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DOES LABOUR MARKET FLEXIBILITY INCREASE TECHNICAL EFFICIENCY OF LABOUR USE? EVIDENCE FROM MALAYSIAN MANUFACTURING

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ABSTRACT

This paper analyses the impact of labour market flexibility on the efficiency of labour use in Malaysian manufacturing. A Cobb-Douglas Stochastic Frontier Model is adopted to estimate the labour input requirement function while at the same time modeling the efficiency effects. The results suggest that labour market flexibility positively affect technical efficiency of labour use. We also found that export share and firm size are positively correlated with technical efficiency of labour use while technical efficiencies of labour use tended to increase throughout the study period.

Keywords: labour market; technical efficiency; labour use; firm

1. Introduction

Labour market flexibility has been seen as playing a key role in the drive for competitiveness. The conventional wisdom is that extreme regulations strangle growth, destroy jobs, raise prices and drives firms elsewhere. For the advanced economies, the flexibility of labour market has been recognized as a key explanation for the sustained growth rates of these economies causing increased pressure on other countries to reduce perceived labour market rigidities.

Malaysian labour market policies has in the past tended to put greater emphasis on job creation rather than protecting workers through labour protection legislations. Towards this end, attempts were made to achieve labour market flexibility through industrial relations legislation which provided for compulsory negotiation of disputes and prohibition on the right to strike. In addition, unions were banned in most industries until 1988, after which only in-house unions were allowed at the plant, rather than the industry level. These labour market policies, despite many criticisms, can positively facilitate the flexibility of labour market.

The role of the Malaysian government in allowing the migration of foreign workers to Malaysia has also delivered labour market flexibility to employers. Arrangements were made during the last decades with the governments of many countries to allow recruitment of workers for employment in the domestic market in manufacturing and other sectors. Given illegal immigrants in Malaysia that comprise a substantial portion of the Malaysian workforces, numbering as many as two million by some estimates resulted in by the late decades a large reserve of illegal aliens in the country whom employers could recruit easily.

While the assumed benefits of labour market flexibility receive much attention in public discussion, little is known about its effect on firm's performance. It is postulated that the use of flexible work practices can have some consequence on savings on labour costs. Firstly, workers may be hired and paid for only if there is work to be done, for example, during temporary production peaks. In addition, the decisions to hire new workers are taken more easily if workers can be fired more flexibly under adverse circumstances. Secondly, because flexible workers on average earn less than comparable regular workers and are not allowed many of the benefits that regular workers are likely to receive from their employers, wage bills tend to be lower. Under temporary and fixed term employment contracts, workers and management agree to the length and scheduling of working over short term period. Such contracts have been widely seen as a potentially important way of achieving greater labour market flexibility and enhanced efficiency in work organization.

Discussions on labour use efficiency and labour market flexibility separately have not been infrequent in the literature. Yet surprisingly the basic question in assessing the relationship between the labour use efficiency and labour market flexibility remains unexplored. It is not known whether industries or firms are more or less efficient in a flexible labour market environment. To fill this gap in the literature, this study is an attempt to examine the relationship between labour use efficiency and labour market flexibility in the Malaysian manufacturing. The results of this paper may have important policy implications on whether flexible labour market practices (which can be enhanced by appropriately crafter government policies) and its affects on the efficiency of labour use.

This study is organized as follows: Section 2 provides a description of the data used in the analysis. The stochastic frontier input-requirement function is presented in Section 3, followed by the empirical results in Section 4. Summary and conclusions are provided in Section 5.

2. Methods and Data

This paper analyses the impact of policies of labour market flexibility on the efficiency of labour use in Malaysian manufacturing sector. A Cobb-Douglas stochastic frontier input-requirement model is utilized in order to assess the technical efficiency of the Malaysian manufacturing in their use of labour. The stochastic frontier function is estimated simultaneously with the parameters of a model for the technical efficiency effects. The utilized parametric method enables the identification of the sources of efficiency and provides future guidelines on how to improve the efficiency and thereby the competitiveness of the firms.

The labour input requirement function is estimated using maximum likelihood estimation. The analysis is applied on panel of 2200 Malaysian firms, which virtually constitutes more than ten percent of population of manufacturing firms. These were observed for a period of six years, from 2000 to 2005.

The variables required for the study are employment, wages, output, and capital expenditure for the frontier model and, labour market flexibility, firm ownership, firm size and, export for technical efficiency model. Appropriate price deflator is needed to convert financial variables into constant process. The producer price index (PPI) series is used for deflating financial variables at a constant 1998 prices.

Employment is defined as the number of workers engaged in firm activities. The number of workers is calculated as all persons engaged during December or the last pay period of the reference year. Wage per worker derived as the total wage bill divided by the number of workers of that firm. Output is measured as the total value of output produced by firm in a fiscal year. Capital expenditure refers to purchases of assets and cost of alteration and major repairs to assets during the year.

Technical efficiency of labour use of a firm can be determined by a number of factors, including variables concerning labour market as well as firm-specific variables. As to technical effects (Z_{it} in equation 2) FLX_{it} represents the labour market flexibility proxied by the ratio of part-time employment on total employment. The presence of part-time or temporary contracts or the easing on restrictions on the hiring and firing of workers reflects more employment flexibility.

In addition to the flexibility of the labour market in our analysis, we introduced some of the firms characteristics as determinants of technical efficiency of labour use .ONR represents ownership takes a value 0 if a firm is a local establishment and 1 if it is a foreign establishment, SIZ represents firm size and defined as SIZ = 1 if number of employees are less than 50 workers, SIZ = 2 if number of employees are between 50 and 100 workers and, SIZ = 3 if number of employees are more than 100 workers; EXP represents export share in total firm sales; and TIM represents time.

Table 1 provides a descriptive summary of the variables in the data set. The amount of labour used varies from 1 to more than 9935 employees. It is thus evident that the analysis involves both small large manufacturing firms. The variation in firm sizes is also reflected from other variables such as output, and capital expenditure.

Table 1: Summary Statistics 2000-2005

Variable	**MEAN**	**MEDIAN**	**MIN**	**MAX**	**S.D.**
L	184	60	1	9,935	453
Y(RM)	64,532	6,584.9	0.298	20,841,000	411,740
W(RM ‘000)	16.610	14.368	0.057	243.760	11.145
K(RM)	2,999.7	135.3	0.372	2,201,100	34,346
FLX	0.024	0.000	0.000	1.000	0.117
EXP	0.232	0.000	0.000	1.000	0.384
ONR	0.126	0.000	0.000	1.000	0.332
SIZ	2.166	2.000	1.000	3.000	0.850

3. The Model

This study utilizes a Cobb-Douglas Stochastic Frontier Model to estimate labour input requirement for the firms in the analysis. The labour use function gives the minimum amount of labour technically necessary to produce a given level of outputs. For this analysis, an input requirement frontier is specified which defines labour use as a function of a given set of outputs and quasi-fixed inputs, together with technical efficiency effects. The latter defines the degree of proximity to the frontier. Further, this model specifies that these efficiency effects are modeled in terms of other observable explanatory variables and all parameters are estimated simultaneously.

The labour use frontier is estimated using the stochastic frontier model, originally proposed by Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977), which accounts for both the random errors and the non-negative technical efficiency effects. In this analysis, the model defined in equations (1) and (2) below is an input requirement counterpart of the stochastic frontier production function model, proposed by Battese and Coelli (1995).

We assume that the labour requirement frontier in the manufacturing sector is represented by a:

$$\ln L_{it} = f(\ln Y_{it}, \ln W_{it}, \ln K_{it}, T_{it} : \beta).\exp(v_{it} + u_{it}) \quad \textbf{(1)}$$

where:

- L_{it} ~ labour;
- Y_{it} ~ output;
- W_{it} ~ wages;
- K_{it} ~ capital expenditures and; the subscripts, i and t, for the i-th firm in year t of observation.

The v_{it} are random variable, associated with measurement errors in the labour variable or the effects of unspecified explanatory variables in the model, which are assumed to be independent and identically distributed normal random variable with mean zero and variance σ_v^2; and the u_{it} are non-negative random variables, associated with the efficiency of the use of labour in the firms, which are assumed to be independently distributed, such that u_{it} is the truncation at zero of the normal distribution with mean, μ_{it}, and variance, σ^2, where μ_{it} is defined by

$$\mu_{it} = \delta_0 + \sum_{i=1}^{n} \delta_1 FLX_{it} + \delta_2 ONR_{it} + \delta_3 EXP_{it} + \delta_5 SIZ_{it} + \delta_6 TIM_{it} \quad \textbf{(2)}$$

where:

- FLX ~ labour market flexibility
- ONR ~ firm ownership
- EXP ~ exports
- SIZ ~ firm size
- TIM ~ time.

The terms in model (1) define the frontier technology for different levels of outputs and quasi-fixed inputs. Deviations from the labour use frontier function are captured in the two error terms. The random variable v_{it} accounts for measurement errors and the effects of misspecification in the frontier technology. The non-negative random variable u_{it} implies that the observed labour input, associated with the given level of outputs and quasi-fixed inputs, are not as small as would be possible if the firms were to operate on the efficient frontier, thereby being fully efficient in their use of labour. Including time as a variable in the model allows for shifts in the frontier over time. These shifts are interpreted as technical change.

The efficiency effects modeled in equation (2) vary by firm and time. They are modeled as a function of the labour market flexibility, firm ownership, export activities, firm size, and the year of observation.

Given the values of the outputs and quasi-fixed inputs, the technical efficiency of labour use for every firm in each year is defined as the ratio of the stochastic frontier labour use to the observed labour use. The measure for the technical efficiency of labour use for the *i*-th firm in year *t* of observation is defined by:

$$TE_{it} = \exp(u_{it}) \quad \textbf{(3)}$$

This measure takes a value less than or equal to one. A firm is technically efficient in the use of labour if this measure equals one, which implies that the firm has an inefficiency effect equal to zero. The amount of exp (u_{it}) is the measure of technical efficiency of labour use.

The parameters of the Cobb-Douglas stochastic frontier model, defined by equations (1) and (2), are simultaneously estimated by the maximum likelihood method of estimation using the computer program, FRONTIER Version 4.1 (Coelli, 1996). The program provides maximum-likelihood estimates of the parameters and predicts technical efficiencies for all firms in the years in which they are observed. The variance parameters in the frontier model are estimated in terms of the variance parameters $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\gamma = \sigma_u^2 / (\sigma_v^2 + \sigma_u^2)$ where the γ - parameter takes values between zero and one.

Tests of hypothesis for the parameters in the stochastic frontier model and in efficiency model can be obtained using the generalized likelihood-ratio test statistic, defined by

$$\lambda = -2[L(H_0) - L(H_1)] \quad \textbf{(4)}$$

Where L(H_0) is the log-likelihood value of a restricted frontier model, as specified by a null hypothesis, H_0 , and L(H_1) is the log-likelihood value of the general frontier model under the alternative hypothesis, . This test statistic has approximately a chi-square (or a mixed chi-square) distribution with degrees of freedom equal to the difference between the parameters involved in the null and alternative hypothesis.

4. Empirical results

Several generalised likelihood ratio tests of null hypothesis involving restrictions on the parameters were performed and are presented in Table 2. The first null hypothesis specifies that the second-order coefficients in the translog stochastic frontier function are equal to zero, which means that the Cobb-Douglas technology applies.

Table 2: Log-Likelihood test for Estimated Models

Null Hypothesis	Log-likelihood Function	LR-Test Statistics	Critical Value	Decision
$H_0=\beta_{YY}=\beta_{WW}=\beta_{KK}=\beta_{YW}=\beta_{YK}=\beta_{WK}=0$	12906.71	4.72	11.07	Accept
$H_0=\beta_{YY}=\beta_{WW}=\beta_{KK}=\beta_{YW}=\beta_{YK}=\beta_{WK}\neq 0$	12530.05	2181.78	19.68	Reject

The value of the generalized likelihood-ratio statistic for this test, as seen from Table 2, is calculated to be 4.72, which is smaller than the critical value of 11.07, the upper five per cent point for the chi-square distribution with 12 d.f. Cobb-Douglas technology is accepted as an adequate representation of the data on manufacturing firms.

The second test shows that, given the specification of the technical efficiency effects model, the null hypothesis that the translog functional form is rejected. All null hypothesizes explored in test 1 and 2 are performed against the basic OLS model which assume that each firm is operating on the technically efficient frontier and that the systematic and random technical efficiency effects are zero. This hypothesis is rejected, suggesting that inefficiency was present in labour use function and that the average function is not an appropriate representation of the data.

Following Battese and Coelli (1995) maximum likelihood estimation was employed to simultaneously estimate the parameters of the stochastic frontier model and the technical efficiency effects model. The results of the estimation are presented in Table 3.

Table 3: Estimates of Labour Frontier Functions and Technical Efficiency Models

	Model-I		Model-II		Model-III	
Variables	Coefficients	SE	Coefficients	SE	Coefficients	SE
Constant	-0.2476	0.0370*	-0.2891	0.0414*	-0.6036	0.1274**
LnY	0.7243	0.0035*	0.7243	0.0035*	0.8573	0.0248*
LnW	-0.6318	0.0107*	-0.6319	0.0104*	-0.6918	0.0699*
LnK	0.0231	0.0024*	0.0233	0.0024*	-0.0168	0.0145**
LnY^2					-0.0199	0.0014*
LnW^2					0.0063	0.0099**
LnK^2					0.0088	0.0008*
LnYW					-0.0016	0.0066**
LnYK					-0.0003	0.0014*
LnWK					-0.0284	0.0042*
Time	0.0279	0.0034*	0.0285	0.0033*	0.0220	0.0043*
Technical efficiency						
Constant			0.1229	0.0892***	0.0164	0.0744
FLX			0.4501	0.0244*	0.3712	0.1060**
EXP			0.0370	0.0477***	0.1124	0.0610**
ONR			0.0103	0.0652	0.1847	0.0692**
SIZ			-0.0414	0.0217**	-0.0025	0.0266
TIM			0.0005	0.0002*	-0.0006	0.0112
σ^2	0.4152		0.4182	0.0054*	0.3933	0.0048*
γ			0.0101	0.0015*	0.0082	0.0029*
Log-Likelihood	-12925.47		-12906.71		-12530.05	

First and second-order parameters β_k are all statistically significant indicating that labour input is increasing in inputs and decreasing in real wages. The variance parameter, γ, is statistically significant, which suggests the importance of technical efficiencies in explaining labour input behavior for our sample. It also suggests that one should not rely only on the average basic labour demand function response as an adequate representation of the sample data. The positive sign of the time coefficient in labour requirement function indicates that the value of labour input has tended to increase over the six year period.

The estimated δ coefficients help us understand the determinants of technical efficiencies of labour use. As expected, labour market flexibility coefficient is positive and significant which indicates flexibility of labour market enables firms to adjust their work system rapidly to market forces and for responding to new business dynamics. The results appear to support the hypothesis that the use of flexible work practices can have some consequence on savings on labour costs.

Turning to other factors related to the characteristics of firms, we see the exporting coefficient is positive and significant. This provides evidence that the export activities increase efficiency in the use of labour due to stronger competitive pressure in global markets. The parameter of the firm size is statistically significant and carries a negative sign. The results suggest that firm size has significant influence technical efficiency of labour use, implying that small firms tend to be more efficient in labour use. The coefficient of firm ownership is not significant suggests that firm ownership has not any impact on technical efficiency of labour use in Malaysian manufacturing. The positive coefficient for the time variable suggests that technical efficiencies of labour use tended to decrease throughout the period studied.

5. Conclusion

This paper analyses the impact of labour market flexibility and firm specific characteristics on technical efficiency of labour use in Malaysian manufacturing. A Cobb-Douglas stochastic frontier model is adopted to estimate the labour input requirement function while at the same time modeling the efficiency effects. Estimation results suggest that labour market flexibility positively affected technical efficiency of labour use which indicates flexibility of labour market enables firms to adjust there work system rapidly to market forces and easily responding to new business dynamics. The use of flexible work practices thus appears to have some consequence on savings on labour costs. We also find evidence that export activities and firm size increase efficiency in the use of labour. Firm ownership structure has no impact on technical efficiency of labour use in Malaysian manufacturing. The positive coefficient for the time variable suggests that technical efficiencies of labour use tended to decrease throughout the period studied.

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