for decision makers in the public sector firms. Many scholars studying privatization emphasize cutting the size of government. They also compare the efficiency and productivity of private and public enterprises. Economists stress the importance of competition in fostering efficiency and argue that the threat of entry is sufficient to inhibit firms from earning monopoly profits.

The year 1979 is a decisive breaking point in the history of public enterprise in Britain. Until that year there was a clear trend in the direction of increasing the numbers of firms under public ownership. However, since 1979, the privatization program has produced a sharp movement in the opposite direction. Among the entities sold to workers, consumers, and the general public are British Rail Hotels, English Channel Ferry Service, Jaguar (automobiles), British Petroleum, British Aerospace, Britoil, National Freight Corporation, Gibraltar Dockyard, the British Telecom system, British Gas, British Airways, British Airports Authority, and Rolls Royce.\*\*

The Thatcher government's sale of more than a million public-owned housing units to residents affected the approximately 40 percent of British families who formerly lived in this "council housing." By selling these units, the government divested itself of money losing facilities, eliminated costly operating subsidies, received income in the form of sales payments, and made independent homeown-

**TABLE 1**  
Public Corporations in Existence: December 1979

Bank of England	National Enterprise Board
British Aerospace	National Film Finance Corp. National Freight Corporation
British Airports Authority	National Ports Council
British Airways Board	National Research Development Corporation
British Broadcasting Authority	National Water Council
British Gas Corporation	New Town Development Corporations and Commission
British National Oil Corp.	Northern Ireland Development Agency
British Railways Board	Northern Ireland Housing Executive
British Shipbuilders	Northern Ireland Transport Holding Company
British Steel Corporation	Northern Ireland Electricity Serv.
British Transport Docks Board	North of Scotland Hydro-Electric Board
British Waterways Board	Passenger Transport Executives & London Transport Executive
Cable and Wireless Ltd.*	Post Office
Civil Aviation Authority	Property Services Agency
Commonwealth Development Corporation	Regional and National (Welsh) Authorities
Covent Garden Market Auth.	Royal Mint
Development Board Rural Wales	Royal Ordnance Factories
Electricity Council	Scottish Transport Group
Highlands and Islands Dev. Board	South of Scotland Electricity Board
Housing Corporation	Trust Ports
Independent Broadcasting Agen.	Welsh Development Agency
Land Authority for Wales	
National Bus Corporation	
National Coal Board	
National Dock Labour Board	

\*Classed as a public corporation in the national accounts.

Source: *National Income and Expenditure* (1980 edn.)

ers out of dependent government residents. The result even won considerable support from the opposition Labor Party.

Some economists will argue however, that privatization has not achieved the major benefits others have claimed for it. Most privatization attempts have been of public utilities and the major result has been that giant public monopolies have become private-sector ones under the same management. It has however, brought monies into the government coffers and increased the attention given to efficiency, and does not seem to have caused any economic losses.\*\*

### *Privatization and Productivity*

Most of the attempts to assess the relative productivity of nationalized and/or privatized industries in the U.S. and Britain have been based upon the analysis of one or more of a variety of productivity indices. There have been few, if any attempts to measure productive aspects of these industries from a parametric-production function approach. Such studies could greatly enhance what is already known about those state-owned enterprises which may potentially be privatized or those firms which have already been returned to the control of the private sector.

Vickers and Yarrow (1988) examine labor and total factor productivity trends for selected British nationalized enterprises for the years 1968-1985. These trends are summarized in Table 2. As can be seen, there are considerable variations among the productivity figures of those industries. The data summarized in this table and in Table 3 represent the norm with respect to the types of productivity studies being done in the area. Most attention has been focused on the limited objective of assessing changes in productivity over time rather than on observed (or derived) productivity levels. Similar studies have been conducted for several U.S. public-managed industries, the Postal Service being one.

**TABLE 2**  
Productivity Trends in Selected Nationalized Industries, 1968-1985

	Output per head (% per annum)		Total factor productivity (% per annum)	
	1968-78	1978-85	1968-78	1978-85
British Rail	0.8	3.9	n.a.	2.8
British Steel	-0.2	12.6	-2.5	2.9
Post Office	-1.3	2.3	n.a.	1.9
British Telecom	8.2	5.8	5.2	0.5
British Coal	-0.7	4.4	-1.4	0.0
Electricity	5.3	3.9	0.7	1.4
British Gas	8.5	3.8	n.a.	1.2
National Bus	-0.5	2.1	-1.4	0.1
British Airways	6.4	6.6	5.5	4.8
U.K. manufacturing	2.7	3.0	1.7	n.a.

Source: Vickers and Yarrow (1988)

There is however, a conspicuous absence of production function attempts at isolating productivity-efficiency aspects of these industries that may be returned to private management. It is the purpose of the remaining portion of this paper, to propose a potential framework for a more intense analysis of the productive aspects of these industries.

### *Toward an Empirical Model*

The pioneering works of Solow (1957) and others in measuring technical change, and by Christensen (1976) in the empirical estimation of scale economies, have provided some of that direction

**TABLE 3**  
Summary of the Efficiency Findings of the Monopolies and Mergers Commission

Case	Management Structure	Financial Control	Use of Manpower	Use of Performance Indicators
British Rail	2	4	2	3
Severn Trent Water Authority	1	2	2	2
Central Electricity Generating Board	—	4	3	4
Anglian Water Authority & North West Water Authority	—	2	4	3
National Coal Board	2	2	—	2
Yorkshire Electricity Board	2	3	3	3
Various bus companies	2	3	2	3
Civil Aviation Authority	2	2	2	2
London Transport Executive	3	2	1	3
South Wales Electricity Board	2	3	3	3
Average Score	2.0	2.7	2.4	2.8

1. Severe criticisms.
2. Critical comments.
3. Suggestions for improvement.
4. Generally satisfactory.
- , Inconclusive or not covered.

Source: Vickers and Yarrow (1988)

mentioned above. There have also been recent contributions to the theory of production made possible by recourse to duality theorems which have greatly aided these empirical studies. The most notable of these contributions has been the introduction of generalized functional forms of flexible production and cost functions. These contributions have allowed us to seek additional information concerning productivity and technological progress.

In recent years there have been significant increases in both the theoretical and empirical analysis of two major economic areas. The first of these fields is the concept of economic growth and the sources, causes, and limits associated with that growth. Such things as technological increases, the exploitation of economies of scale, and relatively inexpensive material resource prices have all been cited as contributing factors to the rapid, post World War II economic growth observed in the United States and in certain industries of the U.K. There have been many studies attempting to estimate and identify the scale economies associated with various industries and regions, but the remaining questions and unexplored avenues are still great in number. Likewise, technological progress, although long regarded as one of the important causes of economic growth, drew little attention from economists until recently. This is due to the fact that it has generally been considered as an exogenous variable, one beyond the scope of empirical economic inquiry. In estimating the sources of economic growth in the U.S. a large part of the growth contribution is taken up by technological progress. Through the years this term has really become a catchall for omitted factors and poor measurement of the capital and labor inputs. Much of the further work has centered on the exploration of this residual, that is, growth not explained by capital accumulation or increased labor input. This bears a resemblance to the methods used to assess the productivity trends of Britain's and the U.S.' state-operated industries. Additional research is needed in order to fully understand and examine the significance that aspects of production—such as economies of scale and technical change—have in determining the extent of economic growth for these enterprises and to potentially assess the benefits which could accompany privatization.

Within the context of these issues, the next phase of this research is to modify and extend earlier empirical works which have sought to estimate industry productivity and/or technical change and to apply certain techniques to representatives of the aforementioned industries. Specifically, a flexible functional form may be used to isolate parameters for selected industries. These parameters, once estimated, would then be presented in order to determine what effects they may have had in contributing to the overall growth and productivity in the selected industries over the period represented by data.

Parameters which carry information regarding scale economies and technical change might also contribute to the formulation of economic and industrial policies on the regional and national levels. "Productive" industries could be defined and targeted as potential sources of increased growth at these levels. Many studies have been done emphasizing "rapid growth" industries and targeting those industries for increased investment. However, few have sought to accurately measure the actual degree of contribution of individual sources in any sophisticated manner. These sources, once identified, could add greatly to the tools used by those involved in designing privatization policies. This study has the potential to be applied to such areas.

Before outlining the proposed model, some attention should first be given to the rationale for employing a flexible functional form in the estimation procedure. The reasons are actually twofold; 1) Such formulations represent the current edge of the econometric-theoretical frontier, and therefore warrant further investigation and usage, and 2) these forms, by their very nature, are not as restrictive and do not place the serious restrictions on parameters (such as the elasticities of substitution between input variables) as did their earlier counterparts. However, discrimination among such functional forms on theoretical grounds is difficult. This is due to the fact that each flexible form can be interpreted as a second order approximation to some arbitrary twice differentiable function of the variables involved. Choice could then be made on the criterion of ease of estimation and/or appropriate stochastic specification. For this research one flexible functional form which merits particular attention is similar to that used by Berndt and Khaled (1979)—the generalized Box-Cox (GBC) functional form. This form is compatible with the national (aggregated) data which would need to be used in the research. The

GBC will also allow for the estimation of parameters which reflect the aspects of economic growth mentioned earlier.

The specific parameters of interest in this research would be industry specific. These parameters would consist of: 1) indexes of economies of scale exhibited by each industry, 2) indices of technological change (which the GBC can readily be adapted to provide) and technical change bias, and 3) an index of total factor productivity. Once these parameters are estimated they will then be used to examine and possibly "explain" the productive aspects of each industry.

**The Model**

It is assumed that the production technology of the various industries to be studied is a continuous, twice differentiable, and concave function in the three inputs and that the input levels are chosen to minimize the total cost of producing a specified quantity of output subject to the given knowledge at hand and prices. The effect of time, *t*, is allowed to represent the overall effect of technological progress.<sup>1</sup> The minimum total cost function is then;

$$(1) \quad C = f(P_K, P_L, P_I, Y, t)$$

which, by duality, would have the properties of linear homogeneity and concavity in prices.

Incorporating disembodied technical change into the GBC cost function specification gives

$$(2) \quad c = [(2/\lambda) \sum \sum P_i P_j]^{1/2} Y^{\beta(Y,P)} e^{-\tau(t,P)}$$

where  $\beta(Y, P)$  is defined as

$$(3) \quad \beta(Y, P) = \beta + (\Theta/2) \ln Y + \sum \phi_i \ln P_i$$

and  $\tau(t, P)$  is defined as

$$(4) \quad \tau(t, P) = t(\tau + \sum \tau_i \ln P_i)$$

As before, differentiating (2) with respect to the exogenous input prices and employing Shephard's Lemma, yields the following system of input-output equations, which, when observed unit costs are inserted, takes the form

$$(5) \quad s_{it} = [(2/\lambda) \sum \sum (P_j/P_i)^{\lambda/2}] Y^{[\beta(Y,P)-1]} e^{-\tau(t,P)} (c^*/P_i)^{1-\lambda} + (\phi_i \ln Y + \tau_i t)(c_i^*/P_i) + u_{it}$$

The actual estimation procedure is applied to the individual share equations given by the general form of (5). Making the appropriate substitutions, the system of equations which is actually estimated takes the form

$$(6) \quad \begin{aligned} s_{Kt}^* &= [2/\lambda(\gamma_{LK}(P_L/P_K)^{\lambda/2} + \gamma_{KK}(P_K/P_K)^{\lambda/2} + \gamma_{IK}(P_I/P_K)^{\lambda/2})] \\ &\quad + Y^{[\lambda(\beta+\Theta/2 \ln Y + \phi_L \ln P_L + \phi_K \ln P_K + \phi_I \ln P_I - 1)]} e^{\lambda(\tau + \tau_L \ln P_L + \tau_K \ln P_K + \tau_I \ln P_I)} \\ &\quad \cdot (c_i^*/P_K)^{1-\lambda} + [\phi_K \ln Y + \tau_K t] c_i^*/P_K \\ s_{Lt}^* &= [2/\lambda(\gamma_{LL}(P_L/P_L)^{\lambda/2} + \gamma_{KL}(P_K/P_L)^{\lambda/2} + \gamma_{IL}(P_I/P_L)^{\lambda/2})] \\ &\quad + Y^{[\lambda(\beta+\Theta/2 \ln Y + \phi_L \ln P_L + \phi_K \ln P_K + \phi_I \ln P_I - 1)]} e^{\lambda(\tau + \tau_L \ln P_L + \tau_K \ln P_K + \tau_I \ln P_I)} \\ &\quad \cdot (c_i^*/P_L)^{1-\lambda} + [\phi_L \ln Y + \tau_L t] c_i^*/P_L \\ s_{It}^* &= [2/\lambda(\gamma_{LI}(P_L/P_I)^{\lambda/2} + \gamma_{KI}(P_K/P_I)^{\lambda/2} + \gamma_{II}(P_I/P_I)^{\lambda/2})] \\ &\quad + Y^{[\lambda(\beta+\Theta/2 \ln Y + \phi_L \ln P_L + \phi_K \ln P_K + \phi_I \ln P_I - 1)]} e^{\lambda(\tau + \tau_L \ln P_L + \tau_K \ln P_K + \tau_I \ln P_I)} \\ &\quad \cdot (c_i^*/P_I)^{1-\lambda} + [\phi_I \ln Y + \tau_I t] c_i^*/P_I \end{aligned}$$

where  $s_i^*$  is the *i*th input's share of output (e.g.  $s_{Kt}^* = K/Y$ ), *Y* is total output,  $P_i$  is the price of input *i*,  $c^*$  is the observed per unit cost of output (i.e.  $c^* = TC/Y$ ), and *t* is time.

TABLE 4

Nonlinear 3-Stage Least Squares Parameter Estimates for The GBC, Industries GOV1-GOV3 and PRZ1-PRZ3, 1955-1984

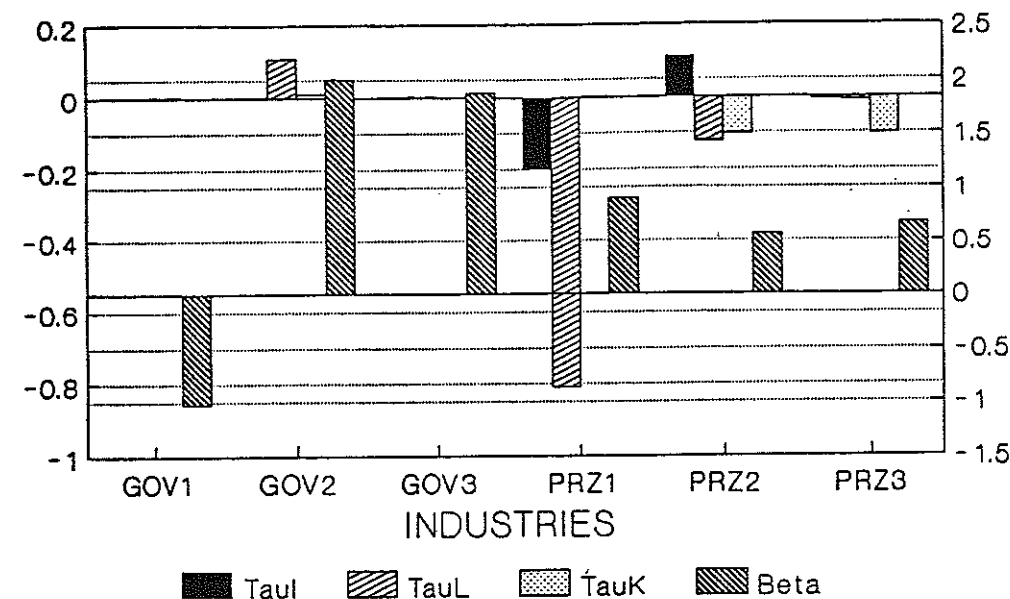
Parameter/Industry	GOV1	GOV2	GOV3	PRZ1	PRZ2	PRZ3
$\lambda$	.1350 (2.14)	.2369 (1.11)	.2434 (3.01)	.3519 (2.45)	.7121 (3.11)	.7009 (2.98)
$\gamma_{LK}$	-.6342 (1.01)	.8784 (0.98)	.6756 (1.89)	.6665 (1.21)	.5436 (1.14)	.7012 (1.53)
$\gamma_{KK}$	.4361 (1.57)	.3245 (1.11)	.2016 (2.01)	.5319 (1.21)	.4678 (1.19)	.6781 (1.33)
$\gamma_{IK}$	.0190 (1.87)	.3001 (1.15)	.1101 (1.89)	.2110 (1.67)	.1980 (1.88)	.2008 (1.36)
$\gamma_{LL}$	-.7779 (2.90)	.2871 (3.19)	.1001 (1.78)	.6767 (2.55)	.4323 (1.99)	.6510 (2.90)
$\gamma_{IL}$	-.4675 (3.14)	.4332 (2.97)	.4476 (3.00)	.1190 (1.90)	.1212 (2.23)	.1999 (1.88)
$\gamma_{II}$	.2334 (2.13)	.2101 (1.88)	.1983 (2.12)	.3119 (1.89)	.2878 (2.22)	.3000 (1.76)
$\beta$	-1.0212 (3.12)	2.0100 (2.88)	1.8776 (3.55)	.8973 (4.91)	.5624 (4.12)	.6655 (7.19)
$\theta$	.7341 (2.12)	.3289 (2.09)	.3889 (2.11)	.9901 (2.32)	.8787 (3.01)	.8022 (1.90)
$\phi_L$	.0111 (2.00)	.0098 (0.90)	.1198 (2.91)	-.0890 (2.22)	-.1212 (2.00)	.0090 (1.88)
$\phi_K$	.0119 (3.11)	-.0021 (0.89)	.2339 (1.98)	-.1001 (2.09)	-.0988 (1.79)	-.2118 (3.10)
$\phi_I$	.0097 (3.09)	.1232 (1.09)	.2311 (2.32)	.0111 (2.17)	.1990 (1.88)	-.0656 (3.20)
$\tau$	.0001 (1.01)	.0001 (0.32)	.0001 (0.91)	.0001 (0.43)	.0001 (0.44)	.0001 (0.64)
$\tau_L$	.0023 (1.87)	.1090 (1.99)	.0034 (1.66)	-.0808 (1.78)	-.1221 (1.98)	-.0099 (2.07)
$\tau_K$	.0035 (1.89)	.0111 (2.00)	-.0002 (0.97)	.0015 (1.86)	-.1010 (2.05)	-.1003 (2.22)
$\tau_I$	.0011 (1.68)	.0002 (2.03)	.0004 (0.99)	-.1990 (1.78)	.1122 (0.62)	-.0078 (1.55)

(Absolute value of ratio of estimated parameter to standard error in parentheses)

The computer package SAS would be employed to estimate the system represented by (6) using a nonlinear, three-stage, least-squares technique. The system would allow for the following parameters (and their respective interpretations) to be isolated:<sup>2</sup>

- (7)  $\lambda$ : a "functional form" parameter. Since the GBC is a generalized functional form, it can take on more specific functional forms as the parameter  $\lambda$  is set equal to various constants. The specific functional form the GBC can take in limiting cases, depends on the value of  $\lambda$ .<sup>3</sup>
- (8)  $\gamma$ : "symmetry parameter" When  $\gamma_{ij} = \gamma_{ji}$  is imposed, symmetry with respect to input prices is imposed upon the GBC model.  $\gamma$  also gives information with respect to the cross input price elasticities.
- (9)  $\beta$ : Scale parameter. For the GBC, the degree of homogeneity is given by  $1/\beta$ . When  $\beta = 1$ , constant returns to scale are exhibited. Increasing, constant, and decreasing returns to scale are indicated as  $\beta$  is less than, equal to, or greater than one. If  $\beta < 0$ , this implies the presence of negative scale economies or diseconomies of scale.

## PRODUCTIVITY PARAMETERS\* Industries GOV1-PRZ3 (Fig. 1)



### \*Simulation Results

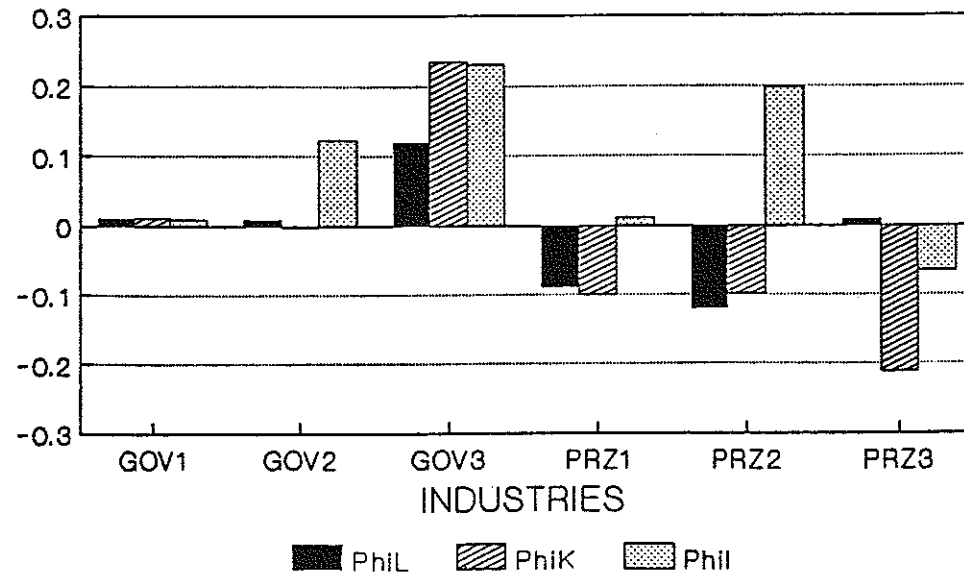
Figure 1. Productivity Parameters.\* Industries GOV1-PRZ3.

- (10)  $\Theta = \delta \ln C / \delta \ln Y^2$ : This parameter carries information regarding the slope of the cost curve of the industry. It indicates when the minimum point of the average cost curve is reached i.e. when  $\Theta$  is positive, that minimum point is reached as output is being increased. This would imply that the curve has the traditional U shape.
- (11)  $\phi_i = \delta s_i / \delta \ln Y$ ; "nonhomotheticity coefficients." These parameters indicate the presence (or lack thereof) of scale economies with respect to the individual inputs. Using the relationship given by (11), an increase in output,  $\phi_i < 0$ , results in larger economies in the  $i$ th input.  $\phi$  represents the scale effect bias in inputs.
- (12)  $\tau_i = \delta s_i / \delta t$ ; Non-neutrality parameters. If  $\tau_i < 0$  then technological (technical) change causes the share of input  $i$  to decline. Given prices and output, this means that the amount required of input  $i$  per unit of output declines at a proportionately greater rate than that of other inputs.  $\tau_i$  measures the degree technical change bias.
- (13)  $\tau$ : in the absence of technical change bias, represents the neutral rate of total cost diminution. If  $\tau_i = 0$  for all inputs  $i$ , then technical change is Hicks neutral at a constant rate of  $\tau$ .

These parameters, once isolated for individual industries (firms), provide information regarding aspects of productivity. They would allow for the eventual "ranking" of currently public-operated/regulated industries and for the creation of a "productive hierarchy." Such information might prove invaluable to policy makers weighing the potential for privatization. Given some time, the productive aspects of industries after privatization could eventually be compared to their "ranking" before privatization.

## SCALE ECONOMY ESTIMATES\*

### Industries GOV1-PRZ3 (Fig. 2)



\*Simulation Results

Figure 2. Scale Economy Estimates.\* Industries GOV1-PRZ3.

### Empirical Results

Subsequent research attempting to analyze the effectiveness of the GBC method in ranking the overall "productivity" of industries has been undertaken. A Monte Carlo study employing computer generated industry data is summarized in tables attached to this paper. Computer generated data on input/output prices and quantities were employed in a Box-Cox estimation procedure. The data represented six different industries, two were characterized as "unregulated" (i.e. privatized) and four were classified as "regulated" (public-operated). Table 4 and Figures 1 and 2 summarize the estimated parameters and attempt to provide the basis for the aforementioned hierarchy construction.

**TABLE 5**  
Two-Digit SIC Industries Utilized in The GBC Estimation Procedure

Unregulated Industries:	
01	- Agricultural Products
02	- Agricultural Services, Forestry
Regulated Industries:	
29	- Railroads
36	- Telephone and Communication
38	- Electric Utilities
48	- Federal Government Enterprises

Table 5 lists the six industries for which time series data on input/output prices and quantities were collected. These data represent the period of 1948 through 1973. (Originally complete data for 14 industries were employed but the Box-Cox estimation procedure produced successful results for these 6.) During that time period it was found that Agriculture and related Industries remained fairly unregulated while Railroads, Telephone and Communications, Electric Utilities and Federal Government Enterprises were highly regulated by the federal (and in some cases state) government.

The results of the estimation procedure are found in Table 6 which lists the parameter estimates for each of the six industries. Figures 3 and 4 are included to provide a graphical reference to the relative size and sign of these parameters. The parameters  $\beta$ ,  $\phi_i$ , and  $\tau_i$  are those which carry the most information regarding the "productivity" of the industries being examined. It is assumed that increasing returns to scale, input-saving economies of scale and input-saving technical change are all characteristics which contribute to overall productivity in a positive manner. These are exhibited when  $\beta < 1$ ,  $\phi_i < 0$  and  $\tau_i < 0$  respectively.

Upon examination, both unregulated industries are characterized by increasing RTS and input

**TABLE 6**  
Nonlinear 3-Stage Least Squares Parameter Estimates for The GBC, Selected Industries, 1948-1973

Parameter/Industry	01	02	29	36	38	48
$\lambda$	27.21 (3.17)	33.91 (2.04)	10.35 (2.67)	-6.144 (3.62)	-4.070 (4.08)	-10.103 (3.98)
$\gamma_{LX}$	-63.42 (1.13)	33.44 (1.09)	31.56 (1.33)	12.98 (1.09)	-3.36 (1.21)	.2112 (1.23)
$\gamma_{KX}$	-23.41 (1.26)	91.45 (0.98)	29.21 (1.81)	9.09 (1.03)	-6.11 (1.05)	.9811 (1.18)
$\gamma_{IX}$	-27.90 (1.91)	65.76 (1.33)	40.01 (1.21)	12.13 (1.69)	-3.90 (1.67)	.6818 (0.35)
$\gamma_{LL}$	-68.23 (1.87)	82.33 (1.11)	41.22 (1.85)	14.47 (1.42)	-2.99 (1.92)	1.789 (1.97)
$\gamma_{IL}$	-100.45 (2.00)	56.24 (1.99)	39.34 (1.76)	19.23 (2.10)	-10.26 (2.09)	.8881 (1.00)
$\gamma_{II}$	-89.21 (2.03)	77.07 (1.27)	54.33 (1.78)	8.97 (1.02)	-5.01 (1.76)	.6558 (0.99)
$\beta$	.6003 (3.11)	.8912 (3.08)	-1.005 (2.09)	1.009 (3.71)	.8778 (3.00)	-1.110 (2.88)
$\theta$	.5671 (2.89)	.3912 (2.12)	.4670 (2.71)	.8877 (2.87)	.6542 (3.22)	.8776 (2.35)
$\phi_L$	-.0091 (2.66)	.1098 (2.91)	.0087 (2.38)	.0090 (2.89)	.0022 (2.40)	-.0010 (1.23)
$\phi_K$	-.0034 (2.89)	-.0021 (3.02)	.0324 (1.98)	-.0231 (2.09)	.0009 (1.79)	.0023 (3.10)
$\phi_I$	.0055 (3.12)	-.0123 (2.00)	.0003 (1.99)	.0057 (2.87)	-.0088 (2.54)	.0012 (3.11)
$\tau$	.0002 (0.98)	.0001 (2.21)	.0003 (1.13)	.0001 (1.20)	.0001 (1.38)	.0001 (1.07)
$\tau_L$	-.0222 (1.87)	-.0040 (2.09)	-.0027 (2.11)	.0808 (2.78)	.0101 (1.98)	.0087 (2.07)
$\tau_K$	-.0105 (2.69)	.0089 (2.11)	.0035 (2.07)	-.0100 (1.99)	-.0080 (2.29)	.0003 (2.00)
$\tau_I$	.0022 (1.88)	-.0054 (2.78)	.0101 (2.43)	-.0119 (2.23)	.0002 (2.22)	.0122 (1.67)

(Absolute value of ratio of estimated parameter to standard error in parentheses)

## PRODUCTIVITY PARAMETERS

### Selected Industries (Fig. 3)

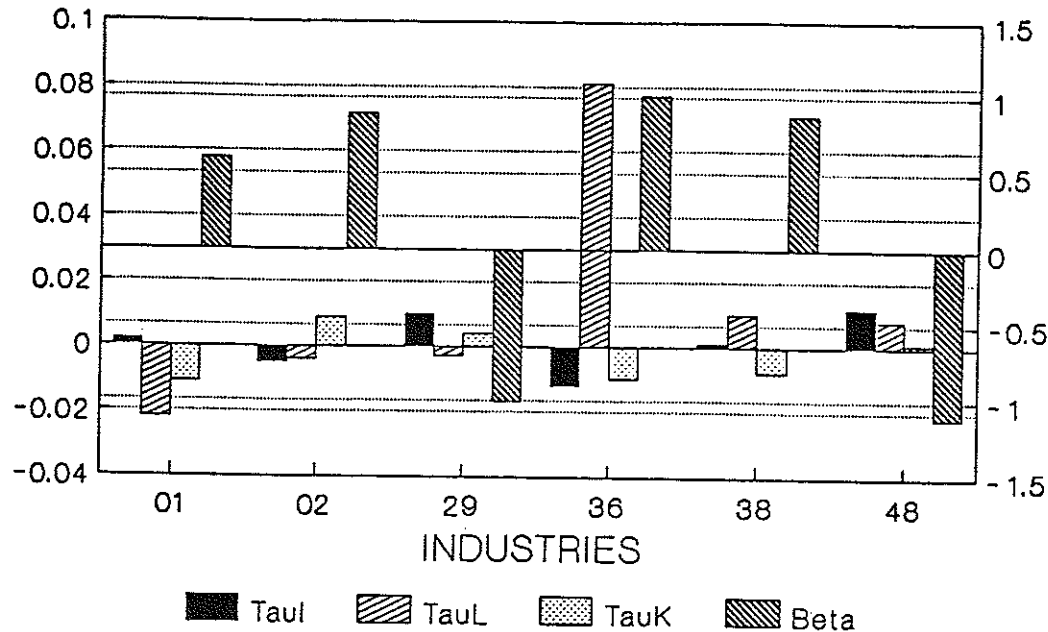


Figure 3. Productivity Parameters. Selected Industries.

saving scale economies and technological change to a significant degree. While Electric Utilities exhibited increasing RTS, the remaining regulated industries did not. Railroads and the Federal Government Enterprises actually displayed diseconomies of scale (i.e.  $\beta < 0$ ). Only Telephone and Communications exhibited input-saving technological change for more than one input as did both of the unregulated industries. None of the regulated industries showed signs of input-saving scale economies for any more than one input. While these results do not, in themselves, substantiate the claim that government regulation necessarily inhibits productivity, they do add supporting evidence to that naive hypothesis. It should also be noted that one can not draw firm conclusions concerning such correlation based upon a sampling of two unregulated and four regulated industries.

### Summary

As summarized in the first half of this paper, privatization has become an important agenda item throughout many of the world's industrialized economies. The increased trend towards privatization is no where more evident than in the United States and her closest ally, Great Britain. While there has been much discussion regarding the costs and benefits of such action here in the U.S., Britain has been actively returning publicly operated enterprises to the private sector since the late 70's. With the recent election of George Bush, the trend toward decreased government involvement in the provision of goods and services in the U.S. will probably continue.

If the potential effects of privatization are to be thoroughly analyzed, then the nature of the production processes involved must be understood. This implies that the relative efficiency and

## SCALE ECONOMY ESTIMATES

### Selected Industries (Fig. 4)

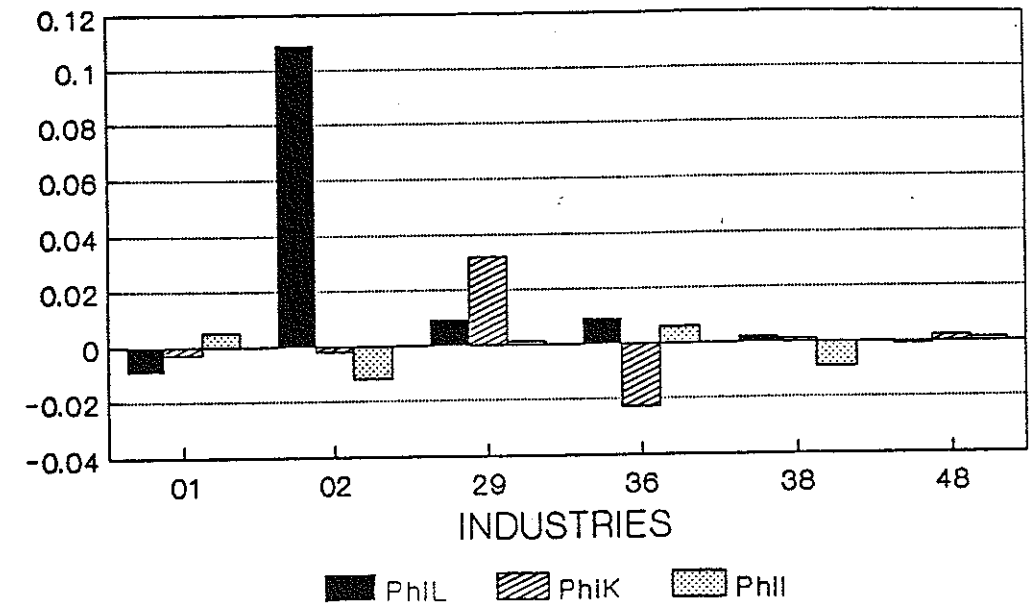


Figure 4. Scale Economy Estimates. Selected Industries.

productivity of those industries must be examined and scrutinized. There has been little research which has attempted to investigate these variables from a functional form approach. This paper attempts to put forth one possible method of gathering information regarding the productive aspects of state operated and privatized industries.

### NOTES

1. This approach is similar to that used by Khaled (1979).
2. These interpretations follow those given by Khaled (1979).
3. Khaled has demonstrated that when  $\lambda = 1$  the GBC takes on the Generalized Leontief functional form and when  $\lambda = 0$  it takes on the Translog.

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