WPS 2599

POLICY RESEARCH WORKING PAPER 2599

State Ownership and Labor Redundancy

Estimates Based on Enterprise-Level Data from Vietnam

Patrick Belser
Martín Rama

To predict the number of workers who will lose their jobs if state-owned enterprises are privatized or restructured, several approaches have been taken: drawing on international experience, accepting estimates from current directors of state enterprises, and inferring the number of redundancies from ad hoc indicators of profitability, productivity, or labor cost. All three approaches may be irrelevant and inferior to systematically comparing employment levels across similar enterprises that differ in the share of capital owned by the state.

The World Bank
Development Research Group
Public Service Delivery
May 2001

Summary findings

Privatizing or restructuring state-owned enterprises may lead to massive layoffs, but the number of redundant workers is usually unknown beforehand. Belser and Rama estimate labor redundancy by comparing employment levels across enterprises with different degrees of state ownership.

In their model, state enterprises are a hybrid between labor-managed enterprises and profit-maximizing enterprises, with the profit motive becoming less prominent as the state share of capital increases. This model leads to an employment equation that is estimated using an enterprise database from Vietnam.

In this database, constructed especially for this paper, roughly a third of the enterprises are fully state-owned, a third are fully private, and a third are joint ventures between the state and the private sector. The employment equations control for sector activity, region, and the enterprise's age, among other variables.

The results suggest that if the state share of capital were brought down to zero, roughly half of the workers in the corresponding enterprises would be redundant. This is more than 10 times the estimate by the current enterprise directors.

The results also show a wide dispersion of redundancy across sectors of activity.

There is only a weak correlation between estimated labor redundancy and 12 ad hoc indicators of profitability, productivity, and labor cost. But the correlation between most ad hoc indicators also is weak, suggesting that these indicators are not reliable tools for identifying the most overstaffed enterprises.

This paper—a product of Public Service Delivery, Development Research Group—is part of a larger effort in the group to understand labor issues in public sector reform. The study was supported by the Bank's Research Support Budget under the research project "Public Sector Downsizing, Phase II" (RPO 683-67). It was also supported by the Vietnam Country Office, East Asia and Pacific Region. Copies of this paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Hedy Sladovich, room MC2-609, telephone 202-473-7698, fax 202-522-1154, email address hsladovich@worldbank.org. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. Martín Rama may be contacted at mrama@worldbank.org. May 2001. (42 pages)

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Patrick Belser

Martín Rama

* Support for the preparation of this paper was provided by the ASEM grant for Social Safety Nets (TF 020714) and the World Bank research project on Public Sector Downsizing (RPO 683-67). Access to the MPDF data was possible thanks to Leila Webster. Nguyet Nguyen Nga provided valuable help with the field work in Haiphong. Valuable comments and suggestions were received from Kazi Mahbub-Al Matin. The views in the paper are those of the authors. They should not be attributed to the World Bank. Correspondence related to this paper should be sent to mrama@worldbank.org.

1. Introduction

The prospect of mass layoffs is one of the main reasons for concern when privatizing or restructuring the state sector. However, reliable estimates of the number of workers who could lose their jobs as a result of privatization or restructuring are usually unavailable beforehand. Only when a few enterprises are affected is a careful assessment of labor redundancy possible. Then, engineers, sector experts, consulting firms or potential buyers can be requested to diagnose the enterprises, one by one, and estimate their excess labor. But this case-by-case approach is clearly unfeasible when hundreds, or even thousands, of state-owned enterprises are at stake, as it often happens in transition economies or in countries that relied on a state-led development strategy over long periods of time. These are typically the countries that need the restructuring of their public sectors the most. Uncertainty regarding the employment implications of privatization or restructuring may in turn be a powerful deterrent for action.

In the absence of better information, several approaches have been tried. One of them is to review the employment effects of privatization and restructuring in other countries (see Kikeri, 1997; Frydman et al., 1999; and Jefferson and Singh, 1999, among others). While this approach has produced a wealth of information, one of its main conclusions is that the effects vary dramatically across experiences, from mass layoffs to substantial expansions in employment. Deciding which of those experiences is more relevant for a particular country and period might be difficult. Another approach is to ask the directors of state-owned enterprises to report the fraction of their workers who are redundant. But their answers may not be revealing either. These directors are more often bureaucrats than managers, and they do not face the right set of incentives to make personnel decisions anyway (World Bank, 1997). Finally, a third approach is to infer the extent of labor redundancy from ad hoc indicators of profitability, productivity or

labor costs. However, these ad hoc indicators might not be very telling. For instance, assessing the actual ratio of profits to capital in a state-owned enterprise is potentially difficult, as substantial government transfers might be hidden under a variety of forms. Given the weaknesses of the usual approaches to estimate the extent of labor redundancy, it is not surprising that downsizing efforts in preparation for privatization have had low or negligible payoffs (La Porta and López-de-Silanes, 1999).

This paper proposes a simple approach to estimate labor redundancy, based on a comparison of employment levels across enterprises with different degrees of state ownership. The analytical framework is provided by the theory of labor-managed enterprises (for a survey, see Bonin, Jones and Putterman, 1993). While privately owned enterprises maximize profits, labor-managed enterprises cater to the objectives of their workers, and these objectives usually involve some combination of employment and earnings. One possibility would be to model state-owned enterprises as if they actually were labor-managed enterprises (see, for instance, Dinopoulos and Lane, 1998). But they can better be seen as a hybrid between labor-managed enterprises and profit-maximizing enterprises, with the profit-maximization objective being more prominent when the state share of capital is small, and the workers' objectives being more prominent when it is large. Such is the approach adopted in this paper.

The proposed analytical framework does not assume that state-owned enterprises are always over-staffed. Whether a reduction in the state share of capital leads to higher or lower employment is an open question, which can only be answered empirically. The theoretical ambiguity results from the fact that different groups of workers may attach different weights to the employment and earnings objectives. If the earnings objective is prominent, a labor-managed enterprise can be under-staffed. This ambiguity is consistent with the substantial

variation in over-staffing revealed by country-specific studies. For instance, it has been claimed that the hardening of the budget constraint faced by Italian state-owned enterprises, which forced them to focus more on profit maximization, led to a reduction in their employment (Bertero and Rondi, 2000). But in Brazil state-owned enterprises are allegedly more capital-intensive, and thus generate fewer jobs per unit of output, than privately owned enterprises (Clements, 1992). In fact, the proposed theoretical framework does not even imply that the effect of state ownership on employment is the same across all enterprises in a country. In this paper it is allowed to vary across sectors of activity.

At the empirical level, the paper estimates labor redundancy by regressing (the log of) employment at the enterprise-level on the share of the capital that is owned by the state, controlling for a variety of enterprise characteristics, such as age, sector of activity and region. The last two control variables are intended to capture the different competitive pressures faced by individual enterprises. In this respect, the economic environment may be as important as state ownership to explain employment levels (see Bartel and Harrison, 2000). Other things equal, employment should be higher in activities that are protected by trade barriers, or enjoy a soft-budget constraint. Unfortunately, reliable indicators of the extent of product market competition, or of access to credit, are unavailable in many countries. In the absence of those indicators, the controls for sector of activity and region can be seen as proxies for the economic environment in which different groups of enterprises operate.

The specification used in the empirical analysis is directly derived from the theoretical framework described in previous paragraphs. The obtained coefficients allow predicting the change in enterprise-level employment if the share of capital owned by the state was set equal to zero, or brought down to some specified level. The labor redundancy indicator used in this paper

is this predicted change, or zero when an expansion in employment is expected. This indicator might not be highly reliable at the enterprise level. But it should become more precise as the estimated difference is aggregated over all the enterprises in a sector of activity, or in the entire economy. The aggregated differences provide information on the number of workers who could lose their jobs if state-owned enterprises were to become (or to operate in the same way as) privately owned enterprises.

The proposed approach is applied to the enterprise sector of Vietnam. In this country, 5,740 state-owned enterprises employing 1.7 million workers will be either privatized or restructured over the next five years. While the personnel of these enterprises only accounts for five percent of the total labor force, it amounts to 15 percent of non-agricultural employment. Moreover, workers in state-owned enterprises are part of the labor elite, and represent one of the most important political constituencies of the Vietnamese government. Many of these workers got their jobs as a reward for their sacrifices and courage during the American war. If a large fraction of them were to experience a dramatic decline in their wellbeing, pressures would mount to delay or even reverse the reform process. Assessing how many workers may lose their jobs as a result of privatization and restructuring is thus crucial to design an appropriate safety net, and to mobilize resources accordingly.

The data used in this paper are from a sample of 338 enterprises whose state share of capital ranges from zero to one hundred percent. One of the contributions of the paper is to have constructed such a database. Other developing countries have plant-level surveys covering large establishments in manufacturing, both state-owned and privately owned. But nothing similar exists in Vietnam. Even for state-owned enterprises, the available information refers mainly to financial indicators, such as revenue, costs or debt. The database used in this paper is made of

detailed records from a variety of sources, including visits to several enterprises. The variables considered include employment, the state share of capital, and the percentage of workers who are redundant according to their current directors, among others. The list of enterprises in the database is determined by feasibility constraints, so that the sample is not randomly drawn. In particular, large enterprises are over-represented, and enterprises fully owned by the private sector are under-represented. However, the distribution of state-owned enterprises according to their institutional nature is similar in the sample and in the universe.

The results in the paper reveal substantial over-staffing in the state-owned enterprises of Vietnam. If the state share of capital were brought down to zero in all of them, around half of their workers, if not more, would become redundant. This figure exceeds the labor redundancy estimate offered by the directors of those enterprises by one order of magnitude. Moreover, the paper shows that labor redundancy at the enterprise level is not correlated with the ad hoc indicators of profitability, productivity or labor cost which are traditionally used to assess the degree of over-staffing. It does not follow necessarily that the estimates in this paper are "better" than those based on ad hoc indicators. However, the latter are also weakly correlated between them, which suggests that ad hoc indicators provide an unreliable basis to assess the degree of labor redundancy.

2. State-Owned Enterprises in Vietnam

With the disintegration of the Soviet Union, Vietnam lost its main trading partner and about one billion rubles a year in aid. The result was a collapse in economic growth and high inflation, peaking at about 450 percent per year. Confronted with this situation, the government

decided to follow China on the road to market socialism, also called market Leninism by reference to Lenin's New Economic Policy. In 1986, the 6th National Congress of the Communist Party adopted the Doi Moi, or renovation process. Since then, several reform policies have been implemented, and Vietnam has been moving steadily from a centrally planned to a market-oriented economy. According to Irvin (1996), Vietnam's reform process went farther than China's over a shorter period of time.

The Doi Moi policies tried to improve the performance of state-owned enterprises by reducing subsidies and increasing competition in product markets. State-owned enterprises were also granted larger autonomy in their decision making, including the ability to adjust their product mix, to procure inputs, to introduce new technologies, to borrow, to acquire or lease assets, to hire and fire employees, and to allocate their after-tax profits. In addition, they were given the freedom to export their products, and to enter into joint ventures with foreign investors (World Bank, 1994). Joint ventures in Vietnam have a state-owned enterprise, rather than a privately owned enterprise, as their local partner. The government's involvement in the management of state-owned enterprises includes their establishment, separation, merger and dissolution; the assignment of their rights to use state assets and capital; and the appointment of their directors and deputy directors.

Further reorganization of the state sector took place in 1994, with the revamping of conglomerates called general corporations. These conglomerates had been created in 1978, with the purpose of achieving vertical integration (from input supply to output delivery) under central planning. But as state-owned enterprises were given more autonomy, general corporations needed to be reorganized (Doanh and Cuong, 1998). Under the new regime, the so-called General Corporations 91 are groups of enterprises which have a cooperative relationship and use

a multi-level accounting system. A typical example is a holding company with subsidiary enterprises. The creation of General Corporations 91 was aimed at facilitating access to capital and technology. There currently are 17 of them. The so-called General Corporations 90, in turn, are groups of enterprises administered by provincial ministries, under supervision from line ministries and the provincial People's Committees.

Employment and pay decisions in state-owned enterprises are regulated by the 1995 labor code. Privately owned enterprises are, in principle, also subject to this code. Household enterprises are not. As a result of the Doi Moi, the government established a minimum wage, but it imposed no caps on individual earnings. It also abolished most government-provided benefits to workers, such as housing and travel allowances, medical insurance and retirement benefits. Responsibility for these benefits was transferred to the enterprises, to the extent allowed by their budget. The result was a widening of the dispersion in earnings and benefits across enterprises, sectors and regions. This dispersion was only partially restricted in 1997, when caps for individual earnings were set.

At present, the state sector of Vietnam is not large compared to most socialist economies, but it still plays a significant role in the economy. State-owned enterprises account for 5 percent of the labor force, but represent around a fifth of GDP. While their participation in agriculture is marginal, they generate almost a third of value added in manufacturing. About 40 percent of these enterprises consistently make profits, whereas 16 percent of them are permanent loss-makers. Profitable enterprises tend to be more labor-intensive, and more export-oriented, than unprofitable ones. It also appears that large enterprises perform better than small ones, and those owned by the central government perform better than those owned by local governments. About 90 percent of the largest 200 enterprises show positive pre-tax profits, but this may be partly due

to their monopolistic position in product markets, and to their preferential treatment in credit and import markets.

When this paper was written, the government of Vietnam was initiating a new phase of its reform program. The National Enterprise Reform Committee had proposed a five-year plan, combining the liquidation of non-viable enterprises, the total or partial divestiture of hundreds of small and medium enterprises, and the restructuring of large enterprises bound to remain in state hands (see World Bank, 2000). Over the first three years of this plan, 2,857 enterprises should be liquidated or divested. The restructuring of enterprises remaining in state hands should be achieved through restrictions on access to credit, diagnostic audits, and labor downsizing. In addition, all enterprises should be exposed to greater competition in product markets, as non-tariff barriers should be gradually removed and tariff barriers lowered.

3. Theoretical Framework

The literature on labor-managed enterprises provides a useful conceptual framework to analyze the consequences of state ownership on employment. A labor-managed enterprise (LME) differs from a profit-maximizing enterprise (PME) in its objective function (see Svejnar, 1982, and Bonin and Putterman, 1987). While a PME caters to the interests of its shareholders, an LME serves the interests of its workers. These interests are likely to include job security and earnings above those offered by the market. In this paper, a state-owned enterprise (SOE) is seen as a hybrid between an LME and a PME, with its objective function reflecting a compromise between the interests of workers and those of shareholders. From this perspective, the

optimization problem faced by an SOE is formally equivalent to the efficient bargaining problem analyzed by the literature on trade unions (see McDonald and Solow, 1981).

In the simplest case, enterprise profits V can be defined as:

$$V = P\,F(L) - W\,L - T \tag{1}$$

In this expression P is the output price, supposed constant, L is the labor input, F(.) is the production function, and T is a net transfer from the enterprise to the government. In an enterprise that is subsidized, or operates under a soft-budget constraint, T is negative.

A PME maximizes V with respect to L, taking the market wage as given. This yields the familiar first-order condition:

$$W = P\,F'(L) \tag{2}$$

Equation (2) implies that workers are employed up to the point where the marginal product of labor, in value terms, is equal to the market wage. The resulting profit has to be non-negative. It can be expected to be strictly positive in the short term.

An LME may pay a salary E above the market wage. The resulting rent, E – W, is one of the arguments of the objective function U(.) of the LME. The other argument is job security or, more simply, the employment level:

$$U = U(E - W, L) \tag{3}$$

The literature on labor-managed enterprises has devoted much attention to the case where maximizing the rent per worker is the only objective of the LME (Ward, 1958), but this is an unnecessarily restrictive and unrealistic assumption. Regardless of the relative weight of the two arguments in function U(.), the LME has no interest in making a profit. Any additional revenue could be used to increase the salary of current workers, or to recruit new ones at the prevailing salary. The zero-profit condition implies:

$$E = \frac{P\,F(L) - T}{L} \tag{4}$$

Equation (4) means that in an LME all net revenue is divided equally among workers.

This simple theoretical framework is illustrated in Figure 1. Profits are constant over all the points in each of the two hump-shaped curves in this figure. The slope of the constant-profit curves is obtained by totally differentiating equation (1), for a given level of V. The slope is positive (negative) when the productivity of the marginal worker is higher (lower) than his or her earnings. A PME prefers the lower curve to the higher one, because labor costs are smaller, for any employment level. However, the PME cannot pay less than the prevailing market wage. It therefore chooses point A, where equation (2) is verified. The dotted line connecting the points where the slope of the constant-profit curves is zero (A and B in the figure) is the neoclassical labor demand curve.

An LME, on the other hand, caters to the objectives of its workers. The utility of the workers is the same over all the points in the downward-sloping curve in Figure 1. The slope of the constant-utility curve is obtained by totally differentiating equation (3), for a given level of U. The farther this curve is from the origin, the higher the utility of the workers. A necessary

condition for the LME to maximize the utility of its workers is to make no profits. In the figure, it is assumed that profits are zero in the higher constant-profit curve. An LME therefore chooses the tangency point between the zero-profit curve and the constant-utility curve, represented by point C. Note that if the only objective of the workers were to maximize the rent per worker, the constant-utility curves would be horizontal and an LME would choose point B.

Although an LME caters to the interests of its workers, its employment level can be either higher or lower than that of an otherwise identical PME. To illustrate this point, consider the case where T = 0, and functions F(.) and U(.) verify:

$$F(L) = L^{\alpha} \tag{5}$$

$$U(E-W, L) = (E-W)^{\beta}\, L^{1-\beta} \tag{6}$$

Equation (5) is a particular case of the Cobb-Douglas production function. Equation (6) is a Stone-Geary utility function, with reservation levels represented by the market wage and the enterprise shutdown. Parameters α and β fall between zero and one.

Employment in a PME can be derived directly from equation (2), inserting the expression of F'(.) resulting from (5):

$$L_{PME} = \alpha^{1/(1-\alpha)} \left(\frac{W}{P}\right)^{-1/(1-\alpha)} \tag{7}$$

Employment in an LME is obtained maximizing equation (6), for T = 0, under the constraints represented by equations (4) and (5):

$$L_{LME} = \left[\frac{1-\beta(2-\alpha)}{1-\beta}\right]^{1/(1-\alpha)} \left(\frac{W}{P}\right)^{-1/(1-\alpha)} \tag{8}$$

According to equations (7) and (8), the elasticity of employment to changes in the real producer wage is the same in an LME and in a PME. But the absolute level of employment can be different. If employment features prominently among the workers' objectives (i.e. if $\beta < 0.5$), the LME is over-staffed compared to the PME. The opposite holds true if maximizing the rent per worker is the most important objective. In Figure 1, the employment level is the same in a PME and an LME (points A and C lie on the same vertical line), which corresponds to the case where $\beta = 0.5$.

The employment and pay decisions made by an SOE can be seen as the outcome of a negotiation between shareholders and workers. Using the Nash-bargaining solution, the objective function Z(.) of an SOE can be written as:

$$Z = U^{S} V^{1-S} \tag{9}$$

In equation (9), S represents the bargaining power of workers. From this perspective, an SOE resembles a profit maximizing enterprise negotiating an efficient contract with its trade union. A key assumption of this paper is that the bargaining power of workers increases with state ownership. In the simplest case, S can be measured by the state share of capital. When S = 0, there is fully private ownership, and the enterprise behaves as a PME. When S = 1, there is full

control by the state, and the enterprise behaves as an LME. In terms of Figure 1, the SOE equilibrium lies on a line connecting points A and C.

Employment in an SOE can be derived replacing equations (1), (4), (5) and (6) in equation (9). For T = 0, the first-order condition of this problem yields:

$$L_{SOE} = \left[\frac{\alpha - S(\alpha - 1 + \beta(2-\alpha))}{1 - S\beta}\right]^{1/(1-\alpha)} \left(\frac{W}{P}\right)^{-1/(1-\alpha)} \tag{10}$$

It follows from equation (10) that employment in an SOE falls in between employment in a PME and in an otherwise identical LME. These two polar cases obtain for S = 0 and S = 1 respectively. Quite intuitively, employment in an SOE increases with the state share of capital if $\beta < 0.5$, and decreases otherwise. State ownership can therefore be associated with either over-staffing or under-staffing, depending on whether workers attach more weight to the employment or the rent objective respectively.

4. The Enterprise Database

The relationship between state ownership and the level of employment is assessed in this paper using individual records from an enterprise database for Vietnam. This database combines information from four sources. Most of the records on state-owned enterprises and joint ventures are from a large survey undertaken in 1999 by Vietnam's Ministry of Finance. This survey reports on the composition and remuneration of each enterprise's work force, as well as on its assets and performance. Most of the records on private enterprises whose owners are

Vietnamese are from a survey conducted in the same year by the Mekong Project Development Facility (MPDF), a program managed by the International Finance Corporation of the World Bank. Other records were obtained from Haiphong's Department of Planning and Investment, and refer to enterprises with foreign owners in that province. The remaining information was collected directly through interviews with the managers of export-oriented private manufacturers (both domestic and foreign) located in the Haiphong province. For the private sector, the focus was on registered enterprises only. As household enterprises do not abide by the 1995 labor code, including them in the analysis would make it difficult to disentangle the employment effects of state ownership from those of compliance with labor regulations

In all, there are 338 enterprises in the database, almost equally divided between state-owned enterprises (111), joint ventures involving a foreign partner and the state (113), and privately owned enterprises (114). The state share of capital is 100 percent for all enterprises in the first group, and zero for all those in the third group. Among the joint ventures, the state share of capital varies between 10.4 and 99.9 percent. In addition to information on employment and state ownership, for a large number of these enterprises there is information on variables such as age, sector of activity, region, capital stock, export orientation, profits, revenue, and average remuneration per worker. For more than three quarters of the enterprises owned to some extent by the state, there is information on the number of workers who are redundant according to their current directors.

Table 1 compares the enterprise database with the enterprise universe of Vietnam. For the private sector, the universe considered in the table includes all enterprises registered under any of the three legal forms existing in Vietnam: private companies, limited-liability companies, and joint-stock companies. The private sector data in the universe are from MPDF (1999), and

correspond to the year 1998. Table 1 reveals that the database is biased towards large enterprises. This is especially true for the private sector, with the average personnel in the database being 529, compared to 19 in the universe. The gap is smaller in the state sector, as the average personnel in the database is 902, compared to 293 in the universe.

Within the state sector, the distribution of enterprises according to their institutional nature reproduces quite closely the distribution observed in the universe. General Corporations are slightly over-represented in terms of enterprises, but not in terms of employment. For each General Corporation in the database, there are 19.5 of them in the universe. The ratio climbs to 31.9 for other state-owned enterprises. However, for each worker in a General Corporation in the database, there are 7.6 of them in the universe. The corresponding ratio for other state-owned enterprises is 8.9. Given this similarity of employment ratios, and given also the employment focus of this paper, the analysis is carried out as if the database was self-weighted, without applying expansion factors to blow it up.

Tables 2 and 3 report the averages of the main variables in the enterprise database, organized by sector of activity and institutional sector respectively. Sectors of activity are defined so as to be relatively homogeneous but include a minimum of three enterprises each. Institutional sectors refer to the type of arrangement governing state ownership, from control by the central government, to control by local governments, to General Corporations. The figures in Tables 2 and 3 are non-weighted averages over all valid observations in each cell, with the number of valid observations depending on the variable considered. For the employment variable, a breakdown by type of labor contract is shown. This breakdown is potentially useful when dealing labor redundancy and its implications, because job termination procedures may vary depending on the nature of the contracts linking workers and enterprises. For instance, not

renewing a contract is a termination option for temporary workers, but not for workers with permanent jobs.

5. Employment Equations

The simple theoretical model presented in section 3 links employment at the enterprise level (L) with a state ownership indicator (S) and the real producer wage (W/P). Whereas the enterprise database contains information on the former two variables, the latter is in most cases unobservable. Enterprises where some of the capital is owned by the state can be expected to pay salaries above the market wage. In terms of the model, the variable observed for these enterprises is E, not W. An alternative would be to infer the value of W from the average salary in fully private enterprises. But this alternative would lead to an endogeneity problem. Some fully private enterprises may pay higher or lower wages than others, and the reasons why they do so may also determine that they employ more or less workers than others. Under these circumstances, the coefficients of an employment equation containing L on its left-hand-side and the observed (or inferred) W in its right-hand-side would be biased.

The alternative chosen in this paper is to replace W/P by exogenous proxies of it (called X hereafter), such as dummy variables for sector of activity and region. The relevant nominal wage W is likely to increase with workers' skills, and the required skills are different across sectors of activity. Nominal wages also display substantial geographical variation; for instance, they tend to be higher in more urbanized areas. As regards the producer price P, it crucially depends on the degree of competition faced by enterprises. For example, other things equal, P should be higher in sectors of activity protected by high tariffs. The dummy variables for sector

of activity and region thus summarize the economic environment in which enterprises operate. This environment is shaped both by geography and by economic policy.

Other potentially useful proxies for the relevant real producer wage are the age of the enterprise, its export orientation, and its capital stock. Age, for instance, could be seen as an indication of the scale of the enterprise, as it takes time to build up the optimal production capacity. Other things equal, an old enterprise could be expected to be "bigger" than a new one, hence to have a higher employment level. Similarly, an export-oriented enterprise could in principle be more labor intensive than one producing for the domestic market only, as labor is the relatively abundant factor in Vietnam. Finally, an enterprise with a large capital stock could be expected to have more workers, as its labor productivity would be higher, other things equal. Arguably, age, export orientation and capital stock are not exogenous. To address this criticism (and also due to data limitations) these other indicators are introduced in the empirical analysis one at a time.

A basic specification for the employment equation is the following:

$$Log\, L_i = \lambda_0 + \lambda_1 S_i + \lambda_2 X_i + \varepsilon_i \tag{11}$$

This specification is directly derived from equation (10). The sub-index "i" refers to the enterprise (i = 1, 2, ..., 338). The stochastic disturbance ε_i captures the effect of other variables not considered in the model, and parameter λ_1 measures the impact of state ownership on (the log of) employment. Equation (11) implicitly assumes that this impact is linear over the relevant range of S, and also that it is the same across all enterprises. To our knowledge, a similar specification has only been used by Jones and Backus (1989) to assess the impact of profit

sharing on employment in the UK. In the paper by Jones and Backus, S is replaced by a series of indicators of workers' involvement in their enterprises.

A more elaborate specification of the employment equation has to allow for a differential impact of state ownership in different sectors of activity. The degree of product market competition, or access to credit, should affect employment levels. But the size of this effect is not necessarily the same for state-owned and privately owned enterprises. It follows that the change in ownership may have different implications depending on the economic environment faced by different enterprises. A more general specification for the employment equation is:

$$Log\, L_i = \theta_0 + \theta_1 S_i + \theta_2 X_i + \theta_3 I_i + \theta_4 S_i I_i + v_i \tag{12}$$

In equation (12), I_i is an indicator variable, set equal to one if the enterprise belongs to a specific sector of activity, and equal to zero otherwise; and v_i is the stochastic disturbance. Deriving Log L_i with respect to S_i yields the effect of state ownership on employment. For the specific sector considered, this effect is equal to $\theta_1 + \theta_4$. Strictly speaking, if there are A sectors of activity, equation (12) has to include A-1 sector indicator variables, and A-1 interactive terms. The specification in equation (12) corresponds to the case where A = 2.

6. Results

Tables 4 and 5 report estimates of equation (11). In Table 4, S is measured through the state share of capital. In Table 5, it is replaced by a set of dummy variables indicating whether the enterprise is fully owned by the state or is a joint venture, with fully private ownership

serving as the default option. The columns in each table differ in the nature of the X variables considered. The most parsimonious specification, in column A, only has S as a right-hand-side variable. Not surprisingly, the fit of the equation is poor. But coefficient λ_1 is highly significant. The value of this coefficient does not vary dramatically as other variables are included in the right-hand-side of the employment equation. Columns are ordered by decreasing number of observations. All the coefficients on the X variables have the expected signs, and almost all of them are significant (the exception is the coefficient on the export-orientation variable, which is not statistically different from zero).

Overall, the results in Tables 4 and 5 indicate that the effect of state ownership on employment is significantly positive. In terms of the model presented above, these results correspond to the case where $\beta < 0.5$, which means that employment carries more weight than rent among the objectives of SOE workers. Moreover, the effect of state ownership is potentially large. For instance, in column A in Table 4, the estimated value of coefficient λ_1 is 0.657. This implies that shifting from S = 0 to S =1 would lead to a 92.9 percent increase in employment ([exp(0.657)-1] = 0.929). The figures are similarly large if other columns in either Table 4 or Table 5 are considered instead. However, these two tables implicitly assume that the effect is the same across all sectors of activity, and this is an excessively restrictive assumption.

Table 6 reports the net impact of state ownership on employment by sector of activity, based on equation (12). The figures in the table correspond to the estimated value of $\theta_1 + \theta_4$ for each sector. The list of X variables included in each specification is the same as in Tables 4 and 5. For instance, column B controls for age, sector of activity and region in all three tables. Unfortunately, estimates cannot be obtained for $\theta_1 + \theta_4$ in all cases, as information on some of the right-hand-side variables is missing (or displays no variation) for all enterprises in some

specific sectors. For the available estimates, the results in Table 6 are quite consistent across specifications, and suggest a substantial dispersion in the effect of state ownership on employment across sectors. In particular, there appears to be no employment effect in enterprises producing food, beverages and tobacco; footwear, bags and leather; and plastic products. On the other hand, state ownership is associated with significantly higher employment levels in textile and garments; construction and infrastructure; machinery and equipment; iron and steel; coal and minerals; oil and gas; and transportation. It is associated with lower employment levels in enterprises producing paper products.

7. Labor Redundancy Estimates

The employment equations estimated in the previous section indicate whether state ownership is associated with higher employment levels, but the analysis has to be taken one step further in order to assess the fraction of workers who are redundant. This fraction depends not only on the estimated effect of state ownership, but also on the share of the capital owned by the state in each enterprise. A large effect of state ownership on employment does not imply that over-staffing is substantial if the state share of capital is small. More generally, the assessment of over-staffing cannot be done without taking into account the distribution of the state ownership variable across enterprises.

Labor redundancy at the enterprise level is measured in this paper as the (downward) change in predicted employment if the state share of capital was brought to zero. If the resulting change in predicted employment is positive, the paper assumes that the enterprise has no redundant workers. In analytical terms the labor redundancy indicator r_i is defined as:

$$r_i = Max\left\{0, 1 - \exp\left(\hat{\lambda}_1 S_i\right)\right\} \cdot 100 \tag{13}$$

when the specification in equation (11) is used, and as:

$$r_i = Max\left\{0, 1 - \exp\left[-\left(\hat{\theta}_1 + \hat{\theta}_4\right) S_i\right]\right\} \cdot 100 \tag{14}$$

when equation (12) is used instead. The hats over the parameters indicate that these are estimated values. By construction, labor redundancy is measured as a percentage of current employment.

Figure 2 shows the kernel density of the labor redundancy indicator across all the enterprises in the sample that have some degree of state ownership. The horizontal axis in all five panels ranges from 0 to 100 percent. The four panels in the bottom part of the figure are constructed using equation (14), with the estimated values of $\theta_1 + \theta_4$ taken from columns B to E in Table 6. The underlying number of observations is smaller in the third panel (based on regression in Table 6C) and especially in the fourth panel (based on regression in Table 6D), as no estimated values of $\theta_1 + \theta_4$ are available for some sectors of activity. However, all four panels show a roughly bi-modal distribution of labor redundancy with a first mode clearly below 25 percent, and a second a much bigger mode at around 75 percent of current employment. The first mode is somewhat blurred in the fourth panel, but this may be due to the fact that this panel is based on fewer observations. For comparison purposes, the panel in the top part of Figure 2 displays the kernel density of the labor redundancies reported by current directors. In this panel, only the first mode is visible.

The labor redundancy indicator can be aggregated over all enterprises with some degree of state ownership in a specific sector of activity, or in the entire economy. Assume there are N^a enterprises in sector "a". The actual employment level of these enterprises can be used to weight the labor redundancy indicator, as follows:

$$r^a = \frac{\sum_{i=1}^{N^a} r_i L_i}{\sum_{i=1}^{N^a} L_i} \tag{15}$$

The aggregate indicator r^a measures the percentage of workers in sector "a" who are redundant. When N^a is the number of enterprises in the sample, r^a measures labor redundancy in the entire economy.

The estimated values of r^a across all sectors of activity and in the entire economy are reported in Table 7. The last four columns in this table are based on the same r_i indicators used to draw Figure 2. The second data column is based on the r_i indicator that can be constructed using equation (13), with the estimated value of taken from column A in Table 4. For comparison purposes, the first data column of the table also reports the average labor redundancy as estimated by the current directors of the enterprises. For the entire economy, the approach used in this paper yields an average labor redundancy around 50 percent, or slightly higher. The figure varies depending on whether the effect of state ownership is assumed to be the same for all enterprises (as in the second data column) or to differ across sectors of activity (as in the last four columns). But all the figures fall within a relatively narrow range. And they are all more than ten times larger than the average labor redundancy estimated by current directors.

The estimated labor redundancy varies considerably across sectors. Only when the regression in column A of Table 4 is used to calculate r_i is the variance small, but this is because the effect of state ownership is assumed to be the same across the board. When the regressions in columns B to E in Table 6 are used instead, state-owned enterprises appear to be "lean" in some sectors, but heavily over-staffed in others. Labor redundancy is not a serious concern in food, beverages and tobacco; in paper products; and in footwear, bags and leather. At the other end, labor redundancy is dramatic in transportation; oil and gas; construction and infrastructure; iron and steel; coal and minerals; and machinery and equipment. Other sectors of activity fall in between these two extremes, or display conflicting labor redundancy estimates depending on the regression used to calculate r_i.

8. Other Redundancy Indicators

The analysis in the previous section shows that the current directors of state-owned enterprises substantially under-estimate the extent of labor redundancy. But it could be argued that their assessment still provides valuable information. Such would be the case if this assessment were correlated with the "true" extent of labor redundancy. For instance, one could imagine a situation where the "true" labor redundancy could be estimated by multiplying the labor redundancy reported by current directors by a factor of 10, or 15. Similarly, the ad hoc indicators of profitability, productivity or labor cost that are often used to identify over-staffed enterprises could be correlated with the "true" extent of labor redundancy. While the latter is not observable, it is at least possible to analyze the correlation between these other indicators of labor redundancy and those generated in this paper.

Table 8 considers three sets of ad hoc indicators of labor redundancy at the enterprise level, in addition to the figures reported by current directors and to the estimates generated by this paper. One set of ad hoc indicators is based on profitability, as measured by the ratio of gross profits to the value of production, the capital stock, value added, or the number of workers. A higher profitability should be associated with lower labor redundancy. The second set of indicators reflects the productivity of the enterprise, measured in a variety of ways, from value of production per worker to exports per worker. A higher productivity should also be associated with lower labor redundancy. Finally, the third set focuses on the labor characteristics of the enterprise; it includes the average labor cost and three measures of the difficulty to layoff workers. These indicators should be positively correlated with labor redundancy.

However, all these ad hoc indicators are weakly correlated, if at all, with the extent of labor redundancy estimated in this paper. The only strong correlations in Table 8 are between the labor redundancy indicators constructed based on the regressions in columns B to E of Table 6. All other coefficients are close to zero. Although they tend to have the expected signs, almost all of them are statistically insignificant. Only gross profits per worker and the value of production per worker display a significant negative correlation with some (but not all) of the labor redundancy indicators estimated in this paper. The percentage of redundant workers reported by current directors is also weakly correlated with all the other indicators, with only two exceptions. These are the ad hoc indicators for the average labor cost and the fraction of workers on permanent and long-term contracts. But the sign of these two correlation coefficients is opposite to what could be expected.

Taken together, the kernel densities in Figure 2 and the correlation coefficients in Table 8 suggest that current directors are willing to recognize over-staffing in viable enterprises, but deny

it in heavily bloated or non-viable enterprises. The kernel densities in Figure 2 showed a roughly bi-modal distribution of labor redundancy, but only the first mode (clearly below 25 percent) was acknowledged by current directors. Admitting the extent of labor redundancy revealed by the second mode (at around 75 percent) would probably amount to pleading guilty of mismanagement. The correlation coefficients in Table 8 show that current directors report lower labor redundancy in enterprises where salaries are high and a large proportion of workers are on permanent or long-term contracts. Laying off workers who earn a substantial rent or enjoy a considerable degree of job security is undoubtedly difficult. Not acknowledging the problem could be a way to avoid conflict within the enterprise.

The weak correlation between the indicators of labor redundancy estimated in this paper and the ad hoc indicators does not imply that the former are better. However, the latter also display a weak correlation between them, which suggests that they are not reliable. In principle, all three sets of ad hoc indicators should tell the same story. More specifically, there should be a positive correlation between profitability and productivity indicators, and a negative correlation between them and the labor cost indicators. At a first glance, Table 9 suggests that this is indeed the case. However, many of the correlation coefficients in this table suffer from a potentially serious measurement-error bias. For instance, consider two indicators whose denominator is the number of workers in the enterprise. If this number is misreported for some enterprises, the estimated correlation coefficient will be positive even if the two indicators are actually uncorrelated. In Table 9, all the correlation coefficients that suffer, by construction, from potential measurement-error bias are highlighted in italics. Only two of the correlation coefficients that are not highlighted in italics turn out to be significant. It follows that the list of

severely over-staffed enterprises could differ considerably depending on the chosen ad hoc indicator of labor redundancy.

9. Conclusions

Several approaches have been tried to predict the number of workers who could lose their jobs due to the privatization or restructuring of state-owned enterprises. In some cases, predictions are simply based on the international experience. In others, the current directors of state-owned enterprises are requested to report the number of redundant workers. The most common practice, however, is to infer the extent of labor redundancy from ad hoc indicators of profitability, productivity or labor cost. This paper casts doubts on the relevance of these three approaches, and proposes an alternative method, based on a systematic comparison of employment levels across enterprises that are similar in many respects, but differ in the share of the capital that is owned by the state.

The proposed method is illustrated using data from Vietnam, a country where thousands of state-owned enterprises are scheduled for privatization and restructuring over the next five years. The results show that the fraction of workers who would become redundant could exceed the fraction estimated by the current directors of these enterprises by one order of magnitude. They also show that labor redundancy varies dramatically across sectors of activity, from negligible in some to overwhelming in others. Finally, the results show that the estimated labor redundancy is only weakly correlated with ad hoc indicators of profitability, productivity and labor cost. More worryingly, these ad hoc indicators are only weakly correlated between them.

However, it should not be inferred that roughly half of the workers in the state-owned enterprises of Vietnam are going to be laid off over the next five years. There are two important reasons why this estimate, done for illustration purposes, may differ from the actual number of layoffs. First, the reform process of Vietnam will lead to changes in the economic environment in which enterprises operate. Trade barriers will be lowered, entry by new enterprises will be facilitated, and access to soft-loans will be curtailed. Increased competition and a harder budget constraint could lead to labor redundancies in all state-owned enterprises, even if their state share of capital remained unchanged. From this perspective, the number of laid off workers could be higher than suggested by the estimate in this paper.

The second reason why the estimate in this paper may differ from the actual number of layoffs is related to the pace and depth of the privatization process. The estimate in this paper implicitly assumes that all state-owned enterprises will instantly become profit-maximizers. In practice, the state share of capital will remain considerable in many of them, and divestiture will only proceed gradually for the others. Over the next five years, these enterprises will be able to adjust gradually by not renewing some of the workers on temporary contracts, and by relying on natural attrition. In principle, at least, for any turnover rate a pace of privatization could be found such that no "hard" layoffs would be required. Without reaching such an extreme, the reform process of Vietnam is likely to differ from instant divestiture.

Applied work is currently being carried at the World Bank to predict the number of workers who could actually be laid off, hence to design an appropriate safety net. This work combines the redundancy estimates in this paper with the announced timetable for privatizing and restructuring state-owned enterprises. The announced timetable includes the number of enterprises to be liquidated and privatized each year, without identifying them (see World Bank,

2000). In the applied work, it is assumed that the enterprises with the lowest profit-to-capital ratio are liquidated first, and the enterprises with the highest ratio are privatized first. It is also assumed that within each enterprise up to two thirds of the workers who are on short-term or temporary contracts can be replaced by workers who are on permanent or long-term contracts. Under these assumptions, the reform program of Vietnam may require that some 400,000 workers be (voluntarily or involuntarily) separated from their jobs. This figure represents roughly one quarter of current employment in state-owned enterprises.

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Table 1

The Sample and the Universe

	Number of enterprises		Number of workers	
	In the sample	In all Vietnam	In the sample	In all Vietnam
STATE SECTOR	224	5,740	202,143	1,680,000
100% state-owned	111	3,540	99,279	
Joint ventures	113	2,200	102,864	
General Corporation	105	1,750	113,685	1,011,205
Owned by central government	13		5,464	
Owned by local government	50		28,432	
Unknown	56		54,562	
PRIVATE SECTOR	114	26,021	60,356	497,481
Domestic owners	101	25,421	58,415	364,481
Foreign owners	13	600	1,941	133,000
ALL	338	31,761	262,499	2,177,481

Note: The universe includes all enterprises in state sector, and registered enterprises in the private sector, as of 1999.

Table 2

Summary Statistics by Institutional Sector

	Share of state capital	Employment			Age of the enterprise (in years)	Value of capital stock	Net annual profits	Annual wage per worker	Export orien-tation
		Total	Permanent	Long-term					
STATE SECTOR	0.835	902.4	0.361	0.805	15.7	159.567	23.748	11.167	0.151
100% state-owned	1.000	894.4	0.336	0.807	19.8	94.042	18.707	10.270	0.130
Joint ventures	0.673	910.3	0.402	0.801	11.9	223.933	32.491	12.704	0.186
General Corporation	0.959	1082.7	0.349	0.822	19.2	131.629	22.706	11.685	0.094
Owned by central government	0.892	420.3	0.256	0.639	15.1	47.982	7.077	8.466	0.163
Owned by local government	0.956	568.6	0.378	0.808	21.2	46.530	7.681	11.041	0.224
Unknown	0.481	974.3	0.543	0.831	5.7	338.782	162.858	9.766	0.368
PRIVATE SECTOR	0.000	529.4			9.5	58.148		10.712	0.768
Domestic owners	0.000	578.3			10.3	5.640		10.792	0.762
Foreign owners	0.000	149.3			3.1	82.383		8.155	0.983
ALL	0.553	776.6	0.347	0.784	12.7	151.637	23.748	11.000	0.377

Notes: Figures are non-weighted averages across all valid observations in the sample. Figures for permanent and long-term employment are shares of total employment. Long-term employment includes permanent employment and employment on fix-term contracts. Figures for capital and profits are in billion dongs. Figures for annual wages are in million dongs. The export variable is equal to one if the enterprise sells some of its production in a foreign market, and equal to zero otherwise.

Table 3

Summary Statistics by Sector of Activity

	Share of state capital	Employment			Age of the enterprise (in years)	Value of capital stock	Net annual profits	Annual wage per worker	Export orien-tation
		Total	Permanent	Long-term					
Food, beverages and tobacco	0.511	563.2	0.332	0.719	15.7	70.655	18.597	9.457	0.408
Textile and garments	0.285	948.1	0.238	0.733	14.0	67.367	11.877	7.951	0.712
Footwear, bags and leather	0.321	1,217.3	0.105	0.403	12.0	33.400	4.635	7.591	0.859
Paper products	0.142	279.1	0.223	0.895	9.7	9.474	2.699	10.121	0.407
Chemicals	0.732	276.5	0.488	0.824	23.9	63.810	13.509	13.620	0.405
Plastic products	0.599	232.0	0.291	0.833	12.6	40.124	7.137	11.686	0.173
Ceramic and glass	0.376	294.8	0.529	0.816	19.0	155.134	7.859	13.612	0.553
Construction and infrastructure	0.732	644.1	0.414	0.789	10.8	277.184	11.133	11.622	0.000
Machinery and equipment	0.755	444.6	0.311	0.830	16.2	75.589	0.826	11.144	0.457
Iron and steel	0.562	256.5	0.250	0.846	9.1	219.418	5.015	14.355	0.000
Coal and minerals	0.658	496.0	0.244	0.902	5.3	37.615	15.417	7.495	0.645
Oil and gas	0.603	457.8	0.403	0.804	11.9	202.000	94.124	16.502	0.274
Transportation	0.814	597.1	0.431	0.801	12.7	101.751	46.777	12.032	0.153
Others	0.448	887.1	0.448	0.877	9.8	276.397	34.749	16.745	0.604

Notes: Figures are non-weighted averages across all valid observations in the sample. Figures for permanent and long-term employment are shares of total employment. Long-term employment includes permanent employment and employment on fix-term contracts. Figures for capital and profits are in billion dongs. Figures for annual wages are in million dongs. The export variable is equal to one if the enterprise sells some of its production in a foreign market, and equal to zero otherwise.

Table 4

Determinants of Employment by Share of State Capital

	Specification				
	A	B	C	D	E
Share of state capital	0.657 ***	1.081 ***	0.524 ***	0.688 ***	1.463 ***
	(5.208)	(6.792)	(2.924)	(3.940)	(5.562)
General corporation			0.626 ***		
			(3.819)		
Owned by local government			-0.091		
			(-0.480)		
Age		0.018 ***	0.010 **	0.011 **	0.019 ***
		(3.689)	(2.314)	(2.405)	(4.253)
Log of capital stock					0.279 ***
					(3.699)
Export-oriented				0.038	
				(0.223)	
Controls for sector of activity	No	Yes	Yes	Yes	Yes
Controls for region	No	Yes	Yes	Yes	Yes
R^2	0.056	0.435	0.393	0.261	0.548
F test	27.12	9.47	8.68	5.79	24.13
Number of observations	338	317	260	248	222

Notes: The dependent variable is the log of employment. All regressions were estimated by ordinary least squares, with White-heteroskedasticity corrected errors. Figures in parentheses are t-statistics. Significant coefficients at the 10, 5 and 1 percent significance levels are identified by one, two and three asterisks respectively.

Table 5

Determinants of Employment by Institutional Sector

	Specification				
	A	B	C	D	E
Fully owned by the state	0.437 ***	0.794 ***	0.536 ***	0.726 ***	0.315
	(3.467)	(4.524)	(2.722)	(3.759)	(1.228)
Joint venture	-0.382 **	0.238	0.571 ***	0.692 ***	-0.337
	(-2.178)	(1.304)	(2.722)	(3.316)	(-1.252)
General corporation			0.611 ***		
			(3.595)		
Owned by local government			-0.117		
			(-0.625)		
Age		0.022 ***	0.010 **	0.011 **	0.026 ***
		(4.449)	(2.270)	(2.263)	(5.609)
Capital stock					0.308 ***
					(3.983)
Export oriented				0.049	
				(0.287)	
Controls for sector of activity	No	Yes	Yes	Yes	Yes
Controls for region	No	Yes	Yes	Yes	Yes
R^2	0.072	0.405	0.394	0.262	0.518
F test	13.02	8.00	8.37	5.74	19.30
Number of observations	338	317	260	248	222

Notes: The dependent variable is the log of employment. All regressions were estimated by ordinary least squares, with White-heteroskedasticity corrected errors. Figures in parentheses are t-statistics. Significant coefficients at the 10, 5 and 1 percent significance levels are identified by one, two and three asterisks respectively.

Table 6

Determinants of Employment by Sector of Activity

	Specification			
	B	C	D	E
Food, beverages and tobacco	-0.166	-0.466	-0.247	-1.050 ***
Textile and garments	1.015 ***	0.725 **	1.064 ***	0.190
Footwear, bags and leather	0.047	0.115	0.301	-0.335
Paper products	-0.505 *	-1.058 ***	-0.404	-1.369 ***
Chemicals	1.182	-0.890 ***	-0.618 **	4.355 ***
Plastic products	0.279	-0.120	0.444	0.558
Ceramic and glass	0.980 ***	0.446	1.079 ***	0.210
Construction and infrastructure	2.530 ***	0.970 **	1.355 ***	3.388 ***
Machinery and equipment	1.458 ***	1.244 ***	1.333 ***	1.444 ***
Iron and steel	1.726 ***			2.804 ***
Coal and minerals	1.727 ***	1.372 *		1.169 *
Oil and gas	3.151 ***			2.618 ***
Transportation	4.218 ***	2.301	2.983	4.074 ***
Other sectors	0.618	0.437	0.475	2.561
Controls for age	Yes	Yes	Yes	Yes
Controls for export orientation	No	No	Yes	No
Controls for capital stock	No	No	No	Yes
Controls for institutional sector	No	Yes	No	No
Controls for sector of activity	Yes	Yes	Yes	Yes
Controls for region	Yes	Yes	Yes	Yes
R^2	0.531	0.459	0.332	0.687
F test	25.54	5.44	3.11	31.40
Number of observations	317	260	248	222

Notes: The dependent variable is the log of employment. All regressions were estimated by ordinary least squares, with White-heteroskedasticity corrected errors. The table reports the sector-specific coefficients multiplying the share of state capital. Significant coefficients at the 10, 5 and 1 percent significance levels are identified by one, two and three asterisks respectively.

Table 7

Percentage of Workers Redundant by Sector

By sector of activity	According to current directors	Based on regression in Table				
		4A	6B	6C	6D	6E
Food, beverages and tobacco	2.0	45.9	0.0	0.0	0.0	0.0
Textile and garments	0.3	47.8	63.3	51.1	65.0	17.1
Footwear, bags and leather	3.2	37.8	3.5	8.2	19.9	0.0
Paper products	0.0	48.2	0.0	0.0	0.0	0.0
Chemicals	0.0	47.5	68.5	0.0	0.0	98.3
Plastic products	0.0	44.6	22.3	0.0	33.0	39.4
Ceramic and glass	3.0	39.5	51.8	29.3	54.9	15.3
Construction and infrastructure	1.8	45.4	88.8	58.8	70.6	94.0
Machinery and equipment	7.1	45.7	74.0	68.4	70.8	73.6
Iron and steel	0.0	37.4	68.2			82.2
Coal and minerals	0.0	48.0	82.1	74.5		68.8
Oil and gas	0.0	45.8	93.1			89.8
Transportation	5.7	46.9	98.0	88.8	94.0	97.7
Other sectors	0.4	47.1	45.1	34.6	36.9	90.9
General corporations	2.0	47.4	70.8	55.7	63.6	70.4
Owned by central government	6.2	44.7	51.2	37.8	41.8	60.4
Owned by local government	4.4	45.2	39.5	31.7	42.2	34.2
All	3.2	46.8	62.1	48.6	56.8	61.2

Note: The percentage of workers redundant is estimated for each state-owned enterprise and joint venture by setting the state share of capital equal to zero. Figures in the table are the average labor redundancy for all enterprises in each sector, using the actual employment of those enterprises as weights.

Table 8

Correlation with Ad Hoc Indicators of Labor Redundancy

	Percentage of workers redundant				
	According to current directors	Based on regression in Table			
		6B	6C	6D	6E
Percentage of workers redundant (6B)	0.056	1.000			
Percentage of workers redundant (6C)	0.127	0.873 ***	1.000		
Percentage of workers redundant (6D)	0.098	0.867 ***	0.955 ***	1.000	
Percentage of workers redundant (6E)	0.044	0.788 ***	0.614 ***	0.546 ***	1.000
Gross profits/value of production	-0.192 *	0.037	0.012	0.042	-0.048
Gross profits/capital stock	-0.143	-0.103	-0.134	-0.159	-0.045
Gross profits/value added	-0.051	-0.041	-0.079	-0.021	-0.088
Gross profits per worker	-0.112	-0.106	-0.175 *	-0.203 **	0.010
Value of production per worker	-0.056	-0.154	-0.156	-0.217 **	0.081
Total revenue per worker	-0.071	-0.031	-0.064	-0.063	-0.055
Capital stock per worker	-0.073	-0.075	-0.139	-0.148	0.008
Exports per worker	0.044	-0.121	-0.089	-0.122	-0.022
Average labor cost per worker	-0.214 **	0.036	-0.007	-0.019	0.081
Permanent workers (%)	-0.004	0.108	0.050	0.053	0.126
Permanent and long-term workers (%)	-0.219 **	0.050	0.046	0.022	0.103
All except temporary workers (%)	0.106	-0.065	0.046	0.027	-0.074

Note: Correlation coefficients are calculated at enterprise-level data, for all state-owned enterprises and joint ventures. Observations are excluded from the calculation due to missing values on a pair-by-pair basis. Significant correlation coefficients at the 10, 5 and 1 percent level are indicated by one, two and three asterisks respectively.

Table 9

Correlation between Ad Hoc Indicators of Labor Redundancy

	Gross profits/ value of product.	Gross profits/ capital stock	Gross profits/ value added	Gross profits per worker	Value of product per worker	Total revenue per worker	Capital stock per worker	Exports per worker	Average labor cost per worker	Perma-nent workers (%)	Perma-nent and long-term (%)
Gross profits/value of production	1.000										
Gross profits/capital stock	*0.454****	1.000									
Gross profits/value added	*0.222***	*0.132*	1.000								
Gross profits per worker	*0.186**	*0.704****	*0.208***	1.000							
Value of production per worker	*-0.221***	0.074	0.079	*0.589****	1.000						
Total revenue per worker	0.269***	0.610***	-0.054	*0.737****	*-0.305****	1.000					
Capital stock per worker	-0.121	-0.159	0.159	*0.294****	*0.831****	*-0.234****	1.000				
Exports per worker	*-0.093*	*0.100*	0.101	*0.313****	*0.405****	*-0.021*	*0.152*	1.000			
Average labor cost per worker	0.084	0.142	-0.069	*0.381****	*0.226****	*0.375****	*0.305****	*-0.002*	1.000		
Permanent workers (%)	0.086	0.071	0.063	0.138	0.135	-0.057	0.115	0.119	-0.090	1.000	
Permanent and long-term workers (%)	0.130	0.127	-0.092	0.028	0.040	-0.121	0.048	0.035	-0.013	*0.341****	1.000
All except temporary workers (%)	0.045	0.072	0.056	0.064	0.072	-0.054	0.048	0.051	-0.028	0.108	*0.296****

Note: Correlation coefficients are calculated at enterprise-level data, for all state-owned enterprises and joint ventures. Observations are excluded from the calculation due to missing values on a pair-by-pair basis. Significant correlation coefficients at the 10, 5 and 1 percent level are indicated by one, two and three asterisks respectively.

Figure 1

Employment and Pay Determination

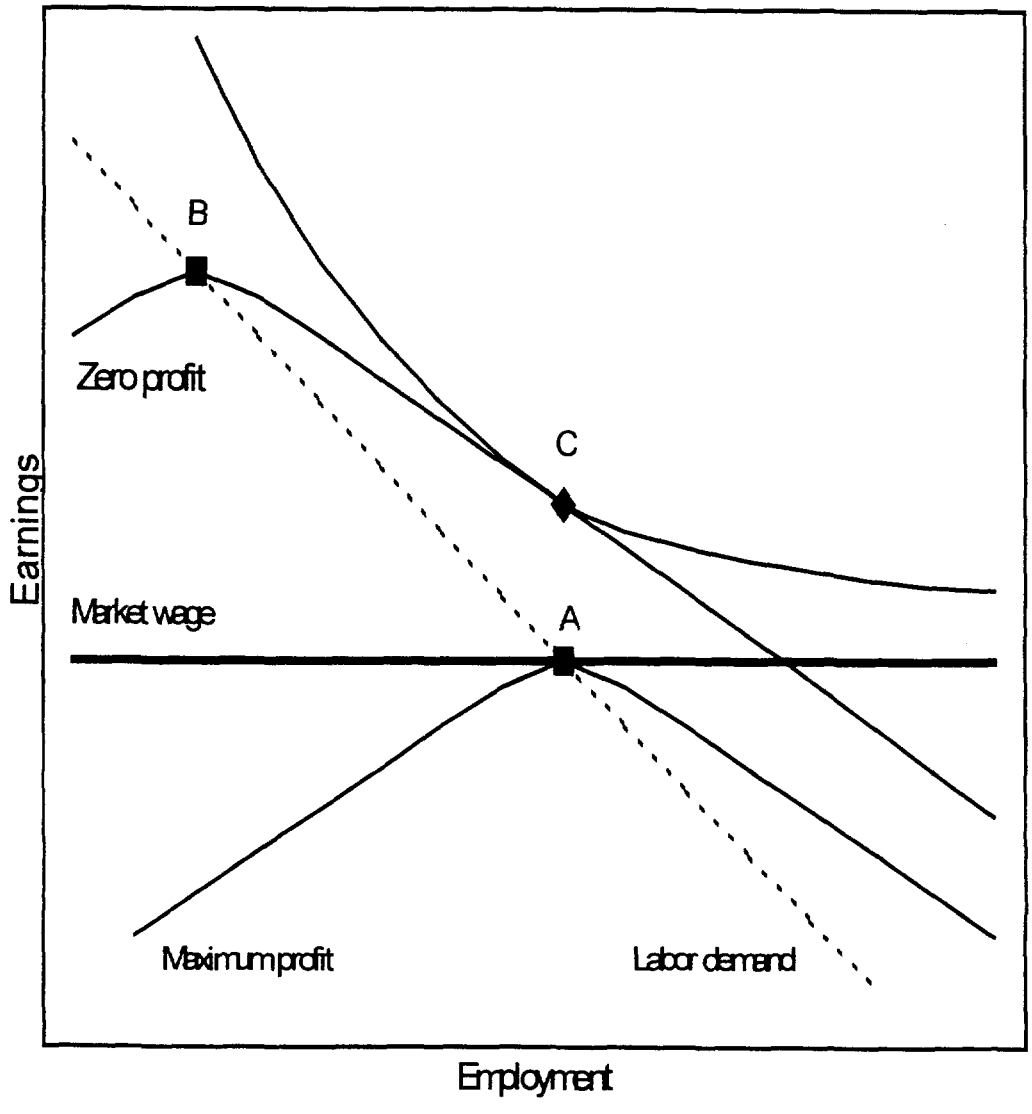
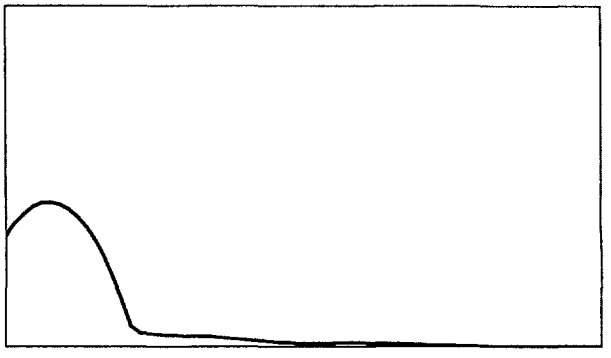
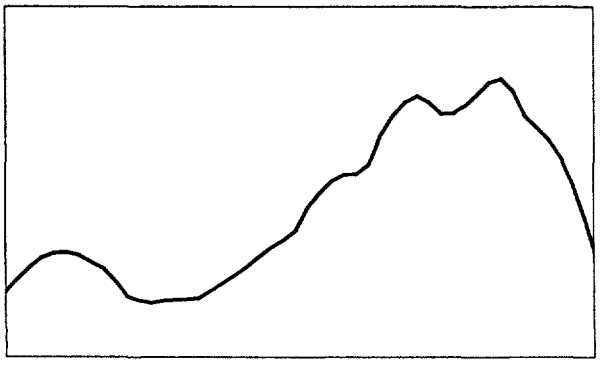


Figure 2

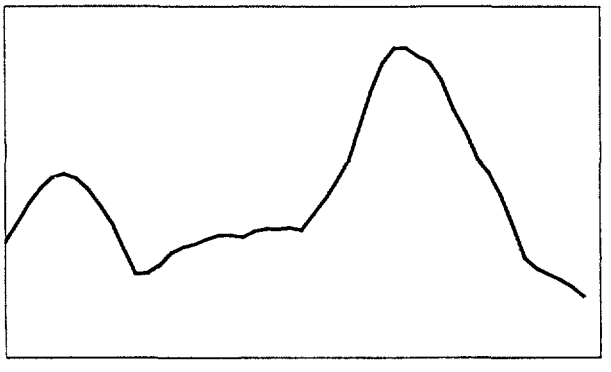
Estimated Density of Labor Redundancy



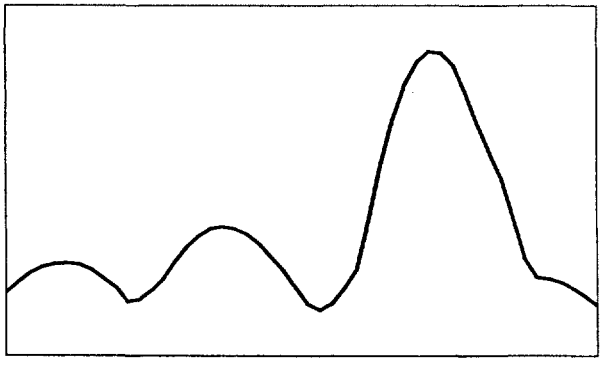
According to current directors



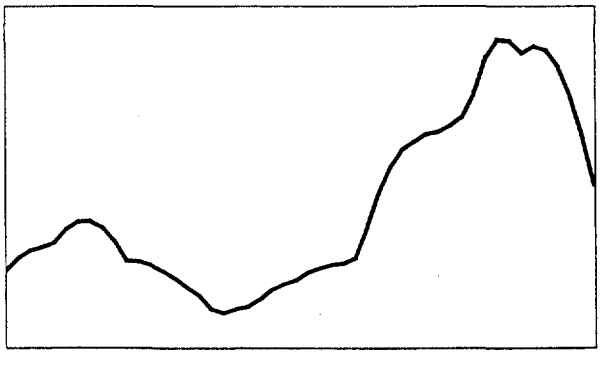
Based on regression in Table 6B



Based on regression in Table 6C



Based on regression in Table 6D



Based on regression in Table 6E

Note: All graphs were constructed using the kernel density function of Stata, for 50 data points and a band width equal to 7 percentage points.

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