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Do Education Earnings Differentials Reflect Productivity?: Evidence from Indonesian Manufacturing 1996 *

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Abstract

The purpose of this paper is to examine the efficiency of labor markets for workers with different levels of educational achievement in Indonesian manufacturing plants in 1996. Specifically, the paper asks (1) are earnings for more educated workers higher than for less educated workers, and (2) do earnings differentials between more educated workers and less educated workers reflect corresponding productivity differentials? The empirical findings suggest that more educated production workers earned more than less educated workers. However, the results suggest that the earnings differentials between more and less educated workers were smaller than corresponding differentials in marginal products for production workers. This finding implies that some of the labor markets examined were not perfectly competitive. Although the precise nature of the imperfect competition cannot be identified with this methodology, the results also imply that the allocative inefficient performance of some plants partially contributed to the inefficiency of the labor markets.

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1. Introduction

Education is believed to play an important role in economic development, and many countries have made efforts to expand access to education. However, in some less developing countries, as more educated workers increased in number, high unemployment rates among more educated workers became a matter of grave concern. One of the possible causes of such a phenomenon is the inefficiency of labor markets. The inefficiency of labor markets is quite capable of hampering economic development because the human resources that have been accumulated through the efforts would not be allocated and utilized efficiently.

Indonesia is a less developed country where the number of more educated workers has increased and unemployment rates among young educated workers have been high, especially in urban areas. This paper examines the efficiency of some Indonesian labor markets and asks two questions. First, do more educated workers earn more than less educated workers? Second, do earnings differentials between more educated and less educated workers reflect corresponding productivity differentials? The former question has been examined by some previous studies (e.g., Clark 1983, Byron and Takahashi 1989). For example, Byron and Takahashi (1989) examined the 1981 *Susenas* data (National Socio-Economic Household Survey) for urban Java. Their simple calculations from estimates of Mincer's earnings equations suggest a 15-17 percent return of income for each additional schooling year. In a related study, Lipsey and Sjöholm (2001) also examined the relationship between wages and educational attainment using the industrial census data for Indonesian manufacturing in 1996. Their results also suggested that wages for more educated workers are higher than for less educated workers.

On the other hand, the latter question has not been examined sufficiently, partially because very few datasets have information on educational attainment, earnings, and productivity from a consistent sample of workers, plants, or firms. In order to examine these questions, this paper is based on the very rich industrial census dataset for Indonesian manufacturing in 1996. Both production functions and earnings equations can be estimated from the information in this dataset making it possible to directly compare earnings and marginal products of more and less educated workers. In this respect, the methodology employed is similar to the methodologies use by Jones (2001) and Hellerstein et al. (1999).

The paper focuses on five industries in Indonesian manufacturing, for which information is relatively abundant, textiles, footwear, metal products, electric machinery, and transportation equipment. The analysis is static focusing on 1996 rather than examining trends over time. The methodology is not sophisticated compared with other papers examining earnings and/or productivity differentials, but it is rigorous enough to provide important insights into the issues at hand.

The next section proceeds to review the educational system and the issue of high unemployment rates among more educated youth in Indonesia. Literature on the relationship between earnings and educational achievement is also reviewed, focusing on the implications of previous theoretical and empirical findings for Indonesian manufacturing. Section 3 explains the methodology used to estimate production functions and earnings equations in this paper and Section 4 describes the data used in this study. Section 5 reports the estimation results and finally, Section 6 offers some concluding remarks.

2. The Educational System and Labor Markets in Indonesia

Indonesia experienced remarkable economic growth for the last few decades, and the growth was driven in part by the huge inflow of foreign direct investment, and financial and trade reforms especially after the second half of 1980's. Development of the educational system might also have contributed to economic growth. The Indonesian government recognized the importance of education, and initiated a primary school construction program using revenue from natural resources during the oil booms in 1970s (Thee 1998). Partially as a result of these efforts, the number of primary school increased from about 65,910 in 1973 to 146,558 in 1990 (Prijono 1999, p. 161), and the gross enrollment ratio for secondary school improved from 20 percent in 1975 to 56 percent in 1996 (World Bank 2002). Following the expansion of education, the average educational level improved from 2.8 years of schooling in 1971 to 4.6 years in 1985 (Hull and Jones 1994). In manufacturing workers, these levels are estimated to have been higher, 3.2 years in 1975 to 6.8 years in 1995 (van der Kamp et al. 1998). In addition, regarding tertiary education, at lest one university was established in each province, and the number of higher education institutions reached 1,159 with about 1.6 million students enrolled those institutions in 1994 (Prijono 1999). Workers with at least an upper secondary school education are projected to increase from 22 million in 1995 to 48 million in 2010 and then to 71 million in 2020 (Oey-Gardiner and Gardiner 1997).

Although these changes helped in some respects, they also created some problems in the education system and labor markets that have been discussed extensively (e.g., Hull and Jones 1994, Jones 2000, Prijono 1999, Sjöholm 2002). First, the rapid expansion of educational access made it difficult to improve the quality of education. Low quality has been attributed to a number of factors including the high proportion of poorly trained staff, low salaries for educators, large classes, the poor quality of text books, deteriorating school buildings, and other factors related to the shortage of educational expenditure. In Indonesia, the ratio of public expenditure on education to GNP in was low compared with other East Asian countries in 1996 (Sjöholm 2002). Second, various mismatches between the supply and demand for educated workers have been discussed. One important mismatch relates to the lack of skills in educated workers and this has been related to the low quality of education. Another important mismatch involves the failure to produce workers with the knowledge and skills demanded by employers. In this respect, the shortage of graduates in natural science has drawn special attention. Although the demand for scientists, engineers, and technicians are thought to be growing rapidly, only 23.3 percent of university students are enrolled in natural sciences (Prijono 1999).

Correspondingly, the unemployment rates among young and more educated workers have been high (Hull and Jones 1994, Manning 1998, Prijono 1999). The unemployment rate for more educated workers (those with at least a senior high school education) was 13.6 percent in urban areas compared to 5.9 percent for less educated workers in 2000.[1] In addition, Manning and Junankar (1998) have expressed concern about the social cost of unemployment among more educated workers, while Hull and Jones (1994) and Keyfitz (1989) highlight the negative effects unemployment among more educated workers has on incentives to make educational investment as a result of the downward pressure this puts on

[1] Unemployment rates for more educated workers were 11.7 percent in 1992 and 13.7 percent in 1996, while corresponding rates for less educated workers were 2.8 percent and 4.4 percent, respectively (calculated from Central Bureau of Statistics, various years c)

wages of educated workers relative to uneducated workers.

Another important characteristic of the Indonesian economy, which is related to technological development as well as the educational system and the functioning of labor markets, is that the high economic growth in late 1980s and early-mid 1990s was driven mainly by the expansion of labor-intensive production and exports. Indonesia, which is endowed with a relatively large number of cheap unskilled workers, has comparative advantage in labor-intensive production, and traditional trade theory suggests that greater dependence on international trade will increase the demand and wages for unskilled workers to relative to skilled workers in such countries. On the other hand, there is evidence supporting an opposite view. For example, Feliciano (2001) examined the impact of trade liberalization in Mexico during 1986-1990 on wage inequality, and the empirical results suggest that trade reform increased wage inequality. Robbins (1996) also insists that trade liberalization may sometime increase wage inequality in developing countries because it accelerates the accumulation of imported capital and this in turn increases in demand for skilled workers, which are thought to be complements to imported capital.

There are also signs suggesting that Indonesian manufacturing sectors have to upgrade technology and that this will lead to an increase in the demand for skilled workers relative to unskilled workers. It has been argued that labor-intensive sectors are forced to upgrade production technology because of increasing competitive pressure from other low-income countries such as China, India, and Vietnam. Correspondingly, production technology and the skill mix have to adjust rapidly (Manning 1998). In this respect, interviews with managers and experts in the textile industry suggested that firms in this industry did indeed start hiring educated workers in the wake of technological modernization (van der Kamp et al. 1998, p. 292).

The questions addressed in this paper illustrate whether there are imperfections in labor markets that hamper the effective allocation of more educated and less educated workers. In this respect, Manning and Junankar (1998) argue that the causes of the unemployment are not only related to a lack of skills in demand by employers but also to labor market rigidity which are in turn related to institutional rigidities such as inflexible modern sector employment contracts. There are several other cases in which labor market rigidity is likely to hamper adjustments in the mix of workers. For example, even if the quality of more educated workers is not high (e.g., because quality of education is low), employers might still have to pay more educated workers a wage premium that exceeds the premium necessary to compensate for the difference in labor quality due to labor markets' rigidity, for instance, arising from limited information on workers. In addition, the wage premium might be higher for non-production workers like managers than production workers like engineers. In this case, students would not be willing to study natural science. Another example is the case where employers undervalue or overvalue the marginal products of more educated and/or less educated workers. For example, if firms in a labor market tend to undervalue the ability or marginal products of more educated workers[2], the demand curve for more educated workers will shift and the wage for more educated workers would be lower than a wage that reflects productivity. In this sense, labor market would be inefficient. In these cases, among others, firms will not choose the efficient quantities of more educated and less educated workers.

Although the precise nature of the imperfect competition cannot be identified, we can

[2] For example, if a firm that has no knowledge of computers, it is likely to undervalue the ability of workers with computer skills compared to firms that have the knowledge of computers.

examine whether a labor market is perfectly competitive or not by testing whether the marginal products of labor equals the wage, because microeconomic theory suggests that a profit-maximizing firm increases or decreases the number of workers until the marginal products of workers equals to wage under perfect competition. This paper examines the equality of marginal products and earnings, but the assumption of profit maximizing behavior is relaxed because the assumption of perfect competition in output markets seems unrealistic. Instead, this paper tests whether labor markets are perfectly competitive by testing whether relative marginal products and relative earnings of more educated workers to less educated workers are equal or not. The important point here is that a cost-minimizing firm will adjust the share of more educated workers so that relative marginal products equals relative earnings if labor market are perfectly competitive and that this condition does not depend on the degree of competition in output markets.

3. Empirical Methodology

Some previous studies have examined the relationship between marginal products and earnings for different types of labor. For example, Hellerstein et al. (1999) examined wage gaps among various types of workers at the plant level distinguishing sex, race, marital status, age, educational level, and occupation and compared them with corresponding productivity gaps. Using a similar framework, Hellerstein and Neumark (1999) also examined sex discrimination using Israeli firm-level data. Jones (2001) examined the productive value of education using data for Ghanaian manufacturing firms by estimating a production function with various types of workers distinguished by educational level at the plant level and an earnings equation at the individual worker level. This paper employs a similar approach, in that a production function and earnings equations are jointly estimated. However, the methodology employed in this paper differs somewhat those used in previous studies partially because of data constraints. This paper focuses on the comparison of productivity differentials and earnings differentials between more educated workers and less educated workers, and in this respect the methodology is rather similar to that of Jones (2001). However, because this dataset doesn't contain information on individual workers, earnings equations are estimated at the plant level. In addition, although the dataset contains information on the number of workers by educational achievement employed in a plant, it does not contain information on work experience. On the other hand, in this paper it is possible to examine the relationships between earnings differentials and productivity differentials separately for production workers and for non-production workers. This is valuable because comparing these relationships for the two types of workers indicates which type of more educated workers are paid higher (or lower) relative wages than justified by productivity gaps.

In order to estimate the ratio of marginal products of more educated workers to less educated workers (relative marginal products), this paper allows for the possibility that the marginal products of more educated workers differ from the marginal products of less educated workers, assuming that the production function is of a modified Cobb-Douglas form as follows:

$$V = AK^{1-\alpha-\beta+\Theta}\left[L_0^p + (\gamma^p + 1)L_1^p\right]^{\alpha}\left[L_0^n + (\gamma^n + 1)L_1^n\right]^{\beta}, \qquad (1)$$

where V is the value added during 1996, K is the amount of operating capital stock at the beginning 1996, L^p is the number of production workers during 1996, and L^n is the number of non-production workers during 1996. The subscripts 0 and 1 refer to less educated workers and more educated workers, respectively. Thus, L_0^p is, for example, the number of more educated production workers. The parameters $(\gamma^p + 1)$ and $(\gamma^n + 1)$ represent the ratios of the marginal product of more educated workers relative to the marginal product of less educated workers for production workers and for non-production workers, respectively. If γ is positive, then marginal products of more educated workers are $\gamma \times 100$ percent greater than that of less educated workers. The parameter $1 + \Theta$ presents the elasticity of scale. Thus, equation (1) is a constant returns Cobb-Douglas production function if $\Theta = 0$. By defining the total number of production workers, $L^p \equiv L_0^p + L_1^p$ and the total number of non-production workers, $L^n \equiv L_0^n + L_1^n$, and dividing by L^p and then taking the natural logarithm of both sides, equation (1) can be expressed as follows:

$$\ln \frac{V}{L^p} = \ln A + (1 - \alpha - \beta + \Theta) \ln \frac{K}{L^p} + \beta \ln \frac{L^n}{L^p} + \Theta \ln L^p + \alpha \ln(1 + \gamma^p S^p) + \beta \ln(1 + \gamma^n S^n) , \qquad (2)$$

where S^p and S^n represent the shares of more educated workers for production workers ($S^p \equiv L_1^p / L^p$), and for non-production workers ($S^n \equiv L_1^n / L^n$), respectively.

In the earnings equation, data on the total earnings of production workers and non-production workers are defined as R^p and R^n, respectively. Following Hellerstein et al. (1999), average earnings for more educated workers, w_1 is assumed to be proportional to average earnings for less educated workers, w_0 (Here, superscripts *p* and *n* are omitted.):

$$w_1 = (\lambda + 1) w_0$$

If λ is positive, then earnings for more educated workers are $\lambda \times 100$ percent greater than that of less educated workers. Using this relationship, total remuneration to each type of worker can be expressed as follows:

$$R^p = w_0^p L_0^p + w_1^p L_1^p = w_0^p (L_0^p + L_1^p + \lambda^p L_1^p) ,$$

$$R^n = w_0^n L_0^n + w_1^n L_1^n = w_0^n (L_0^n + L_1^n + \lambda^n L_1^n) .$$

Furthermore, by dividing both sides of these equations by the number of production workers, L^p and then taking the natural logarithm, an earnings equation for production workers can be written as follows:

$$\ln \frac{R^p}{L^p} = \beta_0^p + \beta_k^p \ln \frac{K}{L^p} + \beta_l^p \ln \frac{L^n}{L^p} + \ln(1 + \lambda^p S^p) , \qquad (3)$$

where w_0^p is assumed to be a function of a constant, $\ln(K / L^p)$ and $\ln(L^n / L^p)$. R^p / L^p on the left hand side of equation (3) represents average earnings per production workers. Similarly, an earnings equation for non-production workers can be derived as follows:

$$\ln \frac{R^n}{L^n} = \beta_0^n + \beta_k^n \ln \frac{K}{L^n} + \beta_l^n \ln \frac{L^p}{L^n} + \ln(1 + \lambda^n S^n) . \qquad (4)$$

Using estimates of equations (2), (3), and (4), we can compare the relative marginal products and relative earnings for production workers ($(\gamma^p + 1)$ and $(\lambda^p + 1)$, respectively), and for non-production workers ($(\gamma^n + 1)$ and $(\lambda^n + 1)$, respectively). If labor markets were flexible and plants minimized total labor cost, the relative marginal products and the relative earnings would equal for both production and non-production workers. Therefore, the following hypotheses are of interest:

$H_0^p: \ \gamma^p + 1 = \lambda^p + 1$ or $\gamma^p = \lambda^p$, and $H_0^n: \ \gamma^n + 1 = \lambda^n + 1$ or $\gamma^n = \lambda^n$.

Equations (2), (3), and (4) are estimated by the seemingly unrelated regression method for a non-linear regression model.[3] These equations were also estimated including some other control variables to see if estimated parameters in equations (2), (3), and (4) might be biased as a result of omitting relevant explanatory variables.[4] Regional dummies (using West Java as the reference region) and sub-industry group dummies are included in each equation to capture region-specific or industry-specific characteristics like the degree of concentration or competition, and income levels. Plant size, measured as the natural logarithm of output in the previous year ($\ln O_{-1}$), is also included in earnings equations because earnings may depend on plants' size (Oi and Idson 1999, Troske 1999).

Using the methodology explained above, we can examine whether relative marginal products and relative earnings of more educated workers compared with less educated workers are equal on average. If they are not equal, the implication is that labor markets are not efficient. The causes of inefficient labor markets could be inefficient behavior in plants and/or to inflexibility in labor markets. Either of these factors could make it possible for plants to increase profits by adjusting the mix of workers if relative marginal products don't equal to relative earnings. This also creates the possibility that relationship of relative marginal products and relative earnings on average would differ between a group of relatively efficient plants and a group of relatively inefficient plants. A disadvantage of the methodology related to this point is the underlying assumption that the ratio of the marginal product of more educated workers to the marginal product of less educated workers is constant regardless of the share of more educated workers. In order to partially relax this assumption, the methodology is applied separately to two groups of plants, exporters and another is a group of non-exporters. The former group is likely to be a group of relatively efficient plants, because a number of empirical studies suggest that exporters are more productive or efficient than non-exporters.[5] Therefore, it is expected that the relative marginal products in exporters would be closer to the relative earnings than in non-exporters. This analysis is applied in only two industries, where there are a relatively large number of

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[3] Some regression results show statistically insignificant estimates of γ or λ because these parameters have relatively large standard errors. These results might indicate a misspecification problem and/or problems with the nonlinear estimation technique used in relatively small samples. Therefore, the following linear transformations of the three equations are also estimated.

$$\ln\frac{V}{L^p} = \ln A + (1-\alpha-\beta)\ln\frac{K}{L^p} + \Theta \ln L^p + \beta \ln\frac{L^n}{L^p} + \alpha\gamma^p S^p + \beta\gamma^n S^n , \qquad (2')$$

$$\ln\frac{R^p}{L^p} = \beta_0^p + \beta_1^p \ln\frac{K}{L^p} + \beta_2^p \ln\frac{L^n}{L^p} + \lambda^p S^p , \qquad (3')$$

$$\ln\frac{R^n}{L^n} = \beta_0^n + \beta_1^n \ln\frac{K}{L^n} + \beta_2^n \ln\frac{L^p}{L^n} + \lambda^n S^n . \qquad (4')$$

These equations can be considered as Taylor's expansions of equations (2), (3), and (4), respectively. Only estimates of γ and λ are reported in Table 2 and 3 because other estimates are almost same as the estimates of the corresponding original non-linear equations.

[4] In this respect, plant age was also included in each equation. However, because the coefficients on this variable were not statistically significant, results of regressions excluding this are reported in this paper.

[5] For example, Sjöholm (1999) suggests that Indonesian manufacturing exporters have higher productivity than non-exporters in 1991.

exporters to facilitate estimation of a non-linear regression model.

4. The Plant-Level Data for Indonesian Manufacturing

The data file used in this paper was created from plant-level datasets of Indonesian manufacturing sector underlying the industrial survey for *Large and Medium Manufacturing Statistics*. Indonesian Central Bureau of Statistics has conducted the survey annually since 1975. The industrial survey covers almost manufacturing plants employing 20 or more workers. The survey information includes the number of various types of workers (production workers, non-production workers, unpaid workers by sex and by educational attainment), remuneration to each type of workers,[6] foreign equity share, export ratios and starting year of commercial production, as well as value added, output, capital stock, operating ratios, and other information on each plant.[7] The dataset for a certain year is mainly cross-sectional, but plant-level panels can be created using a plant identification code. Before creating the data file, a panel dataset was created and the time-wise variation of variables was examined in order to check for errors in the original data and for outliers.[8] Characteristics of the datasets and the methodology used to eliminate outliers and inconsistent entries from sample used in this paper are detailed in Appendix 1.

Only datasets for 1995-1997 contain information on the number of workers and total remuneration by educational attainment. The quality of data on educational attainment in 1995 seemed relatively poor compared with data for other years, and the behavior of Indonesian manufacturing plants in 1997 might be different from normal behavior because the economy was hit by the Asian economic crisis. For these reasons, this paper focuses on the dataset for 1996. In addition, the analysis in this paper was restricted to five industries (textiles, footwear, metal products, electric machinery, and transportation equipment. The analysis was also restricted to a few selected regions that contained a large number of plants in each of the selected industries because earnings differentials among regions appear to be relatively large in Indonesia.

Table 1 shows the descriptive statistics for plants in the industries selected for analysis in this paper. Three or four regions account for more than seventy percent of total value added and employment in each industry with the shares of West Java and DKI Java being particularly high (columns 1-2). Exporters' shares of value added and employment are high in both textiles and footwear, both absolutely and compared to shares of exporters in number of plants. The number of plants in the sample after eliminating plants with inconsistent entries like outliers is about one-third of the total number of plants in each industry (column 4). The large reduction in the number is mainly due to a large number of missing values on capital stock in the dataset for 1995. Average value added per worker, calculated as the average of value added per worker for each plant, is relatively high in West Java, DKI

[6] As indicated in the previous section, remuneration is not available by educational attainment level.

[7] The capital stock variable used in this analysis was calculated using the perpetual inventory method, a series on fixed investment, and a series of capital stock in book value as explained in Appendix 1. The definitions of other variables used in this analysis are listed in Appendix 2.

[8] The panel dataset is also helpful because it enables us to use information on a plant in past or future years. For example, the beginning of period capital stock is defined as the end of period capital stock from the previous year because datasets only contain information on end of period capital stocks.

Jakarta, and Batam Island (column 5).[9] There is variation in value added per worker among regions, but the variation is relatively small in footwear. In regions with relatively high value added per worker, the average capital stock per worker is also relatively high (columns 5, 6). Exporters in textiles and footwear also have higher productivity and capital intensity than industry averages, but the differences are relatively small in footwear.

Average earnings for non-production workers are about twice as high as for production workers (columns 7-8). Average earnings are generally high in DKI Jakarta and West Java compared to other regions. The exception is Batam Island, where average earnings are about twice as high as the average in electric machinery. Earnings are also higher in exporters than in non-exporters in textile and footwear. These estimates of earnings are then compared with corresponding measures calculated from wage data published by Central Bureau of Statistics (1997; column 9). These estimates appear to be somewhat different than estimates from the wage data and this is not surprising given differences in periods and definitions used in the two sources.[10] However, both estimates reveal similar regional disparities in earnings.

Columns 10-11 shows average shares of total production workers and in total non-production worker employed in a plant. Average shares of more educated workers in all workers generally exceed 60 percent for non-production workers, with the exception of a few regions in textiles. Corresponding shares for production workers are lower than for non-production workers, but were relatively high in electric machinery and transportation equipment compared with other industries. The average shares of more educated workers in all workers are higher in West Java and DKI Jakarta than in other regions. Thus, in regions where a relatively large number of more educated workers are employed, plants tend to pay more and to have higher productivity than plants in other regions. Exporters also tend to employ a relatively larger number of more educated workers.

5. Empirical Results

Results of estimating equations (2), (3), and (4) for each industry are shown in Table 2. The point estimate of γ^p for textiles is 0.63 and statistically significant, implying that the marginal product of more educated production workers was 1.63 times higher than for less educated production worker on average. On the other hand, the point estimate of λ^p was 0.12 and statistically significant in textiles, implying that more educated production workers earned 1.12 times more than educated production workers in this industry. The hypothesis $\gamma^p = \lambda^p$ was rejected at the 10 percent significance level. These results thus imply that earnings differentials were smaller than productivity differentials in textiles. Similar results were obtained for metal products. In electric machinery, the estimate of γ^p in the non-linear regression model was large but statistically insignificant, while λ^p was smaller than the γ^p and statistically significant. However, in linear regression estimates, which are reported in the lower part of Table 2, the estimate of γ^p was significantly positive and the hypothesis

[9] Batam island is an export processing zone in Liau province near Singapore, where is called as a corner of the growth triangle with Singapore and Johor Bahru. Regarding the growth triangle, see Pangestu (1991).

[10] In the wage data, annual average earnings as estimated from weekly data for production workers while the industrial surveys provide data on an annual basis. In the wage data, the definitions of textiles and footwear are somewhat broader than in the industrial surveys and the other industries category is defined to include ceramics and metals.

$\gamma^p = \lambda^p$ was rejected at 10 percent significance level, suggesting that productivity differentials may have been smaller than earnings differentials in this industry as well. Results for transportation equipment are similar with the results for electric machinery, but the hypothesis $\gamma^p = \lambda^p$ was not rejected. The estimates of γ^p and λ^p were not significant for footwear. From these results, more educated production workers seems to be paid more than less educated workers, but earnings differential appear to be smaller than productivity differentials in textiles, metal products, and perhaps electric machinery.

Corresponding results for non-production workers differed from the results for production workers in some industries. For example, both non-linear and linear estimates for metal products and the linear estimates for electric machinery indicated that the estimates of λ^n were significantly positive while the estimates of γ^n were negative and insignificant. Furthermore, the hypothesis of $\gamma^n = \lambda^n$ was rejected in the non-linear estimates for electric machinery. These results imply that earnings differentials were larger than productivity differentials for non-production workers in these industries. On the other hand, the estimates of γ^n were greater than the estimates of λ^n for textiles and footwear, and the hypothesis $\gamma^n = \lambda^n$ was rejected based in linear estimates for textiles, implying that earnings differentials were larger than productivity differentials in these industries.

Table 3 presents the estimates for exporters and non-exporters in textiles and footwear. For production workers, estimates of γ^p and λ^p for non-exporters in the two industries were significantly positive, and estimates of γ^p exceeded estimates of λ^p. Although the difference was statistically significant only in footwear, there is thus weak evidence that more educated production workers in these industries received a smaller earnings premium than justified by productivity differentials in non-exporters. In contrast, estimates of γ^p and λ^p were of similar magnitude for exporters in these two industries, and the hypothesis $\gamma^p = \lambda^p$ could not be rejected. These results imply that the earnings premium for more educated production workers in exporting plants was similar to the premium justified by differences in productivity. However, it is somewhat surprising that the estimate of λ^p for exporters in textiles was significantly negative, implying that earnings for more educated production workers were lower than for less educated production workers. One possible cause of this result would be if more educated workers worked shorter hours than less educated workers. It might also be that less educated workers were well trained in exporting plants.

The results for non-production workers in non-exporting plants were similar to the results for production workers. The non-linear estimates of γ^n were not significant, but the linear estimates were statistically significant and greater than the estimates of λ^n. Using linear estimates the hypothesis $\gamma^n = \lambda^n$ was rejected for textiles. In contrast, results for non-production workers in exporting plants were not clear. All estimates of γ^n and γ^n were not significant. From these results, it seems that non-exporters were less efficient than exporters in the two industries in the sense that they were not employing the appropriate mix of more educated and less educated workers, which would equate relative earnings and relative marginal products.

6. Concluding Remarks

This paper has examined questions of whether more educated workers were paid more than less educated workers, and whether earnings differentials between more educated and less educated workers reflect corresponding productivity differentials in Indonesian manufacturing plants in 1996. The results first indicated that more educated workers tend to be paid more than less educated workers, which is consistent with the findings of Lipsey and Sjöholm (2001). Second, these results suggest that the premium paid to more educated production workers tends to be smaller than the premium that would compensate for productivity differentials between more educated production workers and less educated production workers in most of the industries analyzed (textiles, metal products, electric machinery). In these cases, the results imply that plants could have increased profits by employing a relatively larger number of more educated workers than they actually employed. This finding is important given the observation of relatively high unemployment rates among more educated workers. Third, in contrast to the case of production workers, the premium paid to more educated non-production workers was larger than the premium necessary to compensate for productivity differentials between more educated and less educated non-production workers in some industries (metal products and electric machinery). This result implies that more educated non-production workers were generously paid, and is perhaps related to the fact that science courses were not popular with students. Fourth, non-exporters in textiles and footwear seem to have a relatively strong tendency to pay more educated workers a smaller wage premium than differences in relative productivity would justify, but this not the case for exporters in these industries. This result implies that non-exporters were less efficient than exporters in the sense that they were not employing the appropriate mix of more educated and less educated workers, which would equate relative earnings and relative marginal products.

Indonesian labor markets have long been thought to be inflexible in some respects. For example, a binding minimum wage and rigid employment practices by state-owned enterprises are often pointed to as problems. However, the findings in this paper indicate private plants, which dominate the samples used in this study, also use labor inefficiently in many cases. For example, it appears that plants in many industries could become more efficient by increasing the number of more educated production workers. Nonetheless, the results obtained here are often not that strong statistically and several topics remain for future research. First, state-owned plants are not explicitly identified in this paper because the data on state- ownership shares are quite poor. Efforts to clean up these data and then explicitly analyzed the role of state-owned plants could be important in some industries such as metal products. Second, the causes of the observed results are not sufficiently clear. For example, some plants may hire a less than optimal number of more educated production workers because they lack access to new technology and therefore have relatively low demand for skilled labor. Yet, this is apparently not a problem in exporting plants and this suggests that the promotion of exports might be one means to reduce this type of inefficiency. However, before this policy recommendation can be made further investigation into the causes of plant inefficiency are necessary.

Appendix

A.1 Data Processing and Cleaning

Value added

In the Indonesian "Large and Medium Manufacturing Statistics", *value added* is defined as the difference between *output* and *input*. The former is calculated as the sum of production, the increase in stock of non-finished products, the sale of electricity, and other income (e.g. manufacturing service and the sale of goods without modifications). The latter is calculated as the sum of the value of intermediate goods and energy used during the year, and other costs. All records in the 1996 dataset defined these terms consistently.

In order eliminate outliers, some plants were eliminated from the sample examined in this analysis. After calculating the logarithm of value added per worker for each plant, if the absolute value of the difference between a plant's value added per worker and the average value added per worker in the region and industry that the plant belonged to was greater than the 1.96 times the corresponding standard deviation, then the plant was dropped from the sample. When the shares of value added for electric machinery presented in Table 1 were calculated, a plant in DKI Jakarta was dropped from total sample because the plant's value added was extremely high and seemingly implausible.

Capital stock

There are two types of data on capital stock available, book values and estimated values. The book value measure was used in this analysis because book values are available for more plants than are estimated values, and because the definition of estimated value is ambiguous. Note that for some plants book values and estimated values are equal. Data on capital stock depreciation are also available and the capital stock can be classified into five types (land, buildings, vehicles, machinery, and other items).

The relationship of capital stock in book value and investment can be expressed in the following form:

$$K_t^n = I_t + (1-\delta)K_{t-1}^n, \qquad \text{(A1)}$$

where K_t^n is the nominal capital stock in year t, I_t is nominal investment in year t, and δ is the depreciation rate. Because this definition of the capital stock does not account for the change in the price of capital goods over time and Indonesia's wholesale price index, for example, increased about four times during 1980-1997, an estimate of the real capital stock, K_t was constructed as follows:

$$K_t = \frac{K_t^n}{p_t} + \sum_{i=s}^{t-1}(1-\delta)^{t-i}\left(\frac{1}{p_i} - \frac{1}{p_{i+1}}\right)K_i^n \ . \qquad \text{(A2)}$$

This equation can be obtained by substituting the definition of investment in year t, $I_t = K_t^n - (1-\delta)K_{t-1}^n$ (from Equation (A1)), into a definition of the real capital stock in year t, $K_t = \Sigma_{i=s}^{t}(1-\delta)^{t-i} I_i / p_i$, where p_i is the price of capital goods in year i, and s is the year when a plant started production.[11] For the calculation of Equation (A2), the series of K_t^n in the past

[11] Strictly speaking, a plant invests for a few years before starting production. However, the real capital stock was calculated using Equation (A2) for simplicity.

years are needed, and data on capital stock are available in the datasets for 1988-1995, and 1997. However, the capital stock data in these datasets contain several apparent errors and many missing values. Therefore, before calculating the real capital using Equation (A2), the data were checked.

First, in order to be included in the samples used in this paper, a plant had to satisfy all five of the following conditions: (1) values of the capital stock and depreciation for plant *i* in year *t* differed from corresponding values for year *t-1*; (2) a regression of the logarithm of value added on a constant, the logarithm of the nominal capital stock, and the logarithm of the starting year of production was run two times---if the absolute value of the residual for plant *i* from the first regression was less than 1.96 times the standard error of the regression the plant was tentatively included and a second regression was run--- if the absolute value of the residual for plant *i* from the first regression was less than 2.326 times the standard error of the regression the plant was included; (3) a regression of the logarithm of the nominal capital stock on a constant, the logarithm of the number of workers, and the logarithm of the starting year of production was run two times---if the absolute value of the residual for plant *i* from the first regression was less than 1.96 times the standard error of the regression the plant was tentatively included and a second regression was run--- if the absolute value of the residual for plant i from the first regression was less than 2.326 times the standard error of the regression the plant was included; (4) the annual rate of increase of the capital stock was less than 100 percent in year *t* and more than -50 percent in year *t-1*; and (5) the annual rate of increase of the capital stock was more than -50 percent in year *t* and less than 100 percent in year *t-1*. Condition (1) is used to exclude plants that reported the same values in two years running or for which values in year *t* were estimated to be equal to values for year *t-1*. Conditions (2) and (3) were used to identify and exclude extreme outliers in regressions for each industry and region. Conditions (4) and (5) were used to exclude apparently unrealistic fluctuations in the capital stock over time.

Using the data remaining after using conditions (1) to (5) to exclude apparently unrealistic values, missing capital stock values were then estimated as possible. Specifically, if data were missing for two years of less, missing data were linearly interpolated using data for adjacent years. If data were missing for more than two years, the missing values and data for previous years were extrapolated from data years following the years that were missing. Then, the capital stock was calculated for all types of capital except land (buildings, vehicles, machinery, and other items) using Equation (A2). Depreciation rates for each type of capital were taken from Goeltom (1995).[12] The GDP deflator for construction was used to deflate investment in buildings, and wholesale price indices for non-electric machinery, cars, and all goods were used as deflators for investment in machinery, vehicles, and other items, respectively. The total capital stock for 1995 was then estimated as the sum of these types of capital.[13]

However, there were still some plants with extremely high or low values of capital per worker, even after the above calculations and accounting for variations in the operating rate. These outliers were also eliminated from the samples used in this analysis. Specifically, plants for which the absolute value of the difference between logarithm of capital per worker less the corresponding mean for relevant region and industry was more than 1.96 times the corresponding standard deviation. Moreover, this procedure was repeated two times to

[12] Deprecation rates were 0.033 for buildings, 0.1 for machinery, and 0.2 for vehicles and other types of capital.
[13] Land was excluded because the data on land seemed to be of very poor quality.

remove the impact of outliers on the procedure. Finally, plants reporting an operating ratio less than 20 percent were also dropped from the sample.

Labor

Workers employed in a plant are first classified as unpaid workers and paid workers. Paid workers are then classified as production workers or non-production workers. Production and non-production workers are then classified into eight categories by educational attainment (primary school not finished, primary school, junior high school, senior high school, non-degree diploma, Bachelor of Arts or equivalent, Master of Arts or equivalent, Ph.D. or equivalent).[14] Each type of worker can be also classified by sex but distinctions by sex were not examined in this paper.

The employment data were processed as follows. First, the total number of workers employed in a plant was defined as the number of paid workers for simplicity.[15] Second, production and non-production workers were classified as more educated workers if they finished senior high school and less educated workers if they did not. Third, various identities (total production workers = more educated workers + less educated workers), were checked to identify inconsistent records but no inconsistent records were found in the 1996 dataset. A few inconsistent entries were found in the 1995 dataset, however. Fourth, if the share of more educated workers in a category of workers in year *t* was 10 percentage points or more different from year *t-1* and the change in the number of more educated workers and less educated workers were both greater than 14, and one category increased while the other decreased, then data for either or both years were eliminated from the sample examined in this analysis. Fifth, although the process was somewhat arbitrary, data on educational attainment were examined closely for related plants, and plants with large fluctuations in the shares of more educated workers were dropped from the sample. An example of plants dropped in this process is a plant reported having 22 more educated production workers in 1995, 138 in 1996, and 21 in 1997, and having 5 less educated production workers in 1995, 13 in 1996, and 2 in 1997.

Remuneration

Data on remuneration to production workers and non-production workers are available for each plant, but data on remuneration to individual workers are not available. Remuneration includes wages and salaries as well as payments for pensions, social security, insurance, accident allowances, and other miscellaneous items. Data on cash payments and payments in kind are available each type of remuneration. In this analysis remunerations was defined as the sum of all items in cash and in kind.

Data on remuneration were processed as follows. First, potential identities were checked but there were no records that failed to satisfy the relevant identities during the period analyzed. Second, the consistency of remuneration and employment data was checked but there were only a few records that were inconsistent.[16] Third, similar to the procedure used in the capital stock, a regression of the logarithm of remuneration to a type of worker (production, non-production) on a constant, and the logarithm of the number of a type of

[14] See Oey-Gardiner (1997, pp.136-138) for the school system in Indonesia, for example.

[15] The number of unpaid workers was usually zero and almost never very large.

[16] For example, a record with the positive number of non-production workers and no remuneration to non-production workers is inconsistent.

workers, was run two times---if the absolute value of the residual for plant i from the first regression was greater than 1.96 times the standard error of the regression the plant was tentatively excluded and a second regression was run--- if the absolute value of the residual for plant i from the first regression was greater than 2.326 times the standard error of the regression the plant was excluded.

A.2 The definitions of variables

Variable	Definition
V	Value added.
K	Operating capital stock, calculated as the product of operating ratio and the capital stock at the beginning of the period (1996), calculated by perpetual inventory method from data on capital stock in book value (see Equation A2).
L^p	The total number of production workers
L_o^p , L_1^p	The number of production workers that did not finish senior high school, and the number of production workers that finished senior high school, respectively.
S^p	The share of production workers that finished senior high school in total production workers.
L^n	The total number of non-production workers in each plant
L_0^n , L_1^n	The number of non-production workers that did not finished senior high school, and the number of non-production workers that finished senior high school.
S^n	The share of production workers that finished senior high school in total production workers.
R^p	Total payment to production workers for each plant.
R^n	Total payment to non-production workers for each plant.
O_{-1}	Output in the previous year (1995)

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Table 1
Descriptive statistics by industry and region in 1996

	Share of value added in the industry (%)	Share of Labor in the industry (%)	The number of plants in Indonesia	The number of plants examined in this analysis	Average value added per worker (1,000 rupiah)	Average capital stock per worker (1,000 rupiah)
Sample	all	all	all	examined	examined	examined
Column No.	(1)	(2)	(3)	(4)	(5)	(6)
Textiles (ISIC=321)	98.9	95.8	2,255	680	5,257	6,601
Exporters	68.1	53.8	366	112	9,243	12,974
West Java	68.7	59.4	1,022	449	6,219	7,799
DKI Jakarta [1)]	7.7	4.4	143	26	6,929	5,991
East Java	2.2	5.9	244	64	2,843	4,789
Central Java	20.2	26.0	566	141	2,980	3,721
Footwear (ISIC=324)	98.9	96.9	420	117	5,146	3,899
Exporters	89.3	85.4	139	51	6,081	4,326
West Java	65.0	68.1	161	54	5,729	4,655
DKI Jakarta	3.5	3.9	67	17	6,295	3,112
East Java	30.4	24.8	162	46	4,036	3,301
Metal products (ISIC=381)	77.1	88.2	1,052	293	10,212	7,602
West Java	47.4	37.9	354	131	13,891	10,211
DKI Jakarta	13.7	16.9	169	51	11,689	7,787
East Java	14.1	27.9	245	79	5,857	5,042
Central Java	1.9	5.5	142	32	3,545	2,947
Electric machinery (ISIC=383)	72.5	77.7	498	130	14,965	10,406
West Java	43.9	43.2	235	80	14,513	10,010
East Java	3.8	9.0	75	25	7,012	6,619
Batam Island [2)]	24.8	25.4	68	25	24,365	15,457
Transportation equipment (ISIC=384)	97.5	85.0	619	134	11,531	10,897
West Java	34.0	36.2	170	55	15,191	9,238
DKI Jakarta	57.7	30.4	89	25	18,459	27,464
East Java	5.8	18.4	192	54	4,597	4,918

Source) Author's calculation from Central Bureau of Statistics (1997, various years a). 1) "DKI Jakarta" is Special Capital Destrict of Jakarta. 2) Batam Island is an export processing zone in Riau province. 3) Weekly wage for production workers is from Centarl Bureau of Statistics (1997). Figures for tekstil (textile) and Keramik/Kogam (ceramics/metal) in the publications are presented in the row for the first two industries and others, respectively. Figures for other sumatra are presented in the row for Batam Island.

Table 1 (continued)

Descriptive statistics by industry and region in 1996

	Average earnings for prod. workers (1,000 rupiah)	Ave. earnings for non-prod. workers (1,000 rupiah)	Weekly wage for prod. workers times 52 [3] (1,000 rupiah)	Average shares of more educated prod. workers (%)	Ave. shares of more educated non-prod. workers (%)
Sample	examined	examined	examined	examined	examined
Column No.	(7)	(8)	(9)	(10)	(11)
Textiles (ISIC=321)	1,859	3,513	2,163	21.7	64.2
Exporters	2,569	6,161	-	40.6	75.2
West Java	2,106	3,912	2,475	25.6	68.3
DKI Jakarta	2,470	5,255	2,350	25.7	77.6
East Java	1,397	2,773	1,997	15.3	49.5
Central Java	1,171	2,254	1,555	11.5	55.5
Footwear (ISIC=324)	2,027	4,313	2,163	29.6	80.0
Exporters	2,236	5,722	-	39.5	84.1
West Java	2,284	5,568	2,475	30.7	83.1
DKI Jakarta	2,297	4,683	2,350	11.2	87.9
East Java	1,625	2,702	1,997	35.2	73.5
Metal products (ISIC=381)	2,558	5,475	2,600	33.6	77.0
West Java	2,892	6,517	2,954	36.8	79.5
DKI Jakarta	3,215	7,202	3,323	34.2	83.0
East Java	2,021	3,951	2,054	31.5	68.0
Central Java	1,469	2,220	1,867	25.3	79.1
Electric machinery (ISIC=383)	3,498	8,229	2,600	63.6	84.7
West Java	2,877	6,443	2,954	56.8	82.9
East Java	2,276	4,840	2,054	52.8	78.6
Batam island	6,708	17,334	4,529	96.3	96.4
Transportation equipment (ISIC=384)	2,709	5,381	2,600	48.2	80.5
West Java	2,965	5,802	2,954	51.1	84.7
DKI Jakarta	4,188	8,312	3,323	67.3	84.7
East Java	1,764	3,596	2,054	36.5	74.3

Table 2

The nonlinear SUR estimation results of productivity equation and earnings equations

Industry		Textiles (Number of observations = 680)			Footwear (Number of observations = 117)		
Dependent variable		Value added per production worker, $\ln(V/L^p)$	Remuneration to production worker, $\ln(R^p/L^p)$	Remuneration to non production worker, $\ln(R^n/L^n)$	Value added per production worker, $\ln(V/L^p)$	Remuneration to production worker, $\ln(R^p/L^p)$	Remuneration to non production worker, $\ln(R^n/L^n)$
Independent variables	Coeff.						
Constant	$\ln(A)$, β_0	5.20 (0.32)***	5.98 (0.16)***	4.73 (0.25)***	6.72 (0.81)***	6.26 (0.40)***	5.22 (0.61)***
$\ln(1+\gamma^p S^p)$	α	0.65 (0.04)***			0.70 (0.07)***		
$\ln(1+\gamma^n S^n)$, $\ln(L^n/L^p)$	β	0.23 (0.03)***			0.31 (0.07)***		
$\ln(L^p)$	Θ	0.12 (0.02)***			0.13 (0.03)***		
$\ln(K/L^p)$ or $\ln(K/L^n)$	β_k		0.06 (0.01)***	0.07 (0.02)***		0.04 (0.03)	0.07 (0.05)
$\ln(L^n/L^p)$ or $\ln(L^p/L^n)$	β_l		0.03 (0.02)**	0.03 (0.03)		0.04 (0.03)	0.06 (0.05)
$\ln(O_{-1})$	β_s		0.06 (0.01)***	0.15 (0.01)***		0.07 (0.01)***	0.12 (0.02)***
$S^p = L^p_{-1}/L^p$	γ^p, λ^p	0.63 (0.26)**	0.12 (0.06)**		0.41 (0.38)	0.05 (0.10)	
$S^n = L^n_{-1}/L^n$	γ^n, λ^n	0.79 (0.57)		0.14 (0.06)**	1.55 (1.72)		0.38 (0.19)**
DKI Jakarta		0.19 (0.12)	0.11 (0.06)*	0.33 (0.09)***	0.39 (0.15)***	0.15 (0.07)**	0.07 (0.11)
East Java		-0.38 (0.08)***	-0.28 (0.04)***	-0.26 (0.07)***	-0.12 (0.11)	-0.26 (0.05)***	-0.47 (0.08)***
Central Java		-0.34 (0.06)***	-0.49 (0.03)***	-0.45 (0.05)***			
Sub-industry Dummy 1		-0.11 (0.07)	-0.03 (0.04)	-0.04 (0.06)	-0.07 (0.17)	0.08 (0.08)	-0.07 (0.12)
Sub-industry Dummy 2		0.16 (0.07)**	0.02 (0.03)	0.15 (0.05)***			
Sub-industry Dummy 3		0.00 (0.09)	-0.18 (0.04)***	0.09 (0.07)			
(Adjusted R squared)		0.50	0.57	0.47	0.40	0.47	0.61
Hypothesis tests		Joint test (H^p, H^n)	$H^p: \gamma^p = \lambda^p$	$H^n: \gamma^n = \lambda^n$	Joint test (H^p, H^n)	$H^p: \gamma^p = \lambda^p$	$H^n: \gamma^n = \lambda^n$
Wald test statistics (p-value)		0.041 **	0.071 *	0.225	0.326	0.475	0.450
Results of the linearized models (see Footnote 1)							
$S^p = L^p_{-1}/L^p$	γ^p, λ^p	0.43 (0.18)**	0.11 (0.05)**		0.33 (0.28)	0.05 (0.09)	
$S^n = L^n_{-1}/L^n$	γ^n, λ^n	0.69 (0.30)**		0.13 (0.05)***	0.87 (0.57)		0.33 (0.13)**
Hypothesis tests		Joint test (H^p, H^n)	$H^p: \gamma^p = \lambda^p$	$H^n: \gamma^n = \lambda^n$	Joint test (H^p, H^n)	$H^p: \gamma^p = \lambda^p$	$H^n: \gamma^n = \lambda^n$
Wald test statistics (p-value)		0.009 ***	0.097 *	0.050 *	0.331	0.376	0.358

Notes) Standard errors reported in parentheses and wald test statistics are based on White's adjustment for heteroskedasticity (White, 1980, and Davidson and MacKinnon, 1993). Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively. Sub-industry dummies 1, 2, and 3 represents dummies for ISIC=3212, 3213-3215, and 3216+3219 respectively for textiles, and ISIC=3242 for footwear.

Table 2 (continued)

The nonlinear SUR estimation results of productivity equation and earnings equations

Industry		Metal products (Number of observations = 293)			Electric machinery (Number of observations = 130)		
Dependent variable		Value added per production worker, $\ln(V/L^p)$	Remuneration to production worker, $\ln(R^p/L^p)$	Remuneration to non production worker, $\ln(R^n/L^n)$	Value added per production worker, $\ln(V/L^p)$	Remuneration to production worker, $\ln(R^p/L^p)$	Remuneration to non production worker, $\ln(R^n/L^n)$
Independent variables	Coeff.						
Constant	$\ln(A)$, β_0	6.30 (0.66)***	5.62 (0.28)***	5.70 (0.47)***	7.73 (0.97)***	6.76 (0.46)***	4.17 (0.88)***
$\ln(1+\gamma^p S^p)$	α	0.74 (0.07)***			0.50 (0.10)***		
$\ln(1+\gamma^n S^n)$, $\ln(L^n/L^p)$	β	0.22 (0.06)***			0.56 (0.09)***		
$\ln(L^p)$	Θ	0.14 (0.05)***			0.18 (0.06)***		
$\ln(K/L^p)$ or $\ln(K/L^n)$	β_k		0.05 (0.02)***	-0.01 (0.03)		0.06 (0.03)**	0.09 (0.06)
$\ln(L^n/L^p)$ or $\ln(L^p/L^n)$	β_l		0.07 (0.02)***	0.01 (0.04)		0.12 (0.04)***	-0.03 (0.08)
$\ln(O_{-1})$	β_s		0.10 (0.01)***	0.18 (0.02)***		0.02 (0.02)	0.18 (0.03)***
$S^p = L^p_{-1}/L^p$	γ^p, λ^p	1.26 (0.47)***	0.21 (0.07)***		2.14 (1.82)	0.42 (0.16)**	
$S^n = L^n_{-1}/L^n$	γ^n, λ^n	-0.14 (0.55)		0.61 (0.17)***	-0.20 (0.39)		0.68 (0.44)
DKI Jakarta | Batam Island		-0.01 (0.12)	0.13 (0.05)***	0.11 (0.08)	0.45 (0.22)**	0.74 (0.1)***	0.69 (0.19)***
East Java		-0.42 (0.11)***	-0.15 (0.04)***	-0.29 (0.08)***	-0.31 (0.18)*	-0.17 (0.08)**	-0.09 (0.15)
Central Java		-0.64 (0.15)***	-0.31 (0.06)***	-0.74 (0.11)***			
Sub-industry Dummy 1		0.10 (0.15)	-0.02 (0.06)	0.13 (0.10)	-0.25 (0.21)	-0.1 (0.09)	-0.33 (0.18)*
Sub-industry Dummy 2		0.30 (0.15)**	0.18 (0.06)***	-0.03 (0.10)	0.01 (0.41)	-0.28 (0.18)	0.18 (0.36)
Sub-industry Dummy 3		0.17 (0.12)	0.01 (0.05)	0.20 (0.09)**	-0.13 (0.19)	-0.16 (0.09)*	-0.06 (0.16)
(Adjusted R squared)		0.45	0.59	0.49	0.48	0.63	0.45
Hypothesis tests		Joint test (H^p, H^n)	H^p: $\gamma^p=\lambda^p$	H^n: $\gamma^n=\lambda^n$	Joint test (H^p, H^n)	H^p: $\gamma^p=\lambda^p$	H^n: $\gamma^n=\lambda^n$
Wald test statistics (p-value)		0.031 **	0.023 **	0.165	0.12	0.322	0.049 **
Results of the linearized models (see Footnote 1)							
$S^p = L^p_{-1}/L^p$	γ^p, λ^p	0.68 (0.21)***	0.18 (0.06)***		1.38 (0.58)**	0.35 (0.11)***	
$S^n = L^n_{-1}/L^n$	γ^n, λ^n	-0.15 (0.64)		0.44 (0.10)***	-0.32 (0.50)		0.49 (0.24)**
Hypothesis tests		Joint test (H^p, H^n)	H^p: $\gamma^p=\lambda^p$	H^n: $\gamma^n=\lambda^n$	Joint test (H^p, H^n)	H^p: $\gamma^p=\lambda^p$	H^n: $\gamma^n=\lambda^n$
Wald test statistics (p-value)		0.052 *	0.024 **	0.329	0.094 *	0.081 *	0.101

Notes) Sub-industry dummies 1, 2, and 3 represents dummies for ISIC=3812, 3813, and 3819 respectively for metal products, and ISIC=3832, 3833, 3839, respectively for electric machinery.

Table 2 (continued)

The nonlinear SUR estimation results of productivity equation and earnings equations

Industry		Transportation equipment (Number of observations = 134)		
Dependent variable		Value added per production worker, $\ln(V/L^p)$	Remuneration to production worker, $\ln(R^p/L^p)$	Remuneration to non production worker, $\ln(R^n/L^n)$
Independent variables	Coeff.			
Constant	$\ln(A)$, β_0	5.97 (0.82)***	5.76 (0.46)***	5.66 (0.61)***
$\ln(1+\gamma^p S^p)$	α	0.68 (0.10)***		
$\ln(1+\gamma^n S^n)$, $\ln(L^n/L^p)$	β	0.28 (0.08)***		
$\ln(L^p)$	Θ	0.19 (0.06)***		
$\ln(K/L^p)$ or $\ln(K/L^n)$	β_k		0.07 (0.03)*	-0.06 (0.05)
$\ln(L^n/L^p)$ or $\ln(L^p/L^n)$	β_l		0.10 (0.04)**	0.19 (0.06)***
$\ln(O_{-1})$	β_s		0.08 (0.02)***	0.22 (0.03)***
$S^p = L^p_{-1}/L^p$	γ^p, λ^p	0.88 (0.60)	0.23 (0.14)*	
$S^n = L^n_{-1}/L^n$	γ^n, λ^n	-0.47 (0.39)		0.16 (0.19)
DKI Jakarta		-0.06 (0.17)	0.17 (0.09)*	0.25 (0.12)**
East Java		-0.71 (0.14)***	-0.27 (0.08)***	-0.3 (0.10)***
Sub-industry Dummy 1		-0.14 (0.29)	0.11 (0.15)	0.08 (0.21)
Sub-industry Dummy 2		-0.16 (0.29)	0.10 (0.16)	-0.05 (0.21)
Sub-industry Dummy 3		-1.32 (0.73)*	-0.05 (0.39)	-0.35 (0.52)
(Adjusted R squared)		0.58	0.56	0.55
Hypothesis tests		Joint test (H^p, H^n)	H^p: $\gamma^p = \lambda^p$	H^n: $\gamma^n = \lambda^n$
Wald test statistics (p-value)		0.197	0.219	0.162
Results of the linearized models (see Footnote 1)				
$S^p = L^p_{-1}/L^p$	γ^p, λ^p	0.61 (0.33)*	0.22 (0.11)*	
$S^n = L^n_{-1}/L^n$	γ^n, λ^n	-0.44 (0.78)		0.14 (0.16)
Hypothesis tests		Joint test (H^p, H^n)	H^p: $\gamma^p = \lambda^p$	H^n: $\gamma^n = \lambda^n$
Wald test statistics (p-value)		0.350	0.189	0.453

Notes) Sub-industry dummies 1, 2, and 3 represents dummies for ISIC=3843, 3844, and 3845 respectively.

Table 3

The estimation results by exporting status for Textiles

Group		Non-exporters (Number of observations = 568)			Exporters (Number of observations = 112)		
Dependent variable		Value added per production worker, $\ln(V/L^p)$	Remuneration to production worker, $\ln(R^p/L^p)$	Remuneration to non production worker, $\ln(R^n/L^n)$	Value added per production worker, $\ln(V/L^p)$	Remuneration to production worker, $\ln(R^p/L^p)$	Remuneration to non production worker, $\ln(R^n/L^n)$
Independent variables	Coeff.						
Constant	$\ln(A)$, β_0	5.47 (0.42)***	6.09 (0.19)***	5.09 (0.31)***	6.42 (1.00)***	6.67 (0.43)***	5.09 (0.31)***
$\ln(1+\gamma^p S^p)$	α	0.65 (0.05)***			0.60 (0.10)***		
$\ln(1+\gamma^n S^n)$, $\ln(L^n/L^p)$	β	0.23 (0.04)***			0.18 (0.09)**		
$\ln(L^p)$	Θ	0.10 (0.03)***					
$\ln(K/L^p)$ or $\ln(K/L^n)$	β_k		0.05 (0.02)***	0.07 (0.02)***		0.07 (0.03)**	0.02 (0.06)
$\ln(L^n/L^p)$ or $\ln(L^p/L^n)$	β_l		0.02 (0.02)	0.04 (0.03)*		0.07 (0.04)	0.08 (0.10)
$\ln(O_{-1})$	β_s		0.06 (0.01)***	0.12 (0.01)***		0.03 (0.02)	0.08 (0.05)
$S^p = L^p_{-1}/L^p$	γ^p, λ^p	0.59 (0.32)*	0.16 (0.06)**		-0.06 (0.42)	-0.19 (0.09)**	
$S^n = L^n_{-1}/L^n$	γ^n, λ^n	0.80 (0.55)		0.17 (0.05)***	1.02 (3.80)		-0.26 (0.20)
DKI Jakarta		0.29 (0.16)*	0.11 (0.08)	0.40 (0.11)***	-0.08 (0.16)	0.11 (0.13)	0.25 (0.11)**
East Java		-0.40 (0.07)***	-0.29 (0.05)***	-0.32 (0.08)***	-0.36 (0.21)*	-0.17 (0.07)**	-0.06 (0.16)
Central Java		-0.33 (0.06)***	-0.49 (0.03)***	-0.43 (0.05)***	-0.41 (0.16)***	-0.33 (0.09)***	-0.70 (0.16)***
Sub-industry Dummy 1		-0.09 (0.07)	-0.02 (0.04)	0.00 (0.06)	-0.33 (0.15)**	-0.14 (0.10)	-0.43 (0.17)**
Sub-industry Dummy 2		0.19 (0.08)**	0.02 (0.04)	0.24 (0.06)***	-0.12 (0.14)	-0.06 (0.08)	-0.36 (0.15)**
Sub-industry Dummy 3		-0.01 (0.08)	-0.21 (0.06)***	0.10 (0.08)	-0.06 (0.31)	0.11 (0.10)	0.00 (0.27)
(Adjusted R squared)		0.46	0.57	0.45	0.29	0.29	0.26
Hypothesis tests		Joint test (H^p, H^n)	H^p: $\gamma^p = \lambda^p$	H^n: $\gamma^n = \lambda^n$	Joint test (H^p, H^n)	H^p: $\gamma^p = \lambda^p$	H^n: $\gamma^n = \lambda^n$
Wald test statistics (p-value)		0.108	0.159	0.236	0.812	0.746	0.737
Results of the linearized models (see Footnote 1)							
$S^p = L^p_{-1}/L^p$	γ^p, λ^p	0.43 (0.23)*	0.14 (0.06)**		-0.12 (0.46)	-0.19 (0.11)*	
$S^n = L^n_{-1}/L^n$	γ^n, λ^n	0.67 (0.29)**		0.15 (0.04)***	1.15 (1.66)		-0.26 (0.31)
Hypothesis tests		Joint test (H^p, H^n)	H^p: $\gamma^p = \lambda^p$	H^n: $\gamma^n = \lambda^n$	Joint test (H^p, H^n)	H^p: $\gamma^p = \lambda^p$	H^n: $\gamma^n = \lambda^n$
Wald test statistics (p-value)		0.037 **	0.198	0.071 *	0.860	0.411	0.585

Notes) Standard errors reported in parentheses and wald test statistics are based on White's adjustment for heteroskedasticity (White, 1980, and Davidson and MacKinnon, 1993). Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively. Sub-industry dummies 1, 2, and 3 represents dummies for ISIC=3212, 3213-3215, and 3216+3219 respectively.

Table 3 (continued)

The estimation results by exporting status for Footwear

Group		Non-exporters (Number of observations = 66)			Exporters (Number of observations = 51)		
Dependent variable		Value added per production worker, $\ln(V/L^p)$	Remuneration to production worker, $\ln(R^p/L^p)$	Remuneration to non production worker, $\ln(R^n/L^n)$	Value added per production worker, $\ln(V/L^p)$	Remuneration to production worker, $\ln(R^p/L^p)$	Remuneration to non production worker, $\ln(R^n/L^n)$
Independent variables	Coeff.						
Constant	$\ln(A)$, β_0	7.04 (0.9)***	5.98 (0.46)***	5.90 (0.76)***	8.38 (1.39)***	6.37 (0.68)***	4.41 (1.20)***
$\ln(1+\gamma^p S^p)$	α	0.57 (0.08)***			0.67 (0.10)***		
$\ln(1+\gamma^n S^n)$, $\ln(L^n/L^p)$	β	0.32 (0.08)***			0.40 (0.11)***		
$\ln(L^p)$	Θ				0.13 (0.07)*		
$\ln(K/L^p)$ or $\ln(K/L^n)$	β_k		0.08 (0.04)**	0.03 (0.05)		0.01 (0.05)	0.15 (0.08)*
$\ln(L^n/L^p)$ or $\ln(L^p/L^n)$	β_l		0.00 (0.04)	0.05 (0.04)		0.10 (0.06)	0.06 (0.1)
$\ln(O_{-1})$	β_s		0.05 (0.02)***	0.11 (0.02)***		0.09 (0.02)***	0.10 (0.05)*
$S^p=L^p_{-1}/L^p$	γ^p, λ^p	1.52 (0.83)*	-0.02 (0.11)		0.07 (0.41)	0.07 (0.16)	
$S^n=L^n_{-1}/L^n$	γ^n, λ^n	2.24 (1.69)		0.44 (0.13)***	-0.26 (0.63)		0.48 (0.66)
DKI Jakarta		0.67 (0.18)***	0.03 (0.08)	0.11 (0.11)***	0.10 (0.14)	0.56 (0.06)***	0.56 (0.11)***
East Java		0.09 (0.13)	-0.29 (0.05)***	-0.32 (0.08)***	-0.32 (0.15)**	-0.14 (0.09)	-0.54 (0.14)***
Sub-industry Dummy 1		0.01 (0.28)	-0.02 (0.04)	0.00 (0.06)	-0.18 (0.22)	0.21 (0.13)	-0.07 (0.20)
(Adjusted R squared)		0.44	0.55	0.65	0.41	0.37	0.49
Hypothesis tests		Joint test (H^p, H^n)	H^p: $\gamma^p=\lambda^p$	H^n: $\gamma^n=\lambda^n$	Joint test (H^p, H^n)	H^p: $\gamma^p=\lambda^p$	H^n: $\gamma^n=\lambda^n$
Wald test statistics (p-value)		0.064 *	0.048 **	0.297	0.728	0.995	0.436
Results of the linearized models (see Footnote 1)							
$S^p=L^p_{-1}/L^p$	γ^p, λ^p	1.04 (0.48)**	-0.01 (0.11)		0.06 (0.38)	0.06 (0.15)	
$S^n=L^n_{-1}/L^n$	γ^n, λ^n	1.15 (0.55)**		0.36 (0.09)***	-0.33 (0.93)		0.41 (0.40)
Hypothesis tests		Joint test (H^p, H^n)	H^p: $\gamma^p=\lambda^p$	H^n: $\gamma^n=\lambda^n$	Joint test (H^p, H^n)	H^p: $\gamma^p=\lambda^p$	H^n: $\gamma^n=\lambda^n$
Wald test statistics (p-value)		0.002 ***	0.016 **	0.170	0.758	0.991	0.479

Notes) Sub-industry dummies 1 represents a dummy for ISIC=3242.