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Employee Motivation, External Orientation and the Technical Efficiency of Foreign-financed Firms in China: A Stochastic Frontier Analysis

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Abstract

By using a stochastic frontier model, we have identified several firm-specific attributes as determinants of technical efficiency in foreign-financed manufacturing firms in southern China. The empirical results suggest a strong association between efficiency and employee motivation, which includes the use of bonus incentives and flexibility in employment policy. In terms of the external orientation behavior of firms, the findings do not support the export/efficiency relationship. Sample firms with a high degree of export-orientedness were less efficient, possibly due to the high transaction costs in China of exportation. As for the effects of expatriate input on production, our empirical evidence revealed that firms with a relatively high expatriate ratio performed less efficiently than others did. These two findings may have significant implications for the marketing strategies and management (including the localization) of human resources of foreign-financed firms in China.

Keywords: Employee motivation, external orientation, technical efficiency, foreign-financed firms, stochastic frontier, China.

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I. Introduction

China has enjoyed considerable success in attracting foreign direct investment (FDI) since the implementation of economic reforms in 1979. According to the Ministry of Foreign Trade and Economic Cooperation, the total utilized value of FDI reached US\$445 billion between 1979 and 2002. In 2002, the inflow of FDI in China was estimated to be US\$53 billion, accounting for 9.4% of the total FDI in the world.¹ This shows that China is a very popular destination for foreign investors. In a study of the effect of FDI on China's economic growth by a group of multi-variance models, Wei (2002) finds that the inflow of FDI has been a significant driver of growth in southeastern China, such as in Guangdong and Fujian provinces. In terms of promoting China's exports, foreign-financed firms accounted for 50% of China's total exports in 2001. In terms of job creation, the inflow of FDI has supported 23 million jobs, accounting for over 10% of the total workforce in Chinese townships and cities in 2002.² The investigation of the determinants of the performance of foreign-financed firms in China is thus of paramount interest and significance.

However, much of the existing literature has been confined to estimates of the productivity of state-owned or collective enterprises in China. The typical examples are Groves *et al.* (1994), Liu and Liu (1996), Wu (1996), Young (2000), *etc.* Several studies, such as those of Beamish (1993), and Jefferson *et al.* (2000), have revealed disappointing performances from foreign-financed firms in China. Yeung and Mok (2002) provide a glimpse of how Chinese government policies affect the competitiveness of foreign-financed

¹ The large amount of FDI into China in 2002 made it the world's top destination for such inflows and surpassed the USA into the first position. *The Economist*, 6 September 2003, p.59.

firms in China. However, none of the above studies have provided an econometric investigation of the determinants of technical efficiency in foreign-financed firms in China.

Based on a sample of 23 foreign-financed manufacturing firms in Guangdong province spanning the period 1998-1999, this study uses the stochastic frontier approach to examine whether technical efficiency is a key issue in explaining variations in performance among foreign-financed firms in southern China. The sample size was small. However, given the significant role of foreign-financed firms in the economic performance of Guangdong, the findings of this paper add to the growing literature on the determination of efficiency in manufacturing firms in China, and the extent of the role played by such firms.

A discussion of the conceptual issues of variables and of the stochastic frontier model will be provided in the next two sections, before the findings are analyzed and the implications of the paper are discussed.

II. Conceptual Investigation

Many time-invariant factors affect the efficiency of firms in production. They are normally firm-specific attributes; e.g., employee motivation and external orientation. We shall also examine the effects of firm size on efficiency. In this paper, employee motivation encompasses bonus incentives and employment flexibility, while external orientation refers to the input of expatriates (with managerial, marketing and technical expertise) and export-orientedness. These selected firm-specific attributes are generally regarded as having an effect on the productive efficiency of foreign-financed firms in China. The following is a background survey of the conceptual investigation. A more detailed discussion of the association between the selected firm-specific attributes and the efficiency of firms in

² Xinhua News Agency, 9 October 2002.

production as evidenced by our sample firms is provided in the section on empirical analysis.

Employee motivation

Bonuses are often used as a means to motivate workers to perform better (Groves *et al.*, 1994; Laffont and Tirole, 1996). We use bonus per capita to represent the performance-related incentive schemes of foreign-financed firms. It is hypothesized that there is a positive relation between bonus per capita and the efficiency of firms. In other words, the higher the bonus, the higher the level of efficiency the firms are able to achieve, *vice versa, ceteris paribus*. On employment flexibility, China's labor system used to be highly centralized, which meant that the government was responsible for the assignment of jobs. Enterprises often complained about the lack of autonomy in their employment policies, especially in the dismissal of workers. There was no exception for foreign-financed firms.³ The lack of mobility in the labor market obviously reduced an enterprise's performance; i.e., workers were not afraid of redundancy and thus had less incentive to work harder. This rather rigid labor system was often blamed for the poor economic performance of enterprises, whether state-owned or foreign-financed. With the relaxation of government controls over employment, enterprises enjoyed a much higher level of autonomy in managing human resources. In other words, they had the flexibility to dismiss individual employees without the need to obtain prior approval from the relevant authorities. With the *de facto* collapse of the household registration system (*hukou*) and the development of

³ The principal author conducted a field survey of the Coca-Cola Bottling Plant in Tianjin in March 2000. The Deputy General Manager explained that, in the area of employee motivation, he had encountered resistance when firing under-performing workers. The main sources of resistance were the trade unions of the firm and the soft drinks industry, and sometimes, the workers' families.

commodity and labor markets, the rise in the number of migrant workers produced an abundant supply of temporary workers, thus improving the employment flexibility of enterprises in China.⁴ This type of employment flexibility, measured in this paper by the ratio of temporary workers to the total population of workers, is expected to have a positive effect on enterprise efficiency.⁵ However, it may be argued that temporary workers may have a weak sense of belonging to enterprises and are thus associated with a higher labor turnover rate, compared with their permanent worker counterparts. If this is the case, the productivity of temporary workers may be in doubt: a high ratio of temporary workers to total labor force may negatively affect enterprise efficiency. We shall examine this issue by looking at our sample firms.

External orientation

The first firm-specific attribute included in the external orientation of foreign-financed firms is the input of foreign managerial, marketing and technical expertise. It is hypothesized that foreign-financed firms will transfer managerial, marketing and technical know-how to China and that this will result in improvements in enterprise performance (Graham and Krugman, 1991: 58; Blomqvist, 1996: 224). Facilitating the inflow of the know-how is one of the objectives of the economic reforms in China. However, the above argument may not necessarily always hold true. If foreign-financed firms are top-heavy with expatriates, there may be some drawbacks, including problems with localization and

⁴ The household registration system was the legacy of the planned economy, when every household had to register their members with the local Public Security Bureau. Household members had to produce their registration booklets and vouchers before being allowed to “purchase” daily necessities, food, *etc.* With the development of commodity and labor markets since the 1980s, the effectiveness of the household registration system in regulating the mobility of people declined over time.

⁵ Obviously, this “second best” parameter is unable to capture all of the effects of employment flexibility or autonomy in employment policy at the firm level.

cultural conflicts. Along this line of argument, a high proportion of expatriates in foreign-financed firms may instead reduce productive efficiency. It is however very difficult to accurately quantify the impact of foreign managerial and technical expertise at the level of the firm (Helleiner, 1989). Therefore, a “second best” benchmark based on available data on the ratio of expatriates to the total population of employees is used in this paper.⁶ The second firm-specific attribute is the degree of export-orientedness. Theoretically, firms with a higher percentage of exports are likely to be more efficient due to their exposure to competitive international markets. Therefore, firms that export a greater portion of their output are hypothesized to be more efficient than firms that export less. However, Yeung and Mok (2002) note that foreign-financed firms in China experienced high transaction costs in exporting their products.⁷ This implicitly suggests that the export-orientedness may not have a positive relation with foreign-financed firms in China. This hypothesis will be investigated in this paper.

Besides employee motivation and external orientation, we also study the effects of firm size on efficiency. Economies of scale are one of the most commonly used firm-specific attributes in the discussion of enterprise efficiency. According to Fordism, the size of a firm is essential for achieving large-scale production and thus for reaping the beneficial effects of economies of scale and achieving a higher level of efficiency; i.e., a firm’s size is positively related to economies of scale (Dicken, 1998). There are various sources of economies of scale, including technical economies, managerial economies, marketing

⁶ Obviously, a firm with a higher ratio of expatriates may not necessarily indicate a corresponding higher input of foreign managerial and technical know-how, and *vice versa, ceteris paribus*.

economies and financial economies. This refers to the preferential access by large firms to new technologies, managerial expertise, inputs (including discounts on bulk purchasing) and financial resources, due to the fact that large firms are big players in the factor (labor and capital) and financial markets. Theoretically, these types of economies of scale should have positive effects on the efficiency of firms.

III. Stochastic Frontier Production Function

To perform the empirical investigations of the determinants of technical efficiency in foreign-financed firms in China, we use the stochastic frontier approach modeled as follows:⁸

$$Q_{it} = f(\mathbf{X}_{it}, \boldsymbol{\beta}) e^{\varepsilon_{it}} \quad (1)$$

where Q_{it} = output in real terms of the i^{th} sample firm at time t

\mathbf{X}_{it} = a vector of inputs for the i^{th} sample firm at time t

$\boldsymbol{\beta}$ = a vector of unknown parameters to be estimated

ε_{it} = a random disturbance term.

Following Aigner *et al.* (1977), the random disturbance term is split into two error terms:

$$\varepsilon_{it} = v_{it} - u_{it}$$

v_{it} is assumed to be normally and identically distributed (NID) with a zero mean and a variance of σ_v^2 , which captures the effects of random shocks and statistical noise. u_{it} is assumed to be a non-negative random variable and is obtained by truncating the random

⁷ Foreign-financed firms in China are now no longer restricted to exporting most of their products overseas under the constraints of their production contracts and related Customs documentation. They can sell their products locally in the China market.

⁸ A detailed discussion on stochastic frontier can be found in Kumbhakar and Lovell (2000) and Coelli *et al.* (1998).

variable, that is NID $[\mu_{it}, \sigma_u^2]$, and u_{it} is independent of v_{it} . u_{it} is the inefficiency measurement and its mean (μ_{it}) is determined by a number of factors that impact on the firm.

According to Battese and Coelli (1995), μ_{it} is modeled as an explicit function of variables that explain the level of technical inefficiency.

$$\mu_{it} = \delta_0 + \delta_1 Z_{1t} + \dots + \delta_i Z_{it} + \delta_t T_t \quad (2)$$

where Z_i are firm-specific attributes and δ_i are unknown parameters to be estimated. Equation (2) analyzes whether and to what extent firm-specific attributes affect the level of technical inefficiency. The trend variable T_t in the inefficiency function specifies the change in inefficiency over time under the period of investigation.

In the early empirical studies using the stochastic frontier approach, for example, Pitt and Lee (1981) first estimated the stochastic frontier and predicted the technical inefficiency of each sample firm. These were subsequently regressed against a set of firm-specific variables in an attempt to identify some of the reasons explaining the differences in the predicted inefficiencies among the sample firms. This two-step procedure contradicts the assumptions of identically distributed technical inefficiency effects, which is required to obtain predictions for their unknown values. To overcome this problem, Battese and Coelli (1995) propose a one-step procedure allowing the estimation of firm-level inefficiencies and the identification of efficiency determinants in one step.

The technical efficiency of the firm i is defined as $TE_{it} = \exp(-u_{it})$. It is the ratio of observed output to the stochastic frontier output, which has no technical inefficiency.⁹ Hence, the technical efficiency for a firm is inversely related to the inefficiency measurement in equation (2). It ranges from zero to 1, where unity implies that the firm is fully technical efficient.

On the estimation of the stochastic frontier in equation (1) and the inefficiency function in equation (2), the method of maximum likelihood is used for the estimation of their parameters (Battese and Coelli, 1993, 1995). The likelihood function and its partial derivatives with respect to the parameters of the model are given in Battese and Coelli (1993). To simplify the search for a suitable starting value in the iterative process of maximization, σ_v^2 and σ_u^2 are replaced by $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\gamma = \sigma_u^2 / (\sigma_u^2 + \sigma_v^2)$ respectively. With this form of parameterization, the value of γ falls into the range of zero and one. This provides a convenient method for performing hypothesis testing to determine whether the mean response production function model is an adequate representation for the sample data, given the assumptions of the stochastic frontier model that is defined. If there is no measured technical efficiency, i.e. $\sigma_u^2 = 0$, then γ is zero, and it follows that the mean response production function estimation by ordinary least squares (OLS), where the estimated residuals have an expected value of zero, will be an appropriate model for analysis. On the other hand, if γ is large, this implies that the inefficiency function is a significant component in the estimation of the production function by stochastic frontier approach as compared to the mean response production function approach.

⁹ The calculation can be referred to the Appendix of Battese and Coelli (1993).

Data measurement

The data set includes information about one output, three basic inputs and several firm-specific attributes that allow an inter-firm comparison to be made. Table 1 sets out a description of the variables and summary statistics of the data. Q_i is the gross industrial output of firm i at the constant 1990 prices. Many similar studies have used “value-added” as the output variable. However, McGuckin and Nguyen (1993) explain that there is a significant upward bias in estimation when “value-added” is used. Chow and Fung (1997) argue that the use of gross industrial values will alleviate this problem. In this paper, we use gross industrial values as the measurement for output, and labor, capital and raw materials as the basic inputs. L_i is the number of workers and staff. M_i is the raw materials deflated by the ex-factory output price index, compiled from various issues of the *Statistical Yearbook of China*.¹⁰ Capital, K_i , is measured by the net value of fixed assets deflated by a capital price index. The price index of machinery and equipment at base year 1990 was used as the capital price index. There are two common problems in handling the measurement of capital stock in China. First, capital stock includes “non-productive” welfare facilities, such as the schooling and medical facilities (McGuckin *et al.*, 1992), provided by state-owned and collective enterprises. However, in the case of foreign-financed firms in China, the proportion of “non-productive” facilities in capital stock is basically negligible as foreign-financed firms do not bear a similar responsibility. Hence, no adjustment of capital stock is needed in this regard. Second, Chinese firms adopt the

¹⁰ For a better measurement, the raw material input variable has to be replaced by the intermediate input variable. Intermediate inputs for manufacturing production processes typically include not only raw materials, but also energy and water. In our data set, the only available data for intermediate inputs are raw materials.

perpetual inventory method in calculating the values of fixed assets by adding the investment of each year to the amount of fixed assets from the previous year, less depreciation. The capital data we used were the fixed assets net of depreciation. To maintain a consistent “comparability” of the capital stock in the two years of observations in our data set, we did not adjust the capital stock with respect to the second problem of the perpetual inventory method. Hence, this is the limitation of the capital measurement in our study.

[Insert Table 1]

For the firm-specific attributes, we include employee motivation and external orientation. The former encompasses *BONUS* and *TEMPWORK*, the latter refers to *F_EXPAT* and *EXPORT*. *BONUS* measures the bonus per capita. *TEMPWORK* and *F_EXPAT* were respectively obtained as the ratios of temporary workers and expatriates to the total number of employees. *EXPORT* was calculated by the proportion of output exported. All monetary figures were measured at 1990 prices. The model also included the *SIZE* dummy variable to detect any efficiency in scale. The criterion to classify firm size is by employment size. Firms with more than 501 employees on their payrolls are classified as large-scale firms (10 cases), whereas those with 51-500 workers are medium-sized firms (13 cases).¹¹ In addition, the *TREND* variable was included to capture the technical change in the stochastic frontier and to account for changes in inefficiency over time.

Hence, a comparison between the coefficient of raw material input variable in our study with the coefficient of intermediate input variable in other similar studies has to be made with caution.

¹¹ However, it is arbitrary and may be even misleading to use the number of workers to determine the size of a firm, as a large-scale and highly automated firm might, for example, employ only 200 workers, while a medium-sized labor-intensive clothing firm might employ 500 or more.

With all the variables defined, the estimation of equation (1) requires specifications for the production technology form and the error components. For simplicity, we employ the Cobb-Douglas production specification for the production function. The Cobb-Douglas specification is useful for exploring changes in production behavior over time and it is specified as follows:

$$Q_{it} = A_o K_{it}^{\alpha} L_{it}^{\beta} M_{it}^{\theta} e^{v_{it} - u_{it}} \quad (3)$$

where Q_i = gross output, K_i = capital input, L_i = labor input, M_i = raw material input, and α, β, θ are coefficient parameters.

With the inclusion of the *TREND* variable, the computational form of equation (3) is given as follows:

$$\ln(Q_{it}) = \ln(A_o) + \alpha \ln(K_{it}) + \beta \ln(L_{it}) + \theta \ln(M_{it}) + \varphi \text{TREND} + v_{it} - u_{it} \quad (4)$$

where \ln denotes the natural logarithm and φ is the coefficient parameter.

The technical inefficiency function is defined as follows:

$$\begin{aligned} \mu_{it} = & \delta_0 + \delta_1(\text{BONUS}) + \delta_2(\text{TEMPWORK}) + \delta_3(\text{F_EXPAT}) + \delta_4(\text{EXPORT}) \\ & + \delta_5(\text{SIZE}) + \delta_i(\text{TREND}) \end{aligned} \quad (5)$$

Since our estimation involves data from a panel that comprises firms from different types of industries, the effects of inter-industry heterogeneity on productivity is expected. To account for the heterogeneity of firms in different industries, we estimate the models with industry-specific fixed effects and also study whether the coefficients of the input variables are industry-specific. These procedures can also help to deal with inter-industry pricing differences while state prices are implicitly used in the measurement of output,

capital and raw material costs at constant prices.¹²

Capturing the industry effects, the sub-model can be written as:

$$\ln(Q_{it}) = \ln(A_0) + \alpha \ln(K_{it}) + \beta \ln(L_{it}) + \theta \ln(M_{it}) + \phi TREND + \sum_{j=1}^4 d_j D_{ij} + v_{it} - u_{it}$$

(6)

where the subscript j indicates the type of industry for firm i . $\ln(A_0)$ is the intercept of the equation (6) for the fifth type of industry. D is the industry dummy and d is the coefficient parameter.¹³

IV. The Data Set in Guangdong

Data covering two years from 1998 to 1999 were collected from 26 foreign-financed manufacturing firms in Guangdong province. The data were obtained with the help of a local research center in Guangzhou, and contained various economic variables which we have used in this paper.¹⁴ Observations with missing outputs or inputs were deleted, leaving a sample of 23 firms with 45 observations in an unbalanced panel data set. Although the absolute sample size is small, our data set covering various firm-specific attributes permits us to construct measures of key variables that are close to theoretical ideals. For example, we have different categories of labor data to depict the various effects of temporary workers, and managerial/technical expatriates on the efficiency of firms. This type of data was quite

¹² The authors would like to thank Sean M Dougherty for his suggestions for clarifying this point.

¹³ Industry dummy1 equals 1 if a firm is in the textile and clothing sector (7 cases) and 0 otherwise. Similar definitions apply to industry dummy2 to dummy4 for the plastic products sector (6 cases), the food and beverage sector (3 cases) and the leather products sector (2 cases) respectively.

¹⁴ All of the data were collected by a questionnaire survey with the help of the Social Economic Development Research Center in Guangdong province. The research center has access to the Guangdong Provincial Government, which has substantial power to oversee enterprises. Set against this background, the Center has a rather good access to collect firm level data. Details of the sampling procedures are explained in Appendix A.

often absent in other similar studies; e.g., Groves *et al.* (1994), Liu and Liu (1996), Wu (1996), Jefferson *et al.* (2000), Young (2000), and so forth.

The manufacturing industry in Guangdong was chosen for this study for a number of reasons. First, undertaking empirical studies on firm level data in China is often contingent upon accessibility to organizations in China. Second, since the introduction of economic reforms in China in 1979, Guangdong has been given a higher level of economic freedom than other provinces. It is widely viewed as a place that is successful in attracting FDI. The available data allowed an empirical examination of the effects of various firm-specific attributes on industrial production. Third, most other studies have tended to use data from the national level to study the effects of selected firm-specific attributes on efficiency. However, in view of the vast extent of China's industry, certain firm-specific attributes may have produced positive effects in some provinces but not in others. Even within the same industrial sector, it is likely that selected firm-specific attributes will exert different effects on firms in different localities. Thus, based on the manufacturing industry in Guangdong, this paper seeks to determine whether certain selected firm-specific attributes have brought significant changes to firms at the provincial level.

In the sample, there were 16 firms owned by investors originating from Hong Kong, and the rest were mainly from Taiwan, the U.S.A., Singapore and some European countries. The sample firms represented three major investment modes: equity joint ventures (15 cases), contractual joint ventures (7 cases) and wholly foreign-owned firms (1 case). Most of the firms were located in Guangzhou (19 cases), and others were located in the Pearl River Delta, including Dongguan, Panyu and Zhongshan. In terms of industrial sectors, textiles and clothing (7 cases), plastic products (6 cases), food and beverages (3 cases) and

leather products (2 cases) accounted for more than half of the total firms in the sample. The remaining firms were engaged in the production of metal products, toys, and electrical appliances. In terms of employment size, there were 13 cases of medium-sized firms (51-500 workers), and the rest were large-scale firms with more than 501 employees on their payrolls.

V. Results of the Empirical Analysis

The econometric computation was executed using FRONTIER 4.1 software for panel data.¹⁵ FRONTIER estimates the stochastic frontier and the inefficiency function simultaneously in one step with balanced or unbalanced data. The results of the estimation of the equations with gross industrial output as the dependent variable are given in Table 2. The results of the parameter estimation in model (1) were obtained by using OLS estimators.

[Insert Table 2]

To capture the industry effects, we add four industry dummies in the stochastic frontier as shown in equation (6) to control for the heterogeneity in production. The results of the industry-specific fixed effects are presented in model (4). In choosing between model (2) and model (4), the selection is based on the generalized likelihood ratio (LR) test as follows.

$$LR = -2[L_R - L_U]$$

where L_R and L_U denote the log likelihood functions of the restricted model and the unrestricted model, respectively. The LR statistic follows a chi-squared distribution with degrees of freedom equal to the number of restrictions. The test statistics for the null

hypothesis that the four industry dummies are jointly not significantly different from zero is 18.556. This exceeds the chi-square table value, with four degrees of freedom, of 9.488 at the 5 percent significance level. The test result rejects the null hypothesis and led us to select model (4). After we have controlled the industry-specific fixed effects, the estimates in model (4) appear to be more plausible. Furthermore, in examining whether the coefficients of the input variables are industry-specific, we include the industry interaction terms, which are obtained by multiplying industry dummy variables respectively with the logarithm of capital, labor and raw material variables.¹⁶ The statistic of the likelihood ratio test on the null hypothesis that the joint effects of the industry interaction terms are not significant is 15.054. The test statistics is less than the critical value of 21.026 under the chi-squared distribution at the 5 percent significant level. Hence, the null hypothesis is not rejected.¹⁷ This indicates that the industry interaction terms are jointly not significantly different from zero. To account for technical changes, we include a time trend variable in the stochastic frontier presented in equation (6). However, with the inclusion of the time trend, the estimates of most coefficients became implausible. By performing the likelihood ratio test, the test result does not reject the null hypothesis that the trend variable in the stochastic frontier is not significantly different from zero. Hence, we do not include the

¹⁵ The program FRONTIER 4.1 was written by Professor Tim Coelli. See Coelli (1996).

¹⁶ There are twelve industry interaction terms for the inputs and industry dummy variables; e.g., D1K=industry dummy 1 x logarithm of capital, D1L= industry dummy 1 x logarithm of labor, etc.

¹⁷ For the sake of presentation, we do not report the results of the estimation. The results are available from the authors.

trend variable in the stochastic frontier.¹⁸ In sum, model (4) emerges as the preferred specification for discussion in the rest of the paper.

Apart from considering the industry-specific effects, we need to discuss the effects of plant heterogeneity on capital and labor. Bartelsman and Doms (2000) produced a detailed literature survey on the well-known persistence of firm productivity dispersion on a cross-sectional as well as a time series dimension. Bailey, Hulten and Campell (1992:198) noted that “[a]llowing for plant fixed effects in time-series cross-sectional production or productivity estimates will provide much of the explanation of the productivity distribution.” Furthermore, Tybout (2000) raised the question: Is productivity dispersion higher in less developed countries? He discussed the problems of pooling heterogeneous technologies and sorted studies according to whether they employed deterministic or stochastic frontiers. He found that stochastic frontier studies usually produce higher average efficiency levels. Turning to our panel data, which covered 23 firms for two yearly observations, it is apparent that the number of cross sections was too small to permit an estimation of the variance component due to time series. The test for firm-specific effects thus could not be carried out.

We come now to examine whether the mean response production function model is an adequate representation for the sample data. From Table 2, the estimate for the variance parameter, γ , is 0.999 which suggests that the inefficiency effects are likely to be significant in the analysis of the output value of the sample firms. We next turn to test the null hypothesis of $\gamma = \delta_0 = \delta_1 = \dots \delta_5 = \delta_T = 0$ (i.e., no inefficiency effect) versus the

¹⁸ This might be due to the interaction of the two time variables in our sample firms. The results were not shown here but they are available from the authors. Similar experience with the trend variable was also

alternative hypothesis that the above parameters are not all zero. The value of the LR test statistic is 26.213, which is greater than the critical value of 14.853 with eight degrees of freedom at the 5 percent significance level.¹⁹ This test result rejects the null hypothesis of no technical inefficiency effect. Based on these test results, we can conclude that the mean response production function is not an adequate representation for the production of the sample foreign-financed firms in China, given the specification of the stochastic frontier and inefficiency function, presented in equations (6) and (5).

Regarding the efficiency of the sample firms, the mean technical efficiency in the ML model was 70.0% (Model (4) in Table 2). This was in line with other estimates, such as the mean technical efficiency of 62% estimated by Wu (1996) of 87 Chinese iron and steel enterprises in 1988.²⁰

To investigate the impact of firm-specific attributes on technical inefficiency, we check the estimates of the parameters, δ , associated with the firm-specific attributes specified in the inefficiency function. When we examine the coefficients in the inefficiency function, we have to keep in mind that a negative sign of δ indicates that the pertinent explanatory variable has a positive effect on technical efficiency, *vice versa, ceteris paribus*.

The estimated results in Table 2 indicate that, bonus per capita and ratio of temporary workers have positive significant effects on enterprise technical efficiency. The coefficients of ratio of expatriates and ratio of exports show that firms with a relatively high

encountered by Liu and Liu (1996).

¹⁹ This statistic has a mixed chi-squared distribution. The critical value for the testing of the hypothesis is obtained from Kodde and Palm (1986).

²⁰ Jone, Klinedinst and Rock (1998) reported a mean technical efficiency ranging from 63% to 70% for a sample of 247 Bulgarian industrial enterprises spanning the period 1989-1992. In addition, Piesse and Thirtle (2000) found a higher level of mean technical efficiency of 92% in a sample of 43 Hungarian manufacturing firms in 1985-1991.

expatriate ratios or high export ratios are less efficient than others. Besides, the size variable is not significant, rendering no support for the conjecture of the size/efficiency relationship. The following section offers some possible explanations of these estimated results.

Discussion and interpretation of results

To study the impact of employee motivation on efficiency, we first examined the impact of bonus incentives on efficiency. The empirical finding supports the conjecture of a positive association between bonus schemes and enterprise efficiency. A higher level of bonuses may have generated a higher level of technical efficiency.²¹ As a cross-reference, the results are largely compatible with the findings of Groves *et al.* (1994), Liu and Liu (1996), and Yan (1998) on China's state-owned enterprises. However, some other studies criticize the fact that bonuses are not often able to discriminate between the performance of individuals and firms. Lee and Mark's (1989) survey showed that there was an egalitarian distribution of bonuses in China's state-owned enterprises largely due to manager/worker collusion. However, when compared to wages, which were often determined upon the type of job, work experience and qualifications of employees, but not on individual performance (Hussain and Zhuang, 1994), bonuses were usually in principle given out according to some pre-determined methods of measuring performance.²² At any rate, our empirical evidence supports the bonus/efficiency relationship in foreign-financed firms on some level.

²¹ In our empirical results, the causality from efficiency to bonuses was not determined. A causality test, such as a Granger test or Sims test (Granger, 1969; Sims, 1972), is required to examine the causality between efficiency and bonus. However, the limited length of our time series data for two years does not permit such a test to be conducted.

²² Zhao and Nichols (1996) provided a detailed discussion of the bonus structure of China's textile industry.

Next, we investigate the effect of employment flexibility. The empirical results demonstrate that a high level of autonomy on employment policy has positively affected enterprise performance. This evidence may provide a *prima facie* argument that individual dismissals might have strengthened employee motivation. Thus, there is evidently an effect of employment flexibility of some kind at work.

Turning to explain the impact of external orientation on efficiency, the estimated results show that the higher ratio of expatriates has a negative effect on efficiency. This appears to go against the common wisdom that foreign partners in foreign-financed firms will bring the beneficial effects of managerial and technical know-how to firms. What are the possible major drawbacks for foreign-financed firms with higher ratios of expatriates on their payrolls? We shall discuss this question in some detail. First, when firms have higher ratios of expatriates, they may face the problem of **localization** at the top level. Middle-level staff members, usually local employees, then lack the opportunity to be promoted to senior positions in the firm. What are the effects of promotions on firms? In a study of the determinants and consequences of promotions, Francesconi (2001) finds that promotions lead to an increase in job satisfaction, especially satisfaction with the work itself as well as with the pay. Following this line of argument, the lack of promotion opportunities for middle-level employees can partially explain the high turnover rate among mid-ranking managerial staff in foreign-financed firms in China.²³ The likely consequence is an

²³ The lack of promotion opportunities partially accounted for the 50 percent turnover of mid-ranking managerial staff of a foreign-financed food manufacturing firm in Hangzhou in 2002 (Field survey, April 2003).

interruption in daily production (Field survey, April 2003).²⁴ Second, when high-level expatriate managers of various departments are stationed in foreign-financed firms in China to oversee production, they may have less contact with the international market. They may not be able to follow the most up-to-date market information. Quite often, this leads to **conflicts** between managers of marketing departments (who are on the front lines of the international market) and other operational departments when the latter's information about (international) market demand is different (Field survey, January 2002).²⁵ The experience of a famous Europe-based transnational corporation's (TNC) equity joint ventures in Hangzhou serves as an example. As one of 54 joint ventures and the most profitable one in China, the (German) General Manager refused to adopt the latest production technology to facilitate the manufacturing of GIS-circuit breakers in China. The problem was resolved after the (Chinese) Deputy General Manager (who was responsible for marketing) flew to Germany to obtain the approval from headquarters on the adoption of the new technology (Field survey, August 2001). Third, tremendous differences in culture may contribute to the lack of a harmonious **working relationship** between expatriates and local managerial staff. Some foreign managerial and technical staff may be rather self-centered and even arrogant in dealing with their local counterparts; i.e., some of them (including overseas Chinese) intend to "teach" their Chinese colleagues everything from day one, and so on. Language barriers certainly do not help to diffuse the cultural differences and misunderstandings that arise between expatriates and locals (this is the case in some firms financed by Hong Kong-

²⁴ We have conducted various phases of fieldwork in China. The information from the fieldwork undertaken by the authors provides a cross reference to the experiences of foreign-financed firms in other parts of China.

based investors as well). For instance, expatriates tend to sack workers who either underperform or violate company rules, on the spot and in front of other workers, while the local managers tend to talk to the workers concerned privately (to “save their face”) and either give them a “second chance” or ask them to resign. Our field visit to the equity joint venture set up by the Europe-based TNC in Hangzhou provides a typical illustration of the lack of a harmonious working relationship between expatriates and local managerial staff. The General Manager questioned the actions of his Chinese Deputy in spending so much time visiting and dining with potential customers all over China. Yet the Deputy General Manager complained that his boss did not understand the way of doing business in China; i.e., the need to cultivate personal connections, *guanxi*, with potential customers.²⁶ It took the foreign and local managers a tremendous amount of effort to reconcile their differences and focus on the operations of the joint venture (Field survey, August 2001). The above discussion may be able to address the question why foreign-financed firms with high ratios of expatriates appeared to be less efficient.

The second element of external orientation is the degree of export-orientedness. Our empirical results do not find the conjecture of the export/efficiency relationship. Are there similar empirical results involving firms in other countries? Bleaney and Wakelin (2002: 3) noted that, “[t]he major issue is whether firms’ efficiency is significantly improved by the experience of competing in foreign markets. The empirical findings on this have been uniformly negative.” For example, the empirical results of studies of firms in the U.K.

²⁵ This is supported by an informal interview in January 2002 with a senior manager from a large textile group listed in the Hong Kong Stock Exchange. The Group has a large-scale joint venture in Dongguan, Guangdong, employing over 5,000 workers.

(Bleaney and Wakelin, 2002), the U.S. (Bernard and Jensen, 1999), and in some developing countries (Aitken *et al.*, 1997) do not support the common conjecture of an export/efficiency relationship. All of these are the experiences of firms in other countries. In the case of our sample firms in China, we suspect that the negative export/efficiency relationship may be partly attributed to the high transaction costs of exportation due to various government policies. Yeung and Mok (2002) explained that the high transaction costs are due to the ambiguity, complexity and inflexibility of government policies in the labor, capital and products markets. For instance, to fulfill rules on the verification of imports and exports, foreign-financed firms have to keep detailed daily records of the value and quantity of the raw materials that they import, the products that they export, and of their inventories. Foreign-financed firms have to show all these records to the local government and Customs officials. This policy is aimed at preventing foreign-financed firms from illegally reselling tariff-free raw materials in the local market and evading taxes. Nonetheless, complying with this rule imposes tremendous administrative costs on daily operations, thus offsetting part of the profits (and lowering the efficiency) of export-oriented foreign-financed firms.²⁷ This, coupled with the Chinese government's opening of its local market to firms with FDI shortly before its accession to the World Trade Organization, means that foreign-financed firms in China are paying more attention to capturing a share of the local Chinese market.²⁸

²⁶ Readers interested on the concept of "face" (*mianzi*) can refer to Chen (1995). In addition, Davies *et al.* (2003) explains the significance of personal connections for Chinese businesses.

²⁷ Furthermore, the lack of coordination among various bureaus hampered arbitration between foreign investors and government departments, which further increased the transaction costs of exportation.

²⁸ China formally acceded to the World Trade Organization after the government delegate signed the treaty in November 2001.

As shown in Table 2, the coefficient on firm size was positive, suggesting that large firms may be less technically efficient than smaller firms. However, the estimation was statistically insignificant. In this context, there was no evidence to support the conjecture on the relationship between firm size and efficiency in our sample firms. Finally, to check whether there has been a change in inefficiency over time, we included the trend variable in the inefficiency function. The results indicate that the trend variable has a positive sign and that the coefficient is statistically significant by the t-test (Table 2), implying that an increasing inefficiency over time was detected during the period of observation.

VI. Conclusions and Implications

While acknowledging the limitation of the paper in terms of its sample size, from the results of the above quantitative analysis, we can draw some tentative conclusions and implications of empirical significance. In identifying the sources of efficiency in the foreign-financed firms in our sample, there is empirical evidence that enterprise performance was directly related to employee motivation. Our findings strongly support the use of both bonus incentives and flexibility in the management of human resources to enhance enterprise performance.

Perhaps the most unexpected but interesting findings are the effects of the external orientation behavior of firms on efficiency. Our research found that sample firms with relatively high expatriate ratios were less efficient. Therefore, it was not necessarily beneficial for foreign-financed firms to bring in too many expatriates to run their firms in China. Perhaps this reflects the lack of a harmonious working relationship between expatriates and local staff, and the issue of localization. Possible conflicts might occur between the management and marketing departments when expatriates lacked the most up-

to-date market information. Expatriate staff, especially those originally based in the U.S. or Europe, often enjoyed favorable remuneration packages (e.g., substantial pay rises, hardship and housing allowances, generous relocation grants for their families, *etc.*) when they were sent to China to oversee the operations of the joint ventures. Their remuneration packages were about six times those of their local counterparts with similar qualifications and job responsibilities.²⁹ Local employees might lack motivation and thus loyalty to the company, if their chances of being promoted to higher positions were blocked by expatriates (Lasserre and Chin, 1997: 94). In addition to the higher costs of stationing expatriates in China, the lack of a harmonious working relationship between expatriates and local staff may be one of the reasons why more and more foreign-financed firms are keen to localize their management teams (the recruitment of overseas Chinese may be the first step in localization) in China. A typical example of the localization of management is Shanghai Volkswagen, where only 19 of the 320-strong managerial force were comprised of expatriates in 1996 (Lasserre and Chin, 1997: 86).

With China's accession to the World Trade Organization, the already strong demand for experienced local managerial staff is expected to be compounded in China. With the expectation of more FDI, there may be a "bidding war" for experienced and qualified local managerial staff in the Chinese market. If this "bidding war" goes unchecked, it may lead to even higher turnover rates of managerial staff and thus interrupt the daily operations of firms. This would not only partially offset the cost advantages of localization in foreign-financed firms, but also disrupt the long-term development strategies

²⁹ At about US\$300,000/year, the remuneration package of a U.S. expatriate was six times higher than that of a Chinese executive. Other foreign-financed firms that were very keen on localization include ABB, Henkel,

of both foreign-financed and locally-funded firms in China.³⁰ If the negative productivity effects of expatriates are widespread among foreign-financed firms in China, this may have tremendous implications for the recent drive by some Chinese firms (both privately owned and state-owned) to recruit overseas Chinese to improve their competitiveness, a move that has been partly spurred by China's accession to the World Trade Organization.³¹

Another external orientation factor used in this study was the degree of export-orientedness. Our finding that did not support the export/efficiency relationship was not unusual. Similar evidence has been observed in firms in other developed and developing countries. In China, it seems that foreign-financed firms with high ratios of exports suffered the most from the high transaction costs of exportation, partly due to the ambiguity, complexity and inflexibility of Chinese government policies in regulating them. This is illustrated by the requirement for these firms to submit daily records of imports and exports to fulfill verification rules, *etc.* In other words, firms that focused on marketing their output in the local Chinese market appeared to perform better. The implication is in line with the observed business strategy of most foreign-financed firms in China; i.e., to capture market share in China and to reap the benefits of China's rapid economic growth. The Chinese local market is expected to be a more significant one for the majority of firms after China gradually opens it up in accordance with the World Trade Organization's regulations on accession.

Unilever and Hoechst, *etc.* (Lasserre and Chin, 1997: 86-87; Li and Kleiner, 2001: 51).

³⁰ The development of a long-term strategy for a company normally requires a certain level of continuity in the level of top management.

³¹ In April 2002, about 100 firms from Shanghai's Pudong district participated in a career exhibition in Hong Kong for the purpose of recruiting expatriate managers and professionals. Some overseas Chinese from Singapore and North America were said to have visited Hong Kong to explore job opportunities in China. See *South China Morning Post*, 19 April 2002.

Table 1. Description and summary statistics of variables

Variable	Description of variable	
<i>Q</i> =gross output	Gross output at 1990 prices (ten thousand <i>yuan</i>)	
<i>K</i> =capital	Net fixed assets at 1990 prices (ten thousand <i>yuan</i>)	
<i>L</i> =labor	Total number of employees	
<i>M</i> =raw materials	Raw materials at 1990 prices (ten thousand <i>yuan</i>)	
<i>BONUS</i>	Bonus per capita at 1990 prices (ten thousand <i>yuan</i>)	
<i>TEMPWORK</i>	Ratio of temporary workers to the total number of employees	
<i>F _ EXPAT</i>	Ratio of expatriates to the total number of employees	
<i>EXPORT</i>	Ratio of exports to gross output	
<i>SIZE</i>	Size of a firm = 1 if large, = 0 otherwise	
<i>TREND</i>	Trend variable	
Variable	Mean	Standard deviation
<i>Q</i>	16,311	19,232
<i>K</i>	4,914	5,140
<i>L</i>	1,337	1,898
<i>M</i>	6,083	7,232
Employee motivation:		
<i>BONUS</i>	0.021	0.043
<i>TEMPWORK</i>	0.338	0.399
External orientation:		
<i>F _ EXPAT</i>	0.008	0.011
<i>EXPORT</i>	0.449	0.299

Note: Number of firms=23

Table 2. Stochastic frontier model for foreign-financed firms in Guangdong Province, 1998-1999

Dependent variable = real gross output	OLS Model (1)	ML Model (2)	OLS Model (3)	ML Model (4)
<i>Stochastic frontier</i>				
Constant	2.62 (0.42)	3.55 (0.31)	3.00 (0.39)	3.39 (0.20)
Capital	0.142 (0.058)	0.183 (0.037)	0.139 (0.052)	0.184 (0.023)
Labor	0.273 (0.062)	0.380 (0.044)	0.229 (0.060)	0.394 (0.039)
Raw Materials	0.465 (0.052)	0.276 (0.044)	0.483 (0.047)	0.313 (0.031)
Industry Dummy1			-0.25 (0.15)	-0.273 (0.095)
Industry Dummy2			-0.19 (0.16)	-0.249 (0.079)
Industry Dummy3			-0.79 (0.20)	-0.517 (0.088)
Industry Dummy4			-0.08 (0.22)	-0.36 (0.11)
<i>Inefficiency function</i>				
Constant		-2.6 (1.9)		-1.59 (0.42)
<i>BONUS</i> , bonus per capita		-38.5 (3.7)		-3.8 (1.6)
<i>TEMPWORK</i> , ratio of temporary workers		-1.44 (0.78)		-0.66 (0.27)
<i>F _ EXPAT</i> , ratio of expatriates		24.4 (3.2)		4.1 (1.8)
<i>EXPORT</i> , ratio of exports		2.53 (0.77)		1.27 (0.33)
<i>SIZE</i> , firm size		-0.37 (0.42)		0.29 (0.21)
<i>TREND</i> , trend variable		0.91 (0.73)		0.59 (1.9)
$\gamma = \sigma_u^2 / (\sigma_u^2 + \sigma_v^2)$		0.981 (0.018)		0.99999 (0.00083)
Log-likelihood value	-21.958	-10.145	-13.973	-0.867
Mean technical efficiency		0.692		0.700

Note: Figures in parentheses are the estimated standard errors.

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Appendix A: Collection and Characteristics of Samples

Sampling plan and data collection

In April 2000, we requested the Social Economic Development Research Center in Guangdong province (hereafter named the GD Center) to assist us in conducting a questionnaire survey on various data relating to the output, capital, labor, wages, and bonuses of foreign-financed manufacturing firms in the province. Using a business directory containing about 1,800 foreign-financed manufacturing firms in Guangdong, we randomly selected 160 firms from the list.³² The questionnaire, a cover letter from the GD Center (including a declaration of the anonymity of the information provided by the sample firms), and a pre-stamped return envelope was sent to the finance departments of the sample firms. After two follow-ups by FAX and telephone, 26 firms returned the questionnaires, resulting in a response rate of 16%. We did not have any influence over the replies given by the 26 respondents to our questionnaire survey. We may then consider the respondents as random samples.

Data reliability and sample characteristics

In studying the Chinese economy, there is always a concern about the reliability of China's statistics. On the one hand, provincial governments have been accused of exaggerating their statistics to improve their public image. There may also be an upward bias in the statistics reported to the provincial governments by various organizations. On the other hand, for tax reasons, firms may under-report their economic and financial figures.³³ Therefore, it seems that, if independent organizations can obtain the cooperation of firms, they may be in a better position to carry out such a questionnaire survey.

Regarding the consistency of sample data, one way to handle the issue is to cross-check the sample data with the records of the statistical bureau. Besides, if the respondents of the survey are made aware that the investigators have access to the statistical bureau to cross-check the sample data, this may enhance the accuracy of the data in the questionnaires. However, the authors do not have access to the bureau. In order to make our sample more useful, we compare the aggregate statistics of our sample with those from the provincial and national levels. The aggregate statistics are presented as follows.

³² State Statistical Bureau (1994).

³³ Professor Thomas Rawski published two papers in 2001 querying the authenticity of China's official statistics. See Rawski (2001) and Rawski and Xiao (2001) and, among others, the debate by Shi (2002).

Table A1. Comparison of aggregate statistics for the sample firms, Guangdong province and the nation: foreign-financed manufacturing firms

	Labor productivity (ten thousand <i>yuan</i> per employee)	Capital/labor ratio (ten thousand <i>yuan</i> per employee)	Output/capital ratio
Sample firms			
1998	23.44	9.68	6.93
1999	22.14	9.46	6.21
1998-99	22.79	9.57	6.57
Guangdong province			
1998	18.67	6.11	3.05
1999	21.26	6.24	3.41
1998-99	19.96	6.18	3.23
The nation, 1999 [#]	24.27	8.16	2.98
Sample average as percentage of provincial average			
1998	1.26	1.58	2.27
1999	1.04	1.52	1.82
1998-99	1.15	1.55	2.04

Notes:

- (1) The figures for Guangdong province, the nation and the sample firms refer to foreign-financed manufacturing firms only.
- (2) Labor productivity measures gross output at 1990 prices per employee.
- (3) All monetary figures were measured at 1990 prices.
- (4) [#]The figures for 1998 were not available.

Sources:

- (1) *Guangdong Statistical Yearbook*, pp.283-387 of issue 1999 and pp.374-379 of issue 2000.
- (2) *China Industry Economy Statistical Yearbook 2001*, pp.72-77.

The sample firms were more capital-intensive when compared with the average for Guangdong province and with the national average. In terms of capital per employee, the sample average was slightly higher than the national average but about one and a half times higher than the Guangdong average. The sample's output per capital ratio was about twice as large as the averages for Guangdong and the nation. This suggests that capital productivity in the sample firms was higher.

A comparison with the Guangdong and national averages may be misleading, however. This is because the sample has a different sectoral composition than the firms in the provincial and national levels; i.e. with about 78 percent of sample firms in textile and clothing (7 cases), plastic products (6 cases), food and beverage (3 cases) and leather products (2 cases). In addition, the sample has no small-sized firms. Comparison by firm size is also not permitted because data by firm size are not available from the Guangdong Bureau of Statistics and the State Statistical Bureau. The national industrial census in 1995 also did not provide data for foreign-financed firms by industrial sector. Hence, in the following, we only focus on comparing aggregate statistics by industrial sector between our sample foreign-financed firms and foreign-financed firms in Guangdong province.

Table A2. Comparison of aggregate statistics by industrial sector between the sample firms and foreign-financed manufacturing firms in Guangdong province:

	Labor productivity (ten thousand <i>yuan</i> per employee)			Capital/labor ratio (ten thousand <i>yuan</i> per employee)			Output/capital ratio		
	1998	1999	98-99	1998	1999	98-99	1998	1999	98-99
<u>Textile & clothing</u>									
Sample firms (7 cases)	21.20	18.31	19.72	7.09	6.88	6.99	9.59	11.63	10.61
Guangdong Province	16.95	17.05	17.00	6.04	5.73	5.89	2.80	2.98	2.89
Sample average as percentage of provincial average	1.25	1.07	1.16	1.17	1.20	1.19	3.43	3.90	3.67
<u>Plastic products</u>									
Sample firms (6 cases)	25.86	27.40	26.63	12.93	11.54	12.24	5.37	3.99	4.68
Guangdong province	15.64	14.45	15.05	5.46	4.95	5.21	2.86	2.92	2.91
Sample average as percentage of provincial average	1.65	1.90	1.77	2.37	2.33	2.35	1.88	1.37	1.61
<u>Food & beverage</u>									
Sample firms (3 cases) [#]	25.64	16.13	20.89	11.03	8.55	9.79	2.46	1.91	2.19
Guangdong province	22.00	24.82	23.41	10.43	10.63	10.53	2.11	2.33	2.22
Sample average as percentage of provincial average	1.03	0.65	0.89	1.06	0.80	0.93	1.17	0.82	0.99

Leather products

Sample firms (2 cases)	11.13	9.68	10.41	3.18	3.22	3.20	7.35	6.69	7.02
Guangdong province	8.57	8.16	8.37	1.42	1.33	1.38	6.01	6.14	6.08
Sample average as percentage of provincial average	1.30	1.19	1.24	2.24	2.42	2.32	1.22	1.09	1.15

Note: # There were 2 cases in 1998 and 3 cases in 1999, since one firm did not provide data for 1998.

Sources: Same as for Table A1.

From Table A2, it is obvious that most of the firms in the sample are more productive in the use of labor and capital than firms in the province, with the exception of those in the food and beverage sector. In terms of the output per capital ratio, the sample averages in the textile and clothing sector and in the plastic products sector are generally higher. By contrast, the sample average in the food and beverage sector is comparable to the provincial average, and that in the leather products sector is slightly higher than the provincial average. On the whole, the aggregate statistics in Table A2 show that, with respect to the corresponding sectors in Guangdong Province, the sample firms in three sectors are above the average while those in the food and beverage sector are slightly below the average. The general pattern is still somewhat clear. Given the limited sample size, the empirical analysis in the paper is modest and the results obtained are thus only preliminary.