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Abstract
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OWNERSHIP VERSUS ENVIRONMENT: DISENTANGLING THE SOURCES OF PUBLIC-SECTOR INEFFICIENCY

Ann P. Bartel and Ann E. Harrison*

Abstract—An unanswered question in the debate on public-sector inefficiency is whether reforms other than government divestiture can effectively substitute for privatization. Using a 1981–1995 panel data set of all public and private manufacturing establishments in Indonesia, we analyze whether public-sector inefficiency is primarily due to agency-type problems or to the environment in which public-sector enterprises (PSEs) operate, as measured by the soft budget constraint and the degree of internal and external competition. The results, obtained from fixed-effects specifications, provide support for both models. Ownership matters because, for a given level of government financing or competition, PSEs perform worse than their private-sector counterparts. The environment matters because *only* PSEs which received government financing or those shielded from import competition or foreign ownership performed worse than private enterprises. The results suggest that the efficiency of PSEs can be increased through privatization, through manipulation of the environment, or through a combination of both approaches.

> While much has indeed been learned about the effectiveness of privatization as a political and economic policy, there are several important areas that need further research. . . . Researchers need to . . . conclusively document whether reforms other than government divestiture can effectively serve as a substitute (or precursor) for privatization.
>
> Megginson and Netter (2001)

I. Introduction

Why privatize? One primary objective of privatization is to enhance the efficiency of public enterprises. Although most studies find that public-sector plants perform poorly relative to their private-sector counterparts, other studies get mixed or ambiguous results.[1] One explanation for the conflicting evidence is that efficiency gains from privatization depend on a variety of factors, including the degree of competition, the regulatory environment, the magnitude of market failure, and the administrative capabilities of the government. Peltzman (1971) questions whether changing ownership alone can affect firm behavior. Shleifer and Vishny (1994) present a formal argument for this view; in their model, privatization enhances efficiency only if "control rights" over employment decisions are shifted to the plant manager. In their review of the arguments for and against privatization, Vickers and Yarrow (1991) conclude that the attributes of the *environment* influence the efficiency gains from privatization.

Others, however, argue that public-sector ownership is always inferior to private sector ownership. These types of arguments, as illustrated by Ehrlich et al. (1994) and Karpoff (2001), are often based on some variant of a principal-agent problem: the principal (the government) either cannot or does not choose to monitor the managers properly. This approach focuses on *ownership* as the explanation for poor public-sector performance.

The empirical studies on privatization have typically focused on identifying the magnitude of the gains, rather than attempting to identify their sources or to control for the conditions under which privatization occurred. From a policy perspective, however, it is critical to be able to identify the determinants of improved performance that results from privatization. For example, if public-sector enterprises (PSEs) perform poorly because they are located in sectors with very little internal or external competition, or because of access to soft loans, then public-sector plants could be induced to behave like the private sector in a competitive, subsidy-free environment. These considerations become critical if privatization has been delayed or is not politically feasible in the short run. In this paper, we focus on the role of *ownership* versus the *environment* as alternative explanations for poor public-sector behavior.[2] To date, no paper has been able to fully address this issue.[3]

In their review of the state of the literature, Megginson and Netter (2001) conclude that more research is needed to ". . . conclusively document whether reforms other than government divestiture can effectively serve as a substitute (or precursor) for privatization." This is precisely our goal. We use a 1981–1995 panel of all public and private manufacturing establishments in Indonesia and measure two important environmental factors: (1) soft budget constraints[4] and (2) the degree of internal and external competition. Our measures of

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[1] Studies that find that public-sector enterprises perform poorly include Boardman and Vining (1989), Kikeri, Nellis, and Shirley (1994), La Porta and Lopez-de-Silanes (1999), and Boubakri and Cosset (1998). Studies that get mixed or ambiguous results include Funkhouser and MacAvoy (1979), Groves et al. (1994), Kole and Mulherin (1997), and Dewenter and Malatesta (2001).

[2] In contrasting the roles of ownership and environment, we do not distinguish between different types of owners after privatization, that is, our focus is on private versus public owners. Barberis et al. (1996) study the restructuring that occurred in privatized Russian shops when there were new owners and new managers, compared to giving equity to the old managers.

[3] Pinto and Van Wijnbergen (1995), Claessens and Djankov (1997), and Bertero and Rondi (2000) study the effect of soft loans on performance but, due to data limitations, do not fully address the issue of ownership versus environment.

[4] Research on the effects of the soft budget constraint goes back to Kornai (1979), who first postulated that the possibility of bailouts for public-sector enterprises could be used to explain their poor performance. See Kornai (1998) for a more recent discussion of the soft budget constraint.

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competition include import competition, domestic competition, and foreign investment. In Indonesia during 1981–1995, many manufacturing enterprises were privatized, tariff and nontariff barriers were reduced, the financial sector was opened up to private banks, state banks began to be phased out, and controls on foreign owners were relaxed. These large, exogenous changes in ownership and the policy environment provide an ideal setting for this paper.

Our empirical results, which are obtained from fixed-effects specifications, suggest that reforming the environment and privatizing public enterprises are substitute policies. Privatization improves performance, because for a given level of government financing and internal and external competition, PSEs perform worse than their private-sector counterparts. We calculate that if a public firm is fully privatized, its productivity will rise by 1.6 percentage points. The same result, however, could be achieved by manipulating the environment. Specifically, our results show that if the role of state development banks in financing public-sector investment is reduced, public-sector performance improves. In particular, if state financing of new investment by public enterprises falls from 100% to 70%, import penetration rises by 3 percentage points, or foreign ownership in the enterprises increases by three-quarters of a percentage point, then these changes will each produce the same gain in productivity as a full privatization. Reforming the environment is likely to be much less painful politically and represents much more incremental change than a full privatization.

Section II reviews the ownership and environment hypotheses and derives the estimating equation. In section III the Indonesian data are described, and in section IV results are presented. Section V discusses a number of extensions to the basic empirical model. In particular, we consider the possibility of endogeneity bias and use a number of techniques to control for this. We find that taking endogeneity into account does not affect the results. Finally, we show that our findings are robust to a variety of specification checks. Section VI concludes and discusses the implications for government policy.

II. Empirical Framework

A. *The Ownership-versus-Environment Debate*

In the literature on privatization, two primary explanations have been offered for the poor performance of public-sector firms. The first explanation is that PSEs are more inefficient because of principal-agent problems. Ehrlich et al. (1994) is a good illustration of this branch of the literature. In that model, the level of total factor productivity (TFP) is a function of managerial time allocated to current production, and the rate of TFP growth (TFPG) is positively related to the manager's commitment to investments in plant-specific capital. Public-sector managers, according to their model, spend too much time pursuing independent private objectives. This has two effects: it reduces the time spent building plant-specific capital (which raises TFPG in the long run), and it has an ambiguous effect on the time spent monitoring current production, which affects the current level of TFP. This framework implies that *levels* of productivity in public-sector plants need not be lower than in the private-sector in the short run, but that productivity *growth* will be lower for PSEs. In the longer term, of course, lower public-sector productivity growth should eventually lead to lower productivity levels than in the private sector. One insight provided by this model is that it can explain why PSEs could survive in the medium term even in a competitive environment. If the most efficient enterprises were taken over by the government initially—as appears to have been the case in Indonesia—then the myopia of these managers does not immediately translate into lower efficiency levels.

Ehrlich et al. (1994) illustrates a wider literature which argues that PSEs are more inefficient primarily due to principal-agent problems. One implication of this literature is that there should be a consistent negative coefficient on public ownership in any comparisons of productivity growth among public and private enterprises. But others have presented evidence which disputes this view. For example, Vickers and Yarrow (1991) show that in Britain, Chile, and Poland during the 1980s ownership changes by themselves are generally not associated with changes in performance. Kole and Mulherin (1997) use data on U.S. government acquisitions of several foreign firms operating in the United States during World War II to show that in a competitive environment, ownership per se does not determine firm performance. Other evidence reported in the popular press also supports the claim that the effects of privatization in any particular context will be highly dependent upon the environment in which it is implemented.[5]

The debate about the relevance of the ownership and environment hypotheses can only be resolved through empirical analysis. To date, however, no one has conducted a thorough empirical investigation that simultaneously allows for the role of ownership and environment effects. For example, Ehrlich et al. (1994) do not test whether poor public-sector performance is attributable purely to ownership or to the fact that private and public enterprises may operate in different environments. Others who have focused on the attributes of the environment—such as Pinto and Van Winjbergen (1995) and Bertero and Rondi (2000), who study the effects of soft loans—focus only on PSEs and are therefore unable to identify an ownership effect. In the next

[5] For example, see the November 3, 1998 issue of *The Financial Times,* which reports that the Jamaican government retook control of the largest three sugar mills, which had been privatized four years earlier. The government claimed that the mills had "not met productivity and production targets and have depended too heavily on state support." The March 11, 1998 issue of *The New York Times* reports that the Argentinian government has eliminated the duopoly maintained by its two telephone companies, pointing out that since the "1990 privatization, the two companies have increased the number of lines in the country from three million to seven million, but their monopolies have kept Argentine telephone rates high by international standards."

section, we describe the equation we use to simultaneously test the ownership and environment hypotheses.

B. Measuring Total Factor Productivity

As our yardstick of relative performance, we focus exclusively on TFP, at least in part because prior research (La Porta and Lopez-de-Silanes, 1999) has shown that a very large part of the gains from privatization is due to productivity growth.

A general production function for plant i in sector j at time t is given by

$$Y_{ijt} = A_{ijt}F(Z_{ijt}). \tag{1}$$

Here Y_{ijt} is a real measure of plant-level output, and Z is a vector of M inputs. In our estimation, we include as inputs both skilled and unskilled labor, capital inputs, and materials. A_{ijt} is a plant-specific index of Hicks-neutral technical progress which will depend on a number of factors, including ownership. In the Appendix, we show that equation (1) can be rewritten in the following log-difference form:

$$d \ln Y_{ijt} = d \ln A_{ijt} + \mu \sum_{m=1}^{M} B_m d \ln Z_{mijt}. \tag{2}$$

All variables have been rewritten as the first difference of their logs. Output growth can be decomposed into two sources: growth in productivity and growth in input use. In a regression framework, the coefficients on the M inputs include two components: the markup parameter μ, and the factor share B_m. By not constraining the coefficients, we allow both factor shares and markups to vary.

C. Ownership Effects

We denote public ownership as PUB and allow A to have the following components:

$$A_{it} = \exp(\eta_1 PUB_{it} + \eta_2 PUB_{it} \times time + \gamma X_{it} + f_i + d_t + e_{it}). \tag{3}$$

The degree of public ownership, PUB, affects both the level and the growth rate of productivity. The coefficient on PUB measures the relationship between ownership and the level of A; the coefficient on $PUB \times time$ measures the relationship between ownership and the change in A. The framework due to Ehrlich et al. (1994) implies that the coefficient on PUB is ambiguous, whereas the coefficient on $PUB \times time$ should be negative. We also include a vector X of other factors which could also affect productivity; it is discussed in more detail below. The framework in equation (3) allows for a plant-specific fixed effect f_i, which reflects fixed differences across plants which are persistent but unobserved over time; time effects d_t, which are common to plants but which vary over time; and a random unobserved component e_{it}.

In order to take into account the plant-specific effect, we log-linearize equation (3) and transform it into first differences and then combine it with equation (2), which yields the following specification:

$$d \ln Y_{it} = \eta_1 dPUB_{it} + \eta_2 d(PUB_{it} \times time) + \gamma dX_{it} + \sum_{m=1}^{M} \mu B_m d \ln Z_{mit}. \tag{4}$$

In this specification, ownership enters because it can affect Hicks-neutral productivity growth by directly affecting managerial incentives.

A number of previous studies, especially the early studies, simply compare efficiency use, across public and private plants, of one factor, such as capital or labor. This is equivalent to estimating equation (4) in levels with $M = 1$, ignoring the fixed effect, and setting all the γ's and ρ's as well as B_2 through B_M equal to 0. Some examples of these studies are Boardman and Vining (1989), Funkhouser and MacAvoy (1979), and Groves et al. (1994).[6]

Ehrlich et al. (1994) test for the effect of ownership by estimating a levels equation with plant fixed effects which includes ownership and the interaction of ownership with time. Consistent with the predictions of their model, they find a negative and significant coefficient for the interaction between ownership and time, suggesting that TFPG is slower for public enterprises. But the coefficient on ownership alone is not robust, suggesting no clear relationship between TFP levels and public ownership. Furthermore, they do not test whether lower TFPG in the public-sector is attributable purely to ownership or to the fact that private and public enterprises may operate in different environments.

D. Environment Effects

In order to measure the effect of the environment on TFPG ($d \ln A$), we expand equation (4) by including the attributes of the environment in the vector X and also allow PUB's effect on $d \ln A$ to be a function of these attributes. We consider the roles of two main attributes of the environment: (1) the soft budget constraint and (2) the degree of internal and external competition.

[6] Boardman and Vining (1989) use sales per employee and sales per asset as measures of efficiency and find that private enterprises are more efficient, controlling for assets, number of employees, market share, concentration, country, and industry. Funkhouser and MacAvoy (1979) analyze labor productivity and do not control for any other factors. They find that physical output per employee is higher in private plants, but sales or value-added per employee is lower. Groves et al. (1994) find that giving Chinese enterprises greater autonomy (either in selling output outside state quotas or in retaining a larger share of profits) does not lead to an increase in productivity, but increasing the use of bonuses as a fraction of the wage bill and increasing the use of contract workers does.

Compared to private-sector firms, public-sector firms are more likely to operate in a soft budget constraint regime where the government provides additional resources or otherwise bails them out.[7] Hence, the pure effect of ownership can only be measured by controlling for the soft budget constraint. In addition, there is evidence that the softness of the constraint can vary across PSEs at a point in time, and can also change over time (Kornai, 1990). This implies that the effect of ownership will depend on the degree of softness of the budget constraint.

Second, compared to private-sector enterprises, PSEs may face different degrees of internal and external competition. For example, PSEs are often established in sectors where the government seeks to regulate what would have been a natural monopoly. A different competitive environment is likely to directly affect the efficiency parameter, A (see Nickell, 1996). To the extent that PSEs operate in industries with large entry barriers, there is an omitted variable, which could bias our results. The direction of the bias will depend on whether greater internal competition is likely to lead to higher or lower productivity. We also include an interaction term between ownership and internal competition to determine if privatization's success depends on the degree of internal competition.

Third, PSEs are typically located in sectors which receive special protection from import competition. Protection from imports could have a direct effect on the Hicks-neutral term $d \ln A$, if plants subjected to import competition are more likely to innovate, use better quality inputs, or learn about better production techniques. Consequently, failing to control for differences in protection from imports could lead to the incorrect conclusion that PSEs are more inefficient, if lack of international competition is correlated with poor performance. An interaction term between ownership and the degree of international competition tests if privatization's success depends on the degree of competition from imports.

Finally, there is evidence that foreign-owned firms in developing countries exhibit higher levels of productivity or higher productivity growth either because of intangible assets that cannot be exploited through arm's-length agreements, or because of better knowledge about foreign technology developments or better access to credit.[8] Because many privatizations have involved the transfer of assets from public to foreign owners, including an interaction term will allow us to test whether these kinds of public-private ventures are likely to be more successful than privatizations to domestic private owners.

In the next section of the paper we describe the data we use to implement equation (4) empirically.

[7] Sometimes, private firms receive subsidies from the government. Lizal and Svejnar (2002) found that, in the 1990s, large private firms in the Czech Republic were operating under a soft budget constraint.

[8] See Haddad and Harrison (1993), Aitken and Harrison (1999), and Harrison and McMillan (2003).

III. Data

We apply our framework to the manufacturing sector in Indonesia for the period 1981–1995. Indonesia has a number of features which make it an ideal setting for studying the effects of ownership and environment. Over this period the Indonesian government privatized many enterprises, which allows us to examine the impact of changes in ownership on enterprise performance. When Indonesia became independent in 1945, its constitution provided for government ownership of mineral resources and other "important" sectors of the economy. State enterprises were operated by indigenous Indonesians, and the government's infusion of capital into these enterprises was viewed as a way of providing a counterweight to the Chinese firms that tended to dominate the private-sector.[9] During the early 1980s, the government infused much capital into the state enterprise sector, facilitating its growth. But, beginning in the late 1980s and continuing into the early 1990s, a wave of privatizations occurred,[10] so that by 1992, the private-sector in Indonesia became, for the first time, the driving force behind economic growth.[11]

During 1981–1995 there were also important changes in the environment. A significant liberalization of trade occurred in the late 1980s, which provides variation in the variable we use to measure external competition. Average tariffs fell from 26% in 1989 to 18% in 1995, and the maximum tariff was cut in half. There were also important changes in foreign investment legislation. In 1974, in response to riots against Japanese foreign investors, a presidential decree had placed significant limits on the extent of foreign equity participation. New investment by foreign companies could only be conducted through joint ventures; all new ventures required at least a 20% equity stake by Indonesian companies; after 10 years Indonesian equity ownership was supposed to equal 51%. However, from 1986 through 1994, in large measure due to the need for inflows of foreign investment, the government passed a series of exemptions to the 1974 law. Finally, in 1994, the Indonesian government eliminated virtually all restrictions on foreign equity investments.

The banking environment also changed dramatically. In 1983, Indonesia relaxed the credit ceilings of individual banks and also relaxed interest-rate controls. This led to a fall in the share of state banks, which had previously dominated the banking sector. The share of credit provided by state banks fell from 87% in 1981 to 72% in 1988 (Goeltom, 1995, p. 8). Nevertheless, these banks continued to dominate the banking sector, and the interest-rate spread between private and public banks remained a very large 500 to 800 basis points. A series of additional reforms between 1988 and 1990 reduced barriers to entry into the banking

[9] See Bresnan (1993, p. 253).

[10] The Fourth Five-Year Plan, announced in early 1984, called for an increased role for the private-sector (Bresnan, 1993, p. 254).

[11] Bresnan (1993, p. 264).

TABLE 1.—SUMMARY STATISTICS

A. Public-Sector Enterprises

Year	% of Total Output Accounted for by Public-Sector Enterprises	Ratio of Public to Private		
		Age	Size	Skilled/Unskilled
1981	14.4	2.1	4.0	3.0
1983	17.3	2.1	5.3	2.8
1985	17.3	2.4	6.0	2.8
1987	17.8	2.3	6.3	3.1
1989	18.2	2.3	7.0	2.9
1993	13.7	2.0	5.8	3.8
1995	13.3	1.8	5.4	2.8

B. Characteristics of the Environment

Year	% of Investment Financed by Govt.			% of Firms Receiving Govt. Financing		Import Penetration Ratio (%)		Foreign Share of Establishments (%)		Herfindahl Index	
	All Plants	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private
1981	2.9	31.8	1.4	32.7	1.5	28.1	21.4	3.4	3.3	0.08	0.09
1983	3.6	30.3	2.5	28.3	2.9	30.1	20.7	3.9	3.0	0.10	0.09
1985	3.0	30.7	1.8	28.4	2.2	15.9	10.9	3.4	2.2	0.08	0.06
1987	2.7	27.9	1.7	26.4	2.0	18.7	13.4	3.4	2.1	0.08	0.07
1989	3.3	31.6	2.3	26.5	2.3	16.5	12.7	2.3	2.0	0.07	0.06
1993	2.0	31.0	1.2	16.5	1.1	15.6	12.5	3.6	2.5	0.11	0.10
1995	1.7	22.7	1.2	13.6	1.0	16.2	13.5	2.6	3.2	0.11	0.10

system and reduced the privileges of state banks. Forty new domestic banks were established between 1988 and 1990, and there was a dramatic growth in the Jakarta stock exchange, thereby providing new sources of investment financing (see Bresnan, 1993, p. 265). By 1994, the share of private banks in total outstanding loans exceeded 50%, well above the 25% share of 10 years earlier (World Bank, 1995).

The Indonesian data set that we use is an annual census of manufacturing establishments. Data were available for 1975 through 1995, but information on financing sources is only available beginning in 1981. The number of observations ranges from 6,258 in 1982 to over 12,904 in 1995. The data set includes information on output, the number of skilled and unskilled workers, investment, material inputs, compensation, ownership, location, age, and financing sources. Pitt and Lee (1981) used this data set for 1972–1975 to study the impact of foreign ownership on the productivity of weaving firms. Goeltom (1995) used the 1981–1988 census data to study the impact of financial liberalization on efficiency in the manufacturing sector. To date no one has used the Indonesian census to study the effects of ownership and the environment on productivity growth.

Public ownership is measured by the percentage of equity owned by the central government or regional governments (*PUB*). The soft budget constraint is measured by the degree of access to government loans, specifically the share of the plant's investments that are financed by government sources (*GOVFIN*). This variable could include loans from the government as well as transfers of government funds to public-sector plants through direct grants or subsidies. Even if there is a large loan component to the government investment source, government loans have a large subsidy component in that many of these loans are never repaid at all. In addition, as pointed out earlier, the interest-rate subsidy on government loans ranged from 500 to 800 basis points during this period. Domestic competition is proxied by the Herfindahl index (*HERF*) in the plant's industry. The index is defined as the sum of the squared plant-level market shares for all four-digit sectors and years. *FOR* is the foreign share of investment at the plant.

The ideal measure of protection against import competition is data on tariffs and nontariff barriers. Unfortunately, however, time-series sector-level data on tariffs are not available for Indonesia before 1989. Consequently, we use import penetration as an (imperfect) proxy for trade policy. In order to measure the extent of import competition, data from the Indonesian census were merged with import and export data collected by the United Nations. Inasmuch as the United Nations trade data (as made available to the World Bank), are available on an ISIC basis, it was possible to merge the two databases by three-digit ISIC. The United Nations data included information on both net exports and imports by ISIC. Import penetration (*MPEN*) is defined as imports divided by domestic production plus imports. Domestic production was provided by the United Nations as well.

Table 1 provides some summary statistics from the Indonesian manufacturing census. A private establishment is defined as one with 100% private (nongovernment) equity, while a public establishment, as one with any amount of central or regional government equity participation. In the remainder of the paper, however, public ownership is defined as a continuous variable which varies between 0 and 100%. We prefer to remain agnostic on the question of how

much public ownership is sufficient to change behavior, leading us to define *PUB* as continuous in all tables except table 1. Panel A of table 1 shows that PSEs, which accounted for 13%–18% of total manufacturing output over 1981–1995, are twice as old as private firms, are at least four times as large, and have a higher ratio of skilled to unskilled workers. Panel B documents the different environments in which public and private enterprises operate in Indonesia and the changes in these environments over time. Between 1981 and 1993 approximately 30% of public enterprise investment was financed by government sources, compared to only 1% to 2% for private establishments. Note that by 1995, the share of public enterprise investment financed by government sources had fallen to 23%, because of the rise of alternative sources of financing. In the early 1980s, approximately 30% of public firms received government financing, but by 1995, only 13% were doing so. Throughout 1981–1995, no more than 3% of private-sector firms received government financing. There is little difference in the proportion of establishments that are foreign-owned or in the Herfindahl index across the two ownership categories.[12]

There were significant trade reforms in Indonesia during the mid-1980s. In 1989, for example, average tariffs in the manufacturing sector were at 26%, with a minimum tariff rate of 5% and a maximum tariff rate of almost 60%. By 1995, average tariffs had fallen to 18%, with no changes in minimum tariffs but with a reduction in the maximum average tariff across sectors to 35%. These represent significant reductions in protection for manufacturing. At the same time, however, overall import penetration ratios fell after 1983. The results suggest that compared to private-sector firms, public-sector firms operate in sectors where the import penetration ratio is higher. It is certainly possible to observe both falling tariffs and falling import penetration, as domestic firms become more internationally competitive and provide a greater share of domestic demand. Unfortunately, we only have tariff data for 1989–1995 and are thus unable to use tariffs as our measure of international competition. To assess whether import penetration does provide information on openness, we ran regressions and calculated the correlation between import penetration and tariffs for 1989–1995. The correlation coefficient between import penetration and tariffs is 0.50 and is significantly negative at the 1% level—higher tariffs are associated with lower import penetration in Indonesia. This suggests that for our purposes, import penetration is an adequate measure of international competition, but its usefulness is hidden in the aggregate trends presented in table 1.

Table 2 provides information, by industrial sector, on the share of output accounted for by public enterprises and the percentage of investment financed by government sources and foreign sources in public and private enterprises. The degree of private competition facing public enterprises varies significantly across sectors. In some sectors, such as food products, industrial chemicals, and iron and steel, public enterprises account for a major share of production. In many other sectors, such as tobacco, apparel, footwear, and professional equipment, public enterprises account for a small share of overall productive activity. Note that, even within the public-sector, there are variations across industries in the share of investment financed by the government. For example, in the food products industry, 47% of investment by public enterprises is financed by government sources, whereas in the industrial chemicals industry, only 22% is. Similarly, we observe variation across industries in the share of investment financed by foreign owners. For example, in the nonferrous metals industry 47% of investment by public enterprises is financed by foreign owners; in the metal products industry, only 20% is. In order to allow for the possibility that plant-level observations within industry sectors may not be independent, our equations will be estimated with standard errors clustered by industry sector.

OTHER VARIABLE DEFINITIONS: The dependent variable, Y, is measured by the real value of annual output.[13] Inputs in the vector Z include the number of skilled production workers (*SKILLED*), the number of unskilled workers (*UNSKILLED*), the sum of the real value of domestically produced raw materials, imported raw materials, and energy used (*MATERIALS*), and the real value of investment or capital (*CAPITAL*).[14] The manufacturing survey requires respondents to report the current value of their capital stock at the end of the year, which (coupled with the fact that inflation in Indonesia during this period was not very high) permits an accurate measure of capital.

Because public enterprises are less likely to raise funds on the stock exchange and firms that raise funds on the stock exchange may be partially disciplined by the information revealed through share prices, we also add a dummy variable (*STOCK*) which equals 1 if the stock exchange is a source of investment financing for the firm. Laffont and Tirole (1993) argue that the kinds of problems that arise when there is separation of ownership and control can be mitigated by stock market participation. This is because the stock market provides at least a partial disciplining device to managers through stock prices. However, limited stock market participation, noisy prices, and different ownership structures can limit the amount of information such participation is likely to convey. Inasmuch

[12] However, if we weight the means by output, giving more weight to larger enterprises, then the means suggest a much stronger presence of foreign enterprises in the private-sector.

[13] One shortcoming of the data is that we do not have separate price deflators for public and private enterprises. Of course, to the extent that price controls or other regulatory differences are unique to an enterprise and remain fixed over time, these unobservables are captured by plant fixed effect.

[14] Because the census data only report the value of the capital stock beginning in 1987, we have chosen to proxy capital stock by investment. By doing this, we are in effect assuming either zero depreciation or that the omitted term, lagged capital stock multiplied by the rate of depreciation, does not induce any omitted variable bias.

TABLE 2.—OWNERSHIP AND THE ENVIRONMENT, BY INDUSTRIAL SECTOR

ISIC Code	Percentage of Output Produced by Each Sector (%) (1)	Percentage of Output Produced by Public-Sector Enterprises (All Years) (%) (2)	Percentage of Investment Financed by Government (All Years) (%)		Percentage of Investment Financed by Foreign Owner (All Years) (%)	
			Public Sector (3)	Private Sector (4)	Public Sector (5)	Private Sector (6)
311 Food products	9.8	23.7	46.9	1.7	1.3	13.1
312 Food products, NEL	2.7	4.6	22.9	1.7	5.5	20.1
313 Beverages	0.8	8.0	0.0	0.9	54.3	33.0
314 Tobacco	10.9	0.2	16.3	6.6	37.0	4.9
321 Textiles	12.3	5.7	23.5	1.7	10.5	16.6
322 Apparel	1.8	0.2	20.6	2.8	0.0	2.2
323 Leather products	0.3	1.9	40.0	0.6	0.0	54.8
324 Footwear	0.8	0.6	18.4	1.1	0.0	33.3
331 Wood products	11.0	2.1	18.4	1.7	1.1	6.6
332 Furniture	0.4	1.0	0.0	1.3	4.9	0.0
341 Paper products	2.8	17.8	28.0	1.1	0.0	19.9
342 Printing, publishing	0.9	7.1	33.4	1.6	17.9	2.2
351 Industrial chemicals	5.3	50.5	22.1	1.8	5.6	29.5
352 Other chemicals	5.1	2.0	39.8	0.7	27.2	36.5
354 Petroleum products	0.0	—	—	—	—	20.3
355 Rubber products	4.8	7.1	38.7	2.2	0.0	19.7
356 Plastic products	2.4	0.1	3.7	0.8	0.0	9.4
361 Pottery and china	0.4	1.5	3.8	1.2	0.0	15.5
362 Glass products	0.5	11.1	0.0	2.0	0.0	25.8
363 Cement products	2.5	1.4	19.2	2.8	3.7	1.0
364 Clay products	0.1	0.01	7.7	0.9	0.0	0.2
369 Nonmetal products	0.2	5.3	17.8	1.3	0.0	2.1
371 Iron and steel	7.6	62.1	39.1	3.7	13.2	28.7
372 Nonferrous metals	1.3	46.1	21.5	0.0	47.6	13.6
381 Metal products	4.1	11.6	19.4	1.2	19.7	22.3
382 Machinery, NEL	1.1	14.0	31.2	0.8	4.7	42.4
383 Electrical machinery	4.0	10.0	23.0	0.7	27.7	28.5
384 Transport equipment	5.7	9.4	37.7	1.9	1.8	22.1
385 Professional equipment	0.1	0.3	0.0	1.4	0.0	5.6
390 Other industries	2.9	0.2	0.0	1.3	0.0	24.4

as it is very uncommon in Indonesia for firms with public-sector ownership to obtain stock market financing (only 20 observations), we do not include an interaction term between *PUB* and *STOCK*.[15] Finally, all regressions include a vector of industry dummies (*IND*) and a vector of region dummies (*R*).

Our final estimating equation is

$$\begin{aligned} d \ln Y_{it} &= \eta_1 dPUB_{it} - \eta_2 d(PUB_{it} \times time) \\ &+ \sum_{m=1}^{M} \mu_m B_m d \ln Z_{mit} - \gamma_1 dGOVFIN_{it} \\ &- \gamma_2 dHERF_{jt} + \gamma_3 dMPEN_{jt} + \gamma_4 dFOR_{it\,t} \\ &+ \gamma_5 dSTOCK_{it} - \delta_8 d(PUB \times GOVFIN)_{it} \\ &- \delta_{10} d(PUB \times HERF)_{it} + \delta_{11} d(PUB \times MPEN)_{it} \\ &+ \delta_{12} d(PUB \times FOR)_{it} + d_t + R + IND + e_i. \end{aligned} \tag{5}$$

[15] This contrasts with the situation in India, where partially privatized firms do trade on the stock exchange (Gupta, 2003). In addition, although stock market participation may be endogenous, the lack of good instruments prevents us from addressing this issue. *STOCK* is included primarily as an additional control and is not the focus of this paper.

Equation (5) eliminates any unobserved differences between public and private enterprises (e.g., different prices, hidden subsidies, a different product mix, or a different regulatory environment) that are fixed over time. Prior research on estimating production functions has argued that there is a simultaneity bias between productivity and input choices (Olley and Pakes, 1996), leading to biased coefficients on the inputs. A number of approaches have been suggested to address this problem, including the two-step method proposed by Olley and Pakes, the generalized method of moments (GMM), and instrumental variable (IV) techniques. However, previous work by Harrison (1994) as well as new research by Van Biesenbroeck (2003) has shown that the actual productivity estimates derived using these alternative methods are not significantly different from those derived using OLS. The Olley-Pakes approach would require us to eliminate observations with zero investment, and the other approaches would require estimating a value-added production function which ignores how productive material inputs are utilized by the firm. Therefore, in our analysis, we rely on Van Biesenbroeck's conclusion and treat input choices as exogenous.

IV. Results

A. Empirical Estimates of the Effects of Public Ownership and the Environment—First-Difference Fixed-Effects Results

Table 3 presents the results of estimating equation (5). Columns (1) and (2) do not include any controls for the environment. Column (3) includes the direct effects of the environment, and column (4) includes the interaction effects between ownership and environment. The results show that *PUB* by itself is not significant but three out of four interactions between *PUB* and the environment are significant. Specifically, we find that $PUB \times GOVFIN$ is negative and significant, and $PUB \times MPEN$ and $PUB \times FOR$ are positive and significant. In other words, there may be an agency problem associated with public-sector ownership, but it only appears when firms are given access to government financing or protected from import competition or foreign ownership. The kind of agency problem modeled by Ehrlich et al. (1994) does not appear to matter in Indonesia: public ownership *by itself* has no independent, negative effect on either productivity levels or productivity growth. But ownership does matter. The coefficients in column (4) imply that a full privatization would be accompanied by an increase in total factor productivity growth of 1.6 percentage points.[16]

As an alternative to privatization, this increase in productivity could be achieved by manipulating the enterprise's environment. In particular, if state financing of new investment by public enterprises falls from 100% to 70%, or import penetration rises by 3 percentage points, or foreign ownership in the enterprises increases by three-quarters of a percentage point, these changes will each produce the same gain in productivity as a full privatization. These latter changes are likely to be much less painful politically and represent much more incremental changes than a shift in majority ownership from public to private ownership. Reducing the role of state banks to two-thirds of their previous loan levels was not difficult, nor is it difficult to increase foreign ownership by less than 1 percentage point. For example, the number of foreign firms in the manufacturing sector in Indonesia increased from almost 3% of all firms in 1991 to over 6% in 1999. Similarly, import penetration in most developing countries has increased significantly more than 3 percentage points during the last decade.

The results in table 3 provide support for the argument that a major source of public-sector inefficiency is the environment (as measured by the soft budget constraint, import protection, and protection from foreign ownership) in which these firms operate.[17] The environment matters because only PSEs which receive soft loans or are shielded from import competition or foreign ownership perform worse than private enterprises. Ownership matters in that, given the same amount of competition, public-sector firms are less productive than their private-sector counterparts.

Table 3.—Effect of Ownership and the Environment on Productivity: 1982–1995 First Differences

	(1)	(2)	(3)	(4)
PUB	.002	0.60	.796	.289
	(0.04)	(0.99)	(1.11)	(0.43)
$PUB \times T$	—	−.007	−.009	−.004
		(−1.03)	(−1.15)	(−0.52)
GOVFIN	—	—	−.014	.020
			(−0.79)	(0.87)
HERF	—	—	.057	.057
			(0.89)	(0.87)
$MPEN_{-1}$	—	—	.051	.008
			(0.84)	(0.12)
FOR	—	—	.001	.001
			(1.12)	(1.04)
STOCK	—	—	.027	.028
			(1.25)	(1.31)
$PUB \times GOVFIN$	—	—	—	−.069
				(−2.08)
$PUB \times HERF$	—	—	—	.042
				(0.22)
$PUB \times MPEN$	—	—	—	.543
				(2.78)
$PUB \times FOR$	—	—	—	.020
				(1.97)
SKILLED	.068	.068	.080	.079
	(11.73)	(11.75)	(10.66)	(10.66)
UNSKILLED	.191	.191	.173	.173
	(14.61)	(14.51)	(13.78)	(13.87)
MATERIALS	.624	.624	.612	.611
	(31.42)	(31.43)	(30.12)	(30.06)
CAPITAL	.003	.003	.003	.003
	(4.05)	(4.31)	(3.08)	(3.07)
R^2	.65	.65	.62	.62
No. of observations	30,707	30,707	19,085	19,085

Dependent variable: log change in real output. *t*-values in parentheses. Standard errors are corrected for heteroskedesticity and clustering. All specifications include year, ISIC, and region dummies. The change in the capital stock is proxied by investment for first-differences specification.

B. Endogeneity of Ownership and Government Financing

It could be argued that our findings that public ownership and government financing reduce efficiency may reflect reverse causality, that is, that more efficient public-sector firms are selected for privatization and that government financing is essentially a bailout given to failing enterprises.[18] We consider whether this argument is correct by using three approaches, which are described below. First, we compared the performance of firms prior to receiving government financing or prior to privatization with that of other firms. Second, we introduced instruments for our *GOVFIN* variable. Third, we used placebo leads for the *PUB* and *GOVFIN* variables. All three approaches suggest that endogeneity is not a problem.

[16] This number is based on the coefficients reported in column (4) of table 3 and assume that $T = 1989$, $GOVFIN = 1$, $MPEN = 0.165$, $FOR = 0.023$, and $HERF = 0.07$. The assumed values for *MPEN*, *FOR*, and *HERF* are taken from table 1 for public firms in 1989.

[17] The equations in table 3 were also estimated without the $PUB \times T$ interaction term, and the results were virtually unchanged.

[18] It is less likely that the other measures of the environment, import penetration and foreign ownership, are endogenous; for they are likely to vary primarily across industrial sectors, rather than across ownership. Hence our analysis of the endogeneity of the environment focuses only on government financing.

Comparing Pre- and Postprivatization Performance: We examine the performance before and after privatization of privatized firms compared to firms with no change in ownership, and the performance before and after receipt of government financing for public-sector firms that received the financing compared to public-sector firms that did not.[19] The results are shown in table 4, where selection for government financing is examined in panel A and selection into privatization is examined in panel B. Panel A shows that in the two years prior to receipt of government financing, those public-sector firms that receive the financing are not performing either better or worse than other public-sector firms, where performance is measured either as total factor productivity growth, the log of sales per employee, the change in the log of sales per employee, cost per unit, or the change in cost per unit. Panel B shows that public-sector firms that are subsequently privatized perform no better or worse, as measured by total factor productivity growth, the change in the log of sales per employee, or the change in cost per unit, than firms with no change in ownership. Like Ehrlich et al. (1994), we find that privatized firms have higher levels of productivity as measured by the log of sales per employee or cost per unit. However, their growth rates are not significantly different from those of plants with no change in ownership.

The results in table 4 suggest that selection is not the cause of the findings in table 3 that both ownership and environment are responsible for the observed inferior performance of publicly owned manufacturing enterprises in Indonesia. There is no evidence that poor performers were subsequently bailed out with government financing. Nor is there any evidence that privatizing firms were selected on the basis of unusually good or bad previous performance, which could lead to under- or overestimating the gains from privatization.

Instrumental Variable Estimates: We also reestimated the productivity equations using an IV approach. Our focus is on the endogeneity of *GOVFIN*; we assume that changes in ownership are exogenously determined, for several reasons. First, public ownership of enterprises was determined decades earlier, as the government sought to take over the ownership of enterprises that were in foreign hands. Because the privatization of manufacturing enterprises is part of a widespread economy-wide mandate to deregulate the Indonesian economy, and occurred in all sectors, it is reasonable to accept that ownership is exogenously determined. In addition, the results in table 4 indicate no systematic bias in the pattern of privatization. Instruments for *GOVFIN* and *GOVFIN* × *PUB* are: the second lag of *GOVFIN*, the lag of *SKILLED*, (the lag of *PUB*) × *GOVFIN*, (the lag of *SKILLED*) × (the lag of *PUB*), (the lag of *UNSKILLED*) × (the lag of *PUB*), (the lag of *MATERIALS*) × (the lag of *PUB*), (the lag of *CAPITAL*) × (the lag of *PUB*), (the second lag of *CAPITAL*) × (the lag of *PUB*), the lag of *PUB*, the lag of *GIFT*, and the lag of *FOR*. The results are shown in column (1) of table 5. Allowing for endogeneity of *GOVFIN* does not change our earlier conclusion that PSEs in Indonesia perform more poorly if they receive government financing and/or protection from foreign ownership.[20]

TABLE 4.—RELATIVE PERFORMANCE BEFORE AND AFTER RECEIPT OF GOVERNMENT FINANCING AND PRIVATIZATION

	2 Years Prior	1 Year Prior	1 Year After
A. Government Financing*			
TFP growth	−.079	−.031	.052
	(1.2)	(0.7)	(1.6)
log(sales/employee)	−.008	−.002	.002
	(0.5)	(0.2)	(0.2)
Change in log(sales/employee)	−.008	.002	.001
	(0.9)	(0.4)	(0.2)
Cost per unit	−.008	−.020	−.023
	(0.2)	(0.9)	(1.1)
Change in cost per unit	.028	.023	.000
	(0.9)	(1.1)	(0.0)
B. Privatization†			
TFP growth	.018	.028	−.024
	(0.5)	(0.8)	(0.6)
log(sales/employee)	.087	.070	.045
	(6.9)	(6.6)	(3.5)
Change in log(sales/employee)	.002	.011	−.003
	(0.2)	(1.8)	(0.4)
Cost per unit	−.101	−.087	−.086
	(4.8)	(5.0)	(4.1)
Change in cost per unit	.004	−.014	−.010
	(0.2)	(0.8)	(0.5)

Notes: *t*-value for test of differences in means in ( ). Values indicate differences between plants and control group. For all values other than TFP growth, values are normalized by sector means. Therefore a value of 0.014 for log(sales/employee) indicates that firms receiving loans had higher sales per employee (relative to sector mean) by 1.4%. Cost per unit is the ratio of cost of sales to sales.

*Control group is public-sector enterprises without government support.

†Control group is plants with no change in ownership.

Adding Placebo Leads: Our third approach to dealing with potential endogeneity of *GOVFIN* and *PUB* is to add the leads of *GOVFIN*, *PUB* and their interaction to the regressions in order to determine if the relationships between ownership, government financing, and productivity that we observed in table 3 existed before the changes took place. The results are shown in column (2) of table 5. We find that none of the leads are significant and our original finding regarding the negative and significant coefficient on the interaction between *PUB* and *GOVFIN* still holds.

We conclude from the results shown in tables 4 and 5 that endogeneity is not influencing our results. As an additional test, we also examined the results on the determinants of *GOVFIN* using a broad spectrum of variables—essentially expanding the instrument list and examining the results from the first stage

[19] In their analysis of the Fortune 500 companies, Dewenter and Malatesta (2001) found that privatization is associated with improved profitability, but the improvement largely occurs during the 3 years just before privatization, that is, governments efficiently restructure some firms before selling them.

[20] The interaction term between public ownership and import penetration is no longer significant. Our chi-square tests suggest that our instruments are valid. For the chi-square test, a value less than 16.9 indicates that we cannot reject the validity of the instruments at the 95% confidence level.

TABLE 5.—EFFECTS OF OWNERSHIP AND THE ENVIRONMENT ON PRODUCTIVITY: INSTRUMENTAL VARIABLES AND "PLACEBO LEADS" ESTIMATES, 1982–1995

	Instrumental Variables (1)	With Placebo Leads for *PUB* and *GOVFIN* (2)
PUB	−.532	.149
	(−0.53)	(0.16)
PUB × *T*	.006	−.002
	(0.55)	(−0.22)
GOVFIN	.033	.039
	(0.53)	(1.80)
PUB × *GOVFIN*	−.217	−.089
	(−1.84)	(−2.51)
PUB(*LEAD*)	—	.131
		(0.18)
PUB × *T*(*LEAD*)	—	−.003
		(−0.36)
GOVFIN(*LEAD*)	—	−.033
		(−0.76)
PUB × *GOVFIN*(*LEAD*)	—	.031
		(0.55)
HERF	−.069	−.112
	(−0.99)	(−1.71)
$MPEN_{-1}$	.022	−.039
	(0.25)	(−0.62)
FOR	.001	.001
	(1.37)	(1.68)
STOCK	.041	.032
	(1.67)	(1.23)
$PUB \times HERF_{t-1}$	.328	.304
	(1.82)	(1.35)
PUB × *MPEN*	.535	.677
	(1.54)	(3.30)
PUB × *FOR*	.022	.006
	(1.94)	(1.06)
SKILLED	.079	.085
	(7.67)	(9.48)
UNSKILLED	.185	.187
	(11.77)	(12.88)
MATERIALS	.573	.595
	(24.03)	(27.17)
CAPITAL	.005	.002
	(4.19)	(2.36)
R^2	.57	.61
No. of observations	10,008	13,243
Chi-square for over identification test	6.0	

Notes: Dependent variable: log change in real output. *t*-values in parentheses. Standard errors are corrected for heteroskedesticity and clustering. All specifications include year, ISIC, and region dummies. The instruments for *GOVFIN* and *GOVFIN* × *PUB* in column (1) are: the lag of *SKILLED*, (the lag of *PUB*) × *GOVFIN*, (the lag of *SKILLED*) × (the lag of *PUB*), (the lag of first-differences *UNSKILLED*) × (the lag of *PUB*) (the lag of *MATERIALS*) × (the lag of *PUB*), (the lag of *CAPITAL*) × (the lag of *PUB*), (the second lag of *CAPITAL*) × (the lag of *PUB*), the second lag of *GOVFIN*, the lag of *PUB*, the lag of *GIFT*, and the lag of *FOR*. For the chi-square test, a value of less than 16.9 indicates that we cannot reject the validity of the instruments at the 95% confidence level.

of the IV estimation. The results (available on request from the authors) suggest no statistically significant relationship between firm profits and the availability of government financing. What we do find, however, is that firms most likely to receive government financing are small, fast-growing firms in less concentrated sectors. These results seem to suggest that the more successful firms received government financing, refuting the possibility of bailouts.

V. Extensions

In this section, we describe a number of extensions to the basic empirical model, which are presented in table 6. In particular, we expand the model to create a more general framework which allows for variable markups and factor shares across ownership categories and different enterprises, as described in the Appendix. The general conclusion from these extensions is that our basic results in table 3 are robust to alternative specifications.

A. Nonlinear Effects of Ownership

We considered the possibility that the coefficients on the interaction terms between *PUB* and the various measures of the environment are capturing a nonlinear quadratic effect of ownership. This would be the case if *GOVFIN*, *MPEN*, *HERF*, or *FOR* were highly collinear with *PUB* and were simply acting as a proxy for the nonlinear effect of public ownership when it is interacted with the environment. We tested for this by adding the square of *PUB* to the regressions. The results, shown in column (1) of table 6, indicate that our original findings remain unchanged; the interaction terms *PUB* × *GOVFIN*, *PUB* × *MPEN*, and *PUB* × *FOR* remain significant.

B. Alternative Definition of Government Financing

Because government financing is defined as the ratio of public loans to total investment, a firm with a high degree of government subsidies might not appear to be heavily subsidized if investment is also high. Consequently, we redefined government financing as the real value of government financing, instead of normalizing by investment. The results, shown in column (2) of table 6, indicate that *PUB* × *GOVFIN* is still negative and significant.

C. Lagged Effect of Ownership Changes

It is possible that changes in ownership do not have an immediate impact on performance, but only affect performance with a lag. Consequently, we redefined *PUB* and *PUB* × *T* as the lags of those variables. This allows the independent effect of ownership to operate more slowly. The results, shown in column (3) of table 6, indicate that our original results on the effects of ownership, soft loans, and import penetration are unchanged, although the interaction term between *PUB* and *FOR* is no longer significant.

D. Estimating TFPG in Two Steps

Many researchers who investigate the determinants of productivity growth prefer to follow a two-step approach, where they first estimate TFPG and then in a second step regress TFPG on its determinants. This approach is particularly useful if there is multicollinearity between the inputs and the policy variables, creating a challenge to researchers who seek to establish a more precise relationship between policies and performance. We used this two-step approach for estimating TFPG by first estimating an economy-wide production function and then calculating TFPG as the re-

TABLE 6.—ROBUSTNESS CHECKS

	(1) Adds *PUBSQ*	(2) Real Value of *GOVFIN*	(3) Lagged *PUB*	(4) TFP Estimated in Two Steps	(5) Two-Step TFP with Sector-Specific Production Functions	(6) Markups Vary by Ownership and *GOVFIN*
PUB	0.363	0.289	0.258	0.125	0.096	0.032
	(0.54)	(0.43)	(0.40)	(0.20)	(0.15)	(0.05)
PUB × *T*	−0.003	−0.004	−0.004	−0.001	−0.001	−0.001
	(−0.47)	(−0.52)	(−0.56)	(−0.17)	(−0.12)	(−0.07)
PUBSQ	−0.117	—	—	—	—	—
	(−0.50)					
GOVFIN	0.020	0.003	0.037	0.015	0.016	0.054
	(0.86)	(1.84)	(1.24)	(0.88)	(0.96)	(0.74)
HERF	0.057	0.058	−0.047	0.077	0.078	0.078
	(0.87)	(0.89)	(−0.72)	(1.02)	(1.00)	(1.01)
$MPEN_{-1}$	0.008	0.008	−0.023	0.061	0.057	0.058
	(0.12)	(0.13)	(−0.38)	(1.01)	(0.93)	(0.94)
FOR	0.001	0.001	0.0003	0.0003	0.0003	0.0003
	(1.04)	(1.03)	(0.93)	(0.68)	(0.71)	(0.74)
STOCK	0.028	0.027	0.030	0.026	0.028	0.027
	(1.31)	(1.28)	(1.45)	(1.21)	(1.32)	(1.25)
PUB × *GOVFIN*	−0.068	−0.005	−0.083	−0.059	−0.059	−0.051
	(−2.07)	(−2.41)	(−2.06)	(−2.42)	(−2.30)	(−2.18)
PUB × *HERF*	0.044	0.040	0.181	0.193	0.197	0.212
	(0.23)	(0.21)	(0.95)	(0.69)	(0.73)	(0.78)
PUB × *MPEN*	0.543	0.543	0.472	0.478	0.483	0.482
	(2.77)	(2.79)	(3.04)	(2.56)	(2.61)	(2.63)
PUB × *FOR*	0.19	0.020	0.004	0.023	0.023	0.023
	(1.86)	(1.98)	(0.85)	(2.61)	(2.71)	(2.59)
PUB × *dX*	—	—	—	—	—	−0.132
						(−1.91)
GOVFIN × *dX*	—	—	—	—	—	0.023
						(0.62)
$dX = \sum_{m=1}^{M} B_{mijt} d \ln Z_{mij}$	—	—	—	—	—	1.152
						(67.8)
R^2	.62	.62	.60	.02	.03	.67
N	19,085	19,085	15,948	19,085	19,085	19,085

Notes: Dependent variable: log change in real output, 1982–1995. All regressions include *SKILLED*, *UNSKILLED*, *MATERIALS*, *CAPITAL*, year, ISIC, and region dummies. Standard errors are corrected for heteroskedasticity and clustering. See Appendix for a discussion of *dX*. The coefficient on *dX* can be interpreted as the degree of departure from perfect competition, the so-called markup.

sidual by subtracting coefficient-weighted changes in inputs from output growth. We then regressed TFPG on all variables except the inputs. The results, shown in column (4) of table 6, leave our main conclusions unchanged.

E. Two-Step TFPG Estimates by Sector

To the extent that factor shares or markups vary across sectors, the framework presented in equations (1)–(4) would justify presenting separate estimates by sector. We therefore modified the two-step approach described above by estimating sector-specific production functions in the first stage, allowing the coefficients on the inputs to vary for each three-digit manufacturing sector. The results of the second stage, in which TFPG is calculated as the residual, are shown in column (5) of table 6. Again, our main conclusions are unchanged; the main effect of *PUB* is insignificant, and the interaction terms between *PUB* and *GOVFIN*, *MPEN*, and *FOR* are significant.

F. Allowing Factor Price, Factor Shares, and Markups to Vary Across Ownership and Government Financing Categories

The most general framework for production function estimation, presented in the Appendix, allows factor shares to vary across establishments and markups to vary across both ownership categories and government financing categories. If PSEs or enterprises that receive government financing face different factor prices from private enterprises or enterprises without government financing, then their factor shares will not be equal. Different types of ownership or financing sources could also lead to different factor intensities, which would again imply that factor shares should vary across establishments. In addition, coefficients on inputs could also vary due to imperfect competition, as the model presented in the Appendix makes very clear. To allow for these possibilities, we estimated equation (A-6) in the Appendix, which allows us to calculate establishment-specific factor shares from the data and also takes into account the possibility of imperfect competition. In addition, we allowed the degree of imperfect competition to vary across public and private enterprises and also as a function of government financing.

The results, shown in column (6) of table 6, indicate that the coefficients on the inputs *dX* are systematically lower for PSEs, suggesting lower markups. Across all enterprises, the coefficient on factor-share weighted inputs *dX* is equal to 1.152, indicating on average excess profits of 15%. PSEs, however, have essentially zero excess profits, as indicated by the negative and statistically significant coefficient −0.132 on the

interaction between *PUB* and the inputs. This suggests that moving from public to private ownership is likely to increase prices or markups, as many critics of privatization have claimed.

There is no systematic relationship between markups and government financing, as indicated by the small and statistically insignificant coefficient on $GOVFIN \times dX$. Adding all these interaction terms and allowing for this more general specification does not affect the magnitude or the significance of the coefficients on PUB, $PUB \times GOVFIN$, $PUB \times MPEN$, and $PUB \times FOR$.

VI. Conclusions

An unanswered question in the debate on public-sector inefficiency is whether reforms other than government divestiture can effectively substitute for privatization. In this paper we tackle this question using a 1981–1995 panel data set of all public and private manufacturing establishments in Indonesia. We consider two leading hypotheses: (1) the *ownership* hypothesis, which postulates that PSEs are inefficient because of monitoring problems, and (2) the *environment* hypothesis, which postulates that PSEs are inefficient because of the environment in which they operate, as measured by the soft budget constraint or barriers to competition. Indonesia is an ideal setting to test these two hypotheses because of the large exogenous changes in ownership and the environment that took place during 1981–1995.

The empirical results, which are obtained from fixed-effects specifications, provide support for both hypotheses. We find that public ownership by itself has no independent negative effect on either the level of productivity or on productivity growth, but ownership itself does matter in Indonesia, because, for a given level of government financing and competition, PSEs perform worse than their private-sector counterparts. The *environment* matters because only those PSEs which received government financing or those shielded from import competition or foreign ownership performed worse than private enterprises. We calculate that if a public firm is fully privatized, its productivity will rise by 1.6 percentage points. The same result could be achieved by manipulating the environment. In particular, if state financing of new investment by the public enterprise falls from 100% to 70%, or import penetration rises by 3 percentage points, or foreign ownership in the enterprise increases by three-quarters of a percentage point, these changes will each produce the same gain in productivity as a full privatization. We considered the possibility that our results could be plagued by endogeneity bias and used a number of techniques to control for this possibility, all of which led to the conclusion that endogeneity is not a problem in our data.

One question which immediately arises is how significant these gains in productivity are, and how easy it is to reform the environment, in contrast to a full or partial privatization. Between 1989 and 1995, when most of the privatizations, reductions in government financing and increases in foreign investment occurred, TFP growth for PSEs in manufacturing was slightly higher than 1 percentage point per year. This translates to cumulative productivity growth of 7.4 percentage points from 1989 to 1995. During this period, the typical partial privatization led to an increase in private ownership of 20 percentage points (i.e., a reduction of public ownership from 60% to 40%), which would contribute—according to our results—to an increase in productivity of 0.3%. This suggests that partial privatizations alone during this period made a very small contribution to overall productivity growth for PSEs. By contrast, reforms in the environment provided a more significant contribution. The reduction in government financing of investment by PSEs of 9 percentage points between 1989 and 1995 implies an increase in productivity of 0.5%, whereas the 0.6 percentage point increase in foreign ownership of remaining PSEs translated into total factor productivity growth of more than 1%. Together, these two changes account for almost two percentage points, that is, almost 30%, of the observed 7 percentage point increase in total factor productivity for remaining PSEs.

These results suggest that two different types of policies could be used to increase the efficiency of PSEs in Indonesia or in other countries which have recently embarked on privatization programs. Because private firms in Indonesia outperform public-sector firms for a given degree of competition, simply privatizing the firms should lead to gains in efficiency. But the results also demonstrate that an alternative way to achieve efficiency gains is to manipulate the environment, specifically to reduce or eliminate government financing for public enterprises or to increase import competition or foreign ownership for these firms. Because many privatizations are partial and the government typically retains some ownership, a third policy option that combines privatization and environmental reform also exists. Our results indicate that environmental reforms combined with privatization will yield the biggest improvements in efficiency.

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APPENDIX

A general production function for plant i in sector j at time t is given by,

$$Y_{ijt} = A_{ijt}F(Z_{ijt}). \tag{A-1}$$

The output Y_{ijt} is a real measure of plant-level output, and Z is a vector of M inputs. In our estimation, we will include as inputs both skilled and unskilled labor, capital inputs, and materials. A_{ijt} is a plant-specific index of Hicks-neutral technical progress, which will depend on a number of factors, including ownership. Totally differentiating equation (A-1) and dividing through by Y, we have

$$\frac{dY}{Y_{ijt}} = \sum_m \frac{\partial Y}{\partial Z_m}\left(\frac{dZ_m}{Y}\right)_{ijt} + \frac{dA}{A_{ijt}}. \tag{A-2}$$

In this framework, imperfect competition enters equation (A-2) because plants with market power do not set the value marginal product $P(\partial Y/\partial Z)$ equal to the factor price. If we assume Cournot behavior by imperfectly competitive plants, then we can derive the first-order conditions from each plant's profit maximization and write each of the partial derivatives $\partial Y/\partial Z$

$$\left(\frac{\partial Y}{\partial Z_m}\right)_{ijt} = \left(\frac{w_m}{p}\right)_{jt}\frac{1}{1 + S_{ij}/e_j} = \left(\frac{w_m}{p}\right)_{jt}\mu_{ij}. \tag{A-3}$$

Here S is the i^{th} plant's share in the j^{th} industry, and e is the elasticity of demand. Factor prices for input m are given by w_m. If plant i is not perfectly competitive, then the value of the marginal product exceeds the factor cost by some markup μ. For simplicity, we will assume that the markup parameter does not vary across plants or over time.

Substituting equation (A-3) into (A-2) and rearranging terms, we have

$$\frac{dY}{Y_{ijt}} = \mu_j \sum_m \frac{w_m Z_m}{PY}\frac{dZ_m}{Z_m} + \left(\frac{dA}{A}\right)_{ijt}. \tag{A-4}$$

The value of $w_m Z_m/PY$ is the share of the m^{th} factor in total output. We shall denote this share as B_m. Rewriting equation (A-4), we have

$$d\ln Y_{ijt} = d\ln A_{ijt} + \mu \sum_{m=1}^{M} B_m d\ln Z_{mijt}. \tag{A-5}$$

All variables have been rewritten in log form. Output growth can be decomposed into two sources: growth in productivity, and growth in input use. In a regression framework, the coefficients on the M inputs include two components: the markup parameter μ, and the factor share. By not constraining the coefficients, we allow both factor shares and markups to vary. Furthermore, it is possible to estimate the markup parameter by replacing the coefficient B with the plant-specific factor shares based on expenditures on different inputs, which are reported by the establishments each year. This allows factor shares to vary both across time and across establishments. Furthermore, it is also possible to allow markups to vary across ownership categories, leading to the following general specification:

$$\begin{aligned} d\ln Y_{ijt} = {} & d\ln A_{ijt} + \mu_{PRIV_v}\sum_{m=1}^{M} B_{mijt} d\ln Z_{mijt} \\ & + \mu_{PUB}\left(PUB \times \sum_{m=1}^{M} B_{mijt} d\ln Z_{mijt}\right). \end{aligned} \tag{A-6}$$

In equation (A-6), B is not estimated but calculated from the establishment level data, while the markup is estimated. A version of equation (A-6) which also allows markups to vary as a function of government loans is presented in column (6) in table 6.