Impact of Occupational Safety and Health Act 1994 Towards Labour Demand by the Manufacturing Sector: A Case Study in Kuala Lumpur and Selangor

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ABSTRACT

This article analyses the effects of labour market regulation, i.e., the Occupational Safety and Health Act (OSHA) 1994, and all its related regulations, on the demand for labour. The changes that these regulations induce in the technology and costs of production will affect labour demand in the manufacturing sector. The nation's growth in manufacturing output and trade has prompted concern for the effect of economic growth on occupational safety and health at the workplace. Regulatory stringency is expected to increase in Malaysia. Arguments against regulations are often framed in terms of tradeoff between jobs and accident occurrences. The results of this study showed that the introduction of OSHA 1994 has a significant impact on the demand for labour by firms. This study also shows that OSHA 1994 has different impacts on different types of industries in relation to labour demand.

ABSTRAK

Artikel ini menganalisis kesan peraturan pasaran buruh, iaitu Akta Keselamatan dan Kesihatan Pekerja (OSHA) 1994 serta peraturan yang berkait dengannya, terhadap permintaan buruh. Perubahan dalam teknologi dan kos pengeluaran kesan daripada wujudnya peraturan ini akan memberi kesan kepada permintaan buruh sektor pembuatan. Pertumbuhan output dan perdagangan yang dialami oleh sektor pembuatan telah menarik perhatian masyarakat tentang kesan pertumbuhan ekonomi terhadap keselamatan dan kesihatan pekerja di tempat kerja. Dengan itu, peraturan yang berkaitan dengan permasalahan ini dijangkakan meningkat di Malaysia. Hujah yang tidak menyokong peraturan ini selalunya dikaitkan dengan berlakunya perhubungan negatif antara kemalangan dan peluang pekerjaan. Hasil kajian ini menunjukkan pengenalan OSHA 1994 membawa kesan yang signifikan terhadap permintaan buruh oleh firma. Selanjutnya OSHA 1994 juga didapati memberi impak yang berbeza terhadap permintaan buruh bagi industri yang berbeza.

INTRODUCTION

The introduction of the Occupational Safety and Health Act 1994, or more commonly known as OSHA, and its related regulations, reflects the attitude of Malaysian workers towards the importance of safety and health at their workplace.

OSHA imposes upon every employer a duty to ensure the safety, health and welfare at work of all its employees, through the provision and maintenance of plant, systems of work and the working environment; the making of arrangement for ensuring the safe usage or operation, handling, storage and transport of plant and substances; the provision of information, instruction, training and supervision; and the provision and maintenance of the means of access to and egress from any place of work. Besides the above, the act imposes upon every employer a duty to formulate safety and health policy, and to form a safety and health committee at their place of work.

Although the introduction of OSHA is primarily aimed to reduce and prevent the occurrence of accidents, and to promote health and welfare of workers at the place of work, the issue of labour demand by firms cannot be avoided. The introduction of this act, i.e. a form of labour market regulation, may change the production methods of firms as well as their operation costs, and may eventually influence the labour demand by these firms. At the same time, the importance of safety and health can be linked to issue of productivity, where productivity of firms will increase as the rate of accident reduced.

Emphasis on industrialization is part of a long-term goal of achieving Malaysia's target to become a fully developed nation by year 2020. This strategy requires large-scale investments, including new machinery, equipment and technology. Although industrialization is beneficial to the country as a whole, it brings along with it some negative impacts, such as the occurrence of industrial accidents and occupational diseases. This has caused not only huge economic loss, including loss of man-days and productivity, but also pain and suffering to those who are injured.

Accidents and fatalities at the workplace also caused huge payouts, in term of compensations, by the Social Security Organization (SOCSO) to the injured workers and their families. Records from SOCSO showed that compensations paid out have been escalating. For example, in 1993 SOCSO paid out a total of RM170 million in compensations. This figure has increased to RM383 million in 1997, and it is estimated that by the year 2020 SOCSO will have to pay out a total of RM5 billion if steps are not taken to reduce the rate of accidents and fatalities at workplaces. In addition to the above payouts made by SOCSO, accidents and fatalities at workplaces also resulted in other economic loss, such as high opportunity cost resulting from man-days lost. For example, throughout 1996, it was estimated that 1,665,385 man-days lost had cost the nation RM1.6 billion. This situation will affect the growth of the

economy of the nation as the man-loss caused by accidents at the workplace will reduce the production factors available at the market, i.e. labour, and will subsequently reduce the level of production.

The manufacturing sector is one of the main contributors to the growth of the nation's economy. In 1997, the growth of 12.5 percent in this sector had contributed to 35.9 percent of the nation's Gross Domestic Product (GDP), and at the same time had provided the nation with 2,325,300 employment opportunities, or 27.5 percent of the total workforce of Malaysia. The same sector also contributed RM173,235 million, or 82.4 percent of the nation's export in 1997 (Federation of Malaysian Manufacturers Directory 1997). In Selangor alone, the manufacturing sector had contributed RM12,833 million or 57.53 percent of the State's Gross Domestic Product (GDP) in 1990, and this contribution is estimated to be RM19,875 million or 61.13 percent of the State's GDP by the year 2020.

Existing legislation in Malaysia that govern issues pertaining to occupational safety and health at the work place are:

1. Factories And Machinery Act 1967;
2. Employees Social Security Act 1969;
3. Occupational Safety and Health Act 1994;
4. Occupational Safety and Health (Employer' Safety and Health General Policy Statements)(Exception) Regulations 1995;
5. Occupational Safety and Health (Control of Industrial Major Accident Hazards) Regulations 1996;
6. Occupational Safety and Health (Safety and Health Committee) Regulations 1996; and
7. Occupational Safety and Health (Classification, Packaging and Labeling of Hazardous Chemicals) Regulations 1997.

The writing of this paper is motivated by the possible implications following the introduction of OSHA. For example, OSHA will lead to an increase in the welfare of the workforce resulting from a decrease in the rate of accidents at the workplace. From the economic point, the impact of OSHA can be evaluated from a few perspective, such as changes towards production cost, production efficiencies, and the demand for production factors. Anticipating this, the efficiency of labour market regulation, i.e., OSHA, requires accurate estimates towards its impact on labour demand by firms.

Therefore, this paper attempts to establish whether or not the introduction of OSHA will lead to an increase in production cost and subsequently inefficiency in the labour market, thus leading to a decrease in labour demand by firms. This paper also attempts to evaluate the different impact of OSHA towards labour demand in different types of industries.

THE OCCUPATIONAL SAFETY AND HEALTH ACT 1994

OSHA 1994 is introduced to make further provisions for securing the safety, health and welfare of persons at work, for protecting others against risks to safety or health in connection with the activities of persons at work, to establish the National Council for Occupational Safety and Health, and for matters connected with occupational safety and health. The objectives of OSHA are to:

(a) secure the safety, health and welfare of persons at work against risks to safety or health arising out of the activities of persons at work;
(b) protect persons at a place of work other than persons at work against risks to safety or health arising out of the activities of persons at work;
(c) promote an occupational environment for persons at work which is adapted to their physiological and psychological needs; and
(d) provide the means whereby the associated occupational safety and health legislation may be progressively replaced by a system of regulations and approved industry codes of practice operating in combination with the provisions of the Act designed to maintain or improve the standards of safety and health.

OSHA 1994 is a comprehensive legislation governing occupational safety and health. The Act also establishes a National Council for Occupational Safety and Health. It requires employers and self-employed persons to ensure safety at the workplace, and requires manufacturers to test their machinery for safety hazards. It also requires the creation of safety and health committees in enterprises with over 40 employees. Reporting of accidents and occupational diseases is covered. It also prohibits against the use of certain plant or substances, industry codes of practice, and enforcement, investigation, liability and sanctions in relation to the Act. The Act also set forth duties of employees, inter alia, employees must use protective equipment when appropriate.

As the provisions of OSHA are mandatory for all firms in all industries, total compliance can be expected across firms and across industries. This compliance with OSHA regulations will inevitably incur costs to firms (whether direct or indirect), i.e. through the purchase of health and safety enhancing equipment and systems, and other work quality inputs, such as the forming of safety committee at the place of work. On the other hand, failure to comply with OSHA regulations, will expose firms to penalty, i.e. be liable to a fine of between RM5,000 and RM50,000, and or imprisonment for a term of 6 months to 2 years, and a possible stop-work order by the Department of Occupational Safety and Health. This penalty influences the firms' choice of compliance.

THE LITERATURE

Although there are many previous studies conducted on the impact of labour market regulations toward labour demand, they are all conducted in countries outside Malaysia, e.g. United States of America, United Kingdom, and Europe. This is the first study, to the best of our knowledge, that directly estimates the effect of OSHA towards labour demand in a particular geographical location in Malaysia. Therefore, this literature review portrayed studies conducted in other countries other than Malaysia.

Empirical studies by Card (1992), Katz and Krueger (1992), Card and Krueger (1994) and Machin and Manning (1994), on the effect of labour market regulations, such as minimum wage, had questioned the conventional belief that such regulations would reduce the demand for labour by firms. Viscusi (1979) proposed a conceptual analysis of the likely effects of regulations and analyzed the determinants of health and safety investments and the industry injury rates over the 1972-1975 period. His analysis of pooled time series and cross section data failed to indicate any significant OSHA impact for the data set analyzed.

Other empirical studies also evaluated the impact of labour market regulations towards the workforce and other economic effects. Gray (1987), who studied the effect of OSHA and the Environmental Protection Act (EPA), i.e. towards its enforcement and compliance, found that industries with high profit margin, high wages, low compliance cost, and high frequency of inspection, would tend to have higher probability of compliance with these regulations. Bartel and Thomas (1987) had estimated the effect of OSHA and the EPA towards both wages and firms' profits, and found regional differences in the impact of regulation. Gray and Shadbegian (1993) found that manufacturing plants with high abatement costs had lower productivity and high labour demand.

Squire and Suthiwart-Narueput (1997) investigated the impact of market regulations in setting where compliance was incomplete. They review some stylized facts about labour market behavior, present an analytical model that may explain such behavior, and provide a checklist for assessing the distortionary impact of a regulation, such as the minimum wage. They argue that the likelihood of compliance will be greatest when the regulations are binding and the relevant elasticities are sizable. That is, if the distortionary costs of regulations are not rendered insignificant, the returns to non-compliance will be high and, other things being equal, employers will evade or avoid the regulations, thereby minimizing the impact on efficiency. This argument rests on profit maximization subject to a hard budget constraint.

This paper is similar in spirit to investigate the effect of labour market regulation, in particular OSHA, towards labour demand by firms in the manufacturing sector located in Kuala Lumpur and Selangor.

THE EMPRICAL MODEL: LABOUR DEMAND UNDER OSHA

In this section, we motivate our estimating equations with an extended model of labour demand under labour market regulation, that is, OSHA, derived from the Cobb-Douglas production function, with an additional independent variables, i.e. unit cost on expenditure on safety and health equipment (q).

As OSHA made it mandatory for all employers to ensure the safety and health of all their employees by providing them with safety equipment and works quality input, the costs function of firms can be written as follows:

Cost Minimization Objective $C = wL + rK + qS$;

At the same time, the provision of these safety equipment will ensure the increase in the safety and health level at the place of work, or reduction in accident rates, thus leading to productivity enhancement at the firm level. With this, the production function, arising from the introduction of OSHA, can be written as:

Production function $Q = AK^{\alpha}L^{\beta}S^{\gamma}$;

Therefore, the cost minimization objective of a firm can be written as:

Cost Minimization Objective $C = wL + rK + qS$;
subject to output $Q = AK^{\alpha}L^{\beta}S^{\gamma}$;

where:

Q = Output;
L = Labour input;
K = Capital input;
S = Safety equipment and works quality input;
C = Total cost;
w = Wage rate for manual labour;
r = price of capital; and
q = Procurement cost for safety equipment and works quality input.

where firms will minimize their production cost, subject to output maximization (based upon the Cobb-Douglas production function).

The Lagrangian method will be used to solve the problem of minimizing production costs, subject to maximization of output, to be as follows:

$$\mathcal{L} = wL + rK + qS + \lambda(Q - AK^{\alpha}L^{\beta}S^{\gamma}) \tag{1}$$

The first order condition for the cost minimization of equation (1) above, is as follows:

$$\partial \mathcal{L}/\partial L = w - \lambda\beta AK^{\alpha} L^{\beta-1}S^{\gamma} = 0 \qquad (2)$$
$$\partial \mathcal{L}/\partial K = r - \lambda\alpha AK^{\alpha-1}L^{\beta} S^{\gamma} = 0 \qquad (3)$$
$$\partial \mathcal{L}/\partial S = q - \lambda\gamma AK^{\alpha} L^{\beta} S^{\gamma-1} = 0 \qquad (4)$$
$$\partial \mathcal{L}/\partial \lambda = Q - AK^{\alpha} L^{\beta}S^{\gamma} = 0 \qquad (5)$$

Equations (2) and (3) can be re-written as follows to obtain the equation for labour demand (L):

$$w/r = \beta/\alpha \cdot K/L$$
$$\Rightarrow L = \beta/\alpha \cdot r/w \cdot K \qquad (6)$$

Equations (3) and (4) can be re-written as follows to obtain the equation for capital demand (K):

$$r/q = \alpha/\gamma \cdot S/K$$
$$\Rightarrow K = \alpha/\gamma \cdot q/r \cdot S \qquad (7)$$

Equation (5) above can be re-written as follows to obtain the equation for safety equipment demand (S):

$$S^{\gamma} = (Q/A)\ K^{-\alpha}\ L^{-\beta}$$
$$S = (Q/A)^{1/\gamma}\ K^{-\alpha/\gamma}\ L^{-\alpha/\beta} \qquad (8)$$

The equation for labour demand can be obtained by inserting equation (8) into equation (7), to be as follows:

$$K = \alpha/\gamma \cdot q/r \cdot (Q/A)^{1/\gamma}\ K^{-\alpha/\gamma}\ L^{-\beta/\gamma}$$
$$K^{(\gamma/\alpha)/\gamma} = (\alpha/\gamma) \cdot (q/r) \cdot (Q/A)^{1/\gamma}\ L^{-\beta/\gamma}$$
$$K = (\alpha/\gamma)^{\gamma/(\gamma+\alpha)}\ q^{\gamma/(\gamma+\alpha)}\ r^{-\gamma/(\gamma+\alpha)}\ Q^{1/(\gamma+\alpha)}\ (1/A)^{1/(\gamma+\alpha)}\ L^{-\beta/(\gamma+\alpha)} \qquad (9)$$

In order to obtain the labour demand function, equation (9) will be inserted into equation (6), to be as follows:

$$L = \beta/\alpha \cdot r/w \cdot K$$
$$\Rightarrow L = \beta/\alpha \cdot r/w \cdot (\alpha/\gamma)^{\gamma/(\gamma+\alpha)}\ q^{\gamma/(\gamma+\alpha)}\ r^{-\gamma/(\gamma+\alpha)}\ Q^{1/(\gamma+\alpha)}\ (1/A)^{1/(\gamma+\alpha)}\ L^{-\beta/(\gamma+\alpha)}$$
$$\Rightarrow L^{[(\gamma+\alpha)+\beta]/(\gamma+\alpha)} = \beta/\alpha \cdot r/w \cdot (\alpha/\gamma)^{\gamma/(\gamma+\alpha)}\ q^{\gamma/(\gamma+\alpha)}\ r^{-\gamma/(\gamma+\alpha)}\ Q^{1/(\gamma+\alpha)}\ (1/A)^{1/(\gamma+\alpha)}$$
$$\Rightarrow L = (\beta/\alpha)^{(\gamma+\alpha)/[(\gamma+\alpha)+\beta]}\ r^{(\gamma+\alpha)/[(\gamma+\alpha)+\beta]}\ w^{-(\gamma+\alpha)/[(\gamma+\alpha)+\beta]}\ (\alpha/\gamma)^{\gamma/[(\gamma+\alpha)+\beta]}$$
$$\qquad q^{\gamma/[(\gamma+\alpha)+\beta]}\ r^{-\gamma/[(\gamma+\alpha)+\beta]}\ Q^{1/[(\gamma+\alpha)+\beta]}\ (1/A)^{1/[(\gamma+\alpha)+\beta]}$$
$$\Rightarrow L = [(\beta/\alpha)^{(\gamma+\alpha)/[(\gamma+\alpha)+\beta]}\ (\alpha/\gamma)^{\gamma/[(\gamma+\alpha)+\beta]}\ (1/A)^{1/[(\gamma+\alpha)+\beta]}]\ r^{\alpha/[(\gamma+\alpha)+\beta]}$$
$$\qquad w^{-(\gamma+\alpha)/[(\gamma+\alpha)+\beta]}\ q^{\gamma/[(\gamma+\alpha)+\beta]}\ Q^{1/[(\gamma+\alpha)+\beta]} \qquad (10)$$

From equation (10), the labour demand function can be written in the form of natural logarithm, as follows:

$$\ln L = \ln[(\beta/\alpha)^{(\gamma+\alpha)/[(\gamma+\alpha)+\beta]} \ (\alpha/\gamma)^{\gamma/[(\gamma+\alpha)+\beta]} \ (1/A)^{1/[(\gamma+\alpha)+\beta]}] + \alpha/[(\gamma+\alpha)+\beta] \ \ln r$$
$$- \ (\gamma+\alpha)/[(\gamma+\alpha)+\beta] \ \ln w + \gamma/[(\gamma+\alpha)+\beta] \ \ln q + 1/[(\gamma+\alpha)+\beta] \ \ln Q$$

$$(11)$$

Therefore, the labour demand function, with the introduction of OSHA, can be simplified as follows:

$$\ln L = \ln \alpha_0 + \alpha_1 \ln r - \alpha_2 \ln w + \alpha_3 \ln q + \alpha_4 \ln Q + \mu_0 \qquad (12)$$

with μ_0 being the error term.

where:
$$\alpha_0 = [(\beta/\alpha)^{(\gamma+\alpha)/[(\gamma+\alpha)+\beta]} \ (\alpha/\gamma)^{\gamma/[(\gamma+\alpha)+\beta]} \ (1/A)^{1/[(\gamma+\alpha)+\beta]}$$
$$\alpha_1 = \alpha/[(\gamma+\alpha)+\beta]$$
$$\alpha_2 = - \ (\gamma+\alpha)/[(\gamma+\alpha)+\beta]$$
$$\alpha_3 = \gamma/[(\gamma+\alpha)+\beta]$$
$$\alpha_4 = 1/[(\gamma+\alpha)+\beta]$$

DATA DESCRIPTION

For the purpose of analyzing the empirical model of labour demand by firms, cross sectional data, for the year 1997, have been obtained through questionnaires conducted upon 50 manufacturing firms located in Kuala Lumpur and Selangor. From the 50 manufacturing firms surveyed, 12 firms are plastic-based, 10 are metal-based, 9 are chemical and non-mineral products, 6 are food and beverage products, 5 are wood and paper-based, another 5 are transport equipment, and the remaining 3 are electric electronic industries.

The dependant variable (L), i.e. labour demand by firms, is obtained based on only the demand for manual labour by firms. Labour demand by firms can be divided into three categories, namely professionals to include engineers, accountants, architects and technical personnel; semi-professionals to include administrative and management staffs, technicians, supervisors, typists and sales personnel; and manual labour to include production workers and general workers. These three categories of labour cannot be analyzed collectively as different categories of labour are paid in accordance to their professional status. Should they be analyzed collectively, it will create bias and inaccurate results. Therefore, any analysis must be based upon one common category at any one time. For the purpose of this paper, the category

of manual labour is chosen as it made up an average of 61.29 percentage of the total workforce surveyed.

Other independent variables used in this analysis are wage rate (w), price of capital (r), procurement cost for safety equipment and works quality input (q) and the value of firms' output (Q).

Based on the reason mentioned above, the wage rate (w) is reflective of the wage rate received by labour of manual category only. Price of capital (r) is made up of the combination of Average Lending Rate of Commercial Banks in Malaysia over a 12 months period in 1997, i.e. at 10.63 percent (Bank Negara Malaysia 1997), and the depreciation value (in percentage) of capital goods of the 50 firms surveyed. The procurement cost for safety equipment and works quality input (q) reflects the safety equipment used by labour of manual category, and not of other categories, such as safety gloves, safety shoes, safety helmet, masks, breathing equipment, safety glasses, ear-plugs, and others. For the purpose of this analysis, since the physical output produced by different sub-sectors are not common, the value of firms' output (Q) will be measured using Ringgit Malaysia, as opposed to their physical product.

THE EMPIRICAL RESULTS

TABULATION ANALYSIS

The education level of labour in the survey can be divided into 5 categories, that is, without education (8.54%), primary education (37.33%), secondary education (14.30%), post-secondary education (31.20%), and university education (8.61%). In term of years of working experience, 4 categories can be derived from the pool surveyed, i.e. with less than 5 years of experience (57.7%), between 6 to 10 years of experience (22.6%), between 11 to 20 years of experience (13.9%), and those above 20 years of experience (5.8%).

84 percent of the firms surveyed employed partial automation in their production process. While the remaining employed simple electric cum hand-held equipment and full automation. The highest number of accident occurred in wood and paper-based industries (11.60 times per year or 21.15% of the total number of accidents recorded for the total firms surveyed), followed by food and beverages-based industries (10.33 times per year or 18.83%). While transport equipment industries recorded the lowest number of accident occurrence (4 times per year or 7.29% of the total number of accidents recorded for the total firms surveyed).

Due to the difference in the intensity of labour usage in production, the survey establish that the wood and paper-based industries invested the highest average in the procurement of safety equipment, i.e. RM67,000 per year, compared to transport equipment industries which invested the lowest average in the procurement of safety equipment, i.e. RM23,160 per year.

The above concluded that, in the sample surveyed, there are more manual labour compared to non-manual labour, with the majority of labour having no education or with primary education, and with little working experience.

ESTIMATING THE LABOUR DEMAND USING TOTAL SAMPLE

For the purpose of estimating the labour demand function, equation (12) can be written as:

$$\ln L = \ln \alpha_0 + \alpha_1 \ln r + \alpha_2 \ln w + \alpha_3 \ln q + \alpha_4 \ln Q + \mu_0$$

The results of estimation using total sample are shown in Table 1.

TABLE 1. Results of regression on the total sample explaining labour demand by firms

Explanatory variables	Coefficients (t-ratio)
	Labour demand of pool sample[a]
Constant	6.5014
	(1.820)
Price of capital (r)	0.2308
	(0.678)
Wage rate (w)	-0.5529
	(-2.060)**
Procurement rate for safety equipment (q)	-0.7818
	(-5.705)*
Value of firms' output (Q)	0.4283
	(4.216)*
R^2	0.6723

Note: a This model was estimated using the Ordinary Least Square (OLS) method.
*p < .01. **p < .05

The above results showed that the t-ratio for variable on procurement cost for safety equipment and works quality input (q) and the value of firms' output (Q) are significant at the 0.01 level, and the t-ratio for variable on wage rate paid out to manual labour (w)) is significant at the 0.05 level. While the t-ratio for variable on price of capital (r) is statistically not significant. The signs of all coefficients are in line with economic theory. The R^2 value of 0.6723 indicated that the dependant variables in the model represented 67.23 percent of firms' behavior towards labour demand.

From the above regression analysis, the following interpretation can be forwarded:

1. The price of capital (r), although having positive correlation towards labour demand, has shown an insignificant result. This insignificance correlation may be due to the low substitution rate between labour and capital resulting from the rigidity towards technological change in such short time duration, and also due to the short run financial constraint. Furthermore, the low elasticity value between labour demand and the price of capital of 0.2308 is also reflective of the low substitution rate between the two inputs.

2. Labour demand is influenced by the wage rate of labour (w), and this negative correlation is significant. However, the value of wage elasticity of labour demand of -0.5529 indicated that an increase of 1 percent of wage rate would incite 0.5529 percent reduction in labour demand by firms. This situation may be due to the inherent nature of wage rigidity, and at the same time contributed by the competitive demand for labour by firms as a result of the bullish economy of the country, until the third quarter of 1997.

3. The cost of procuring safety enhancement equipment (q) has a negative and significant correlation towards labour demand. The value of elasticity, i.e. -0.7818 indicated that an increase of 1 percent in the cost of safety equipment will reduce labour demand by 0.7818 percent. This indicated a significant reflection by firms towards demand for labour in respond to changes in the cost of safety equipment. The cost of compliance with OSHA will caused firms to incur cost as a result of procuring safety enhancement equipment and systems. Alternatively, firms can choose not to comply with the requirement of OSHA, and risk the cost of penalties for non-compliance. Therefore, the introduction of OSHA has added another cost element to the demand for labour, whether or not firms choose to comply with its requirement.

4. The value of firms' output (Q) indicated a positive and significant correlation towards labour demand. However, the low elasticity of 0.4283 reflects low responsiveness by firms towards labour demand as output level changes–where a 1 percent increase in output will only induce firms to increase their labour intake by 0.4283 percent only.

ESTIMATING THE IMPACT OF OSHA TOWARDS LABOUR DEMAND BY INDUSTRIAL CATEGORIES

To further enhance the analysis of this paper to evaluate the different impact of OSHA regulations towards different industries, the total sample will be divided into three subgroups in accordance with their source of production inputs. Such subgroups are necessary as different industries differ in their

intensity of usage of production factors, i.e. between labour and capital, due to different technology used in the process of production. The differences in the intensity of production factors, together with the different processes engaged in production will in turn present different levels of risk in each industry. The subgroups are:

1. The combination of plastic-based with chemical and non-metallic products industries.
2. The combination of wood and paper-based with food and beverages products industries.
3. The combination of metal-based with transport equipment and electrical electronic industries.

For the purpose of analyzing the above, the basic model will be regressed by inserting dummy variables to represent the three different subgroups. There are two types of estimated regressions involved in this section.

Regression 1

$$\ln L = \ln \alpha_0 + \alpha_1 \ln r + \alpha_2 \ln w + \alpha_3 \ln q + \alpha_4 D_1 \ln q + \alpha_5 D_2 \ln q + \alpha_6 \ln Q + \mu_0$$

Regression 2

$$\ln L = \ln \alpha_0 + \alpha_1 \ln r + \alpha_2 \ln w + \alpha_3 \ln q + \alpha_4 D_1 \ln q + \alpha_5 D_3 \ln q + \alpha_6 \ln Q + \mu_1$$

with:

L = Manual labour demanded by firms;
r = Price of capital;
w = Wage rate for manual labour;
q = Expenditure rate in procuring safety equipment;
Q = Value of output produced by firms;
D_1 = Dummy variable representing the combination of plastic-based, chemical and non-mineral products industries;
D_2 = Dummy variable representing the combination of wood-based, paper-based and food and beverage products industries;
D_3 = Dummy variable representing the combination of metal-based, transport equipment and electrical electronic industries; and
μ_0, μ_1 = Error terms.

The estimation of these regressions will use Ordinary Least Square (OLS) procedure and the results of the estimation are presented in Table 2.

TABLE 2. Results of regression explaining labour demand by firms by industrial categories.

Explanatory variables	Regression 1[a]	Regression 2[a]
Constant	7.5470	7.5470
	(2.150)**	(2.150)**
Price of capital (r)	0.3311	0.3311
	(0.990)	(0.990)
Wage rate (w)	-0.5888	-0.5888
	(-2.250)**	(-2.250)**
Procurement rate for safety equipment (q)	-0.7233	-0.6739
	(-5.118)*	(-4.735)*
Value of firms' output (Q)	0.3826	0.3826
	(3.787)*	(3.787)*
Interaction of dummy variable (D1) with q	-0.0761	-0.1255
	(-1.448)	(-2.128)**
Interaction of dummy variable (D2) with q	-0.0494	-
	(-0.825)	
Interaction of dummy variable (D3) with q	-	-0.0494
		(-0.825)
R^2	0.7057	0.7057

Note: a Both models were estimated using the Ordinary Least Square (OLS) method.
* $P < 0.01$ ** $P < 0.05$

RESULTS OF REGRESSION 1

Coefficient $D_1 lnq$ reflects the difference of elasticity between the combination of plastic-based, chemical and non-mineral products industries and the combination of metal-based, transport equipment and electrical electronic industries, i.e. the difference of -0.0761, and not significant, thus indicating that there in no significant difference in labour demand between these 2 sub-categories when there is a change in the cost of procuring safety equipment.

The result also shows that the cost of procuring safety equipment for the combination of wood-based, paper-based and food and beverage products industries i.e the coefficient of $D_2 lnq$ at -0.0494 is also statistically insignificant, thus indicating that there is no difference, in elasticities of demand for labour, between this combination and the combination of metal-based, transport equipment and electrical electronic industries.

The coefficient of lnq at -0.7233 and significant at 0.01 level indicates that a 1 percent increase in the cost of procuring safety equipment for the combination of metal-based, transport equipment and electrical electronic industries will reduce the demand for labour in this group of industries by

0.7233 percent. The value of labour demand elasticity with respect to safety equipment for the combination of plastic-based, chemical and non-mineral products industries is -0.7994 indicating that an increase of 1 percent in the cost of procuring safety equipment will reduce the demand for labour in this group of industries by 0.7994. This elasticity for the combination of wood-based, paper-based and food and beverage products industries is -0.6739 indicating a reduction of labour demand in this group is 0.6739 as a result of 1 percent increase in the cost of procuring safety equipment.

RESULTS OF REGRESSION 2

In this regression, coefficient of $D_1 lnq$ reflects the difference of elasticity between the combination of plastic-based, chemical and non-mineral products industries and the combination of wood-based, paper-based and food and beverage products industries, i.e. the difference of -0.1255, and significant at 0.05 level indicating a significant difference in labour demand between these 2 sub-categories when there is a change in the cost of procuring safety equipment. The coefficient of $D_2 lnq$ reflects the difference of elasticity for the combination of metal-based transport equipment and electrical electronic industries and the value is -0.0494 as indicating as well in the regression 1.

The above results show that the value of elasticity of -0.7994 for the combination of plastic-based, chemical and non-mineral products industries is higher that of the combination of wood-based, paper-based and food and beverage products industries (-0.6739), as well as the combination of metal-based, transport equipment and electrical electronic industries (-0.7233). Whereas, the value of elasticity of the combination of metal-based, transport equipment and electrical electronic industries (-0.7233) is higher than the combination of wood-based, paper-based and food and beverage products industries (-0.6739). In other word, the combination of plastic-based, chemical and non-mineral products industries is more sensitive towards the impact of OSHA, on its labour demand, compared to the other 2 sub-industries. This may be due to the fact that this combination of firms are more labour intensive and are more capable of switching to capital usage when there is a change in the cost of labour.

While the above results show that there is a significant difference towards labour demand, as a result of OSHA regulations, between the combination of plastic-based, chemical and non-mineral products industries and the combination of wood-based, paper-based and food and beverage products industries, there appear no significant difference between other combination of industries

As in the results of regression 1, the value of elasticity of demand for labour with respect to changes in the cost of procuring safety equipment in 3 subgroups of industries i.e metal-based, transport equipment and electrical

electronic (-0.7233), plastic-based, chemical and non-mineral products industries (-0.7994) and wood-based, paper-based and food and beverage products industries (-0.6739) can be derived from the results of regression 2.

POLICY IMPLICATIONS AND CONCLUDING REMARKS

POLICY IMPLICATION

From the above analysis, the introduction of OSHA has a significant effect on the demand for labour by firms. At the same time, it was reported that the number of accidents has decreased 29 percent from 134,546 occurrence in 1993, to 95,098 occurrence in 1997. This is an early indication of the success of OSHA, as while the number of industrial accidents moved towards a declining trend, the firms' demand for labour remain unaffected by the same regulation.

As the above results indicated that the impact of OSHA towards labour demand, varies in accordance to industries, the implementation of any policies of OSHA must take into account the different sensitivities in different industries. Therefore, a blanket coverage of OSHA regulations may have undesirable impacts towards some industries, such as a possible reduction in the demand for labour arising from capital substitution.

Anticipating such favorable situation, safety and health at workplaces should go beyond the mere procurement of safety equipment by firms. Safety and health work culture should be established and should be the reflection of a positive attitude and commitment by all levels in an organization and workplaces. Thus, safety and health at workplaces have to be managed, through awareness, information and training. With the management of safety and health at workplaces, the social responsibilities of employers become an issue - where the costs-benefits of such provision of safety and health goes beyond accounting standards to reflect the social welfare of labour.

CONCLUDING REMARKS

At the end of this paper, the question of whether the introduction of OSHA has indeed resulted in labour market inefficiencies and thus reduced the demand for labour by firms, has to be addressed. The results of this analysis, however indicate that the opposite is quite true, at least for manufacturing firms located at Wilayah Persekutuan Kuala Lumpur and Negeri Selangor Darul Ehsan. The result of this study is in line with the result of Squire dan Suthiwart-Narueput's (1997) study, i.e. when labour demand is inelastic, labour market regulations has little impact towards firms' efficiencies.

It must, however, be stressed here that this research conducted using cross sectional data of the year 1997, and subject to assumptions, is far from the true reflection of the actual situation and the conclusive and comprehensive

behaviour of all manufacturing firms. The long run impact of OSHA towards labour demand by firms is yet to be seen. Continuous studies need to be conducted from time to time to establish the long run impact of OSHA, as in the long run, the possibility of labour-capital substitution is high.

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