The Role of R&D Expenditure on Job Creation in the Malaysian Manufacturing Sector

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***Abstract*— In order to remain competitive in the world economy, Malaysia needs to constantly generate and establishes new sources for economic growth and job creation. One of the means of achieving such a goal is to increase the nation capability and effectiveness in adopting, developing and translating science and technology through Research and Development (R&D). However, until now still unclear interpretation between employment and job creation. Resulting in the unsettled issue of the relationship between R&D and job creation. Thus, the present paper attempts to examine and establish the relationship between R&D and job creation by using GMM-System across 54 industries in the Malaysian manufacturing sector. The empirical evidence provided in this paper suggests that R&D significantly determined job creation. R&D policy can contribute a positive effect on job creation in the Malaysian manufacturing sector. This is indeed in line with the National Science, Technology and Innovation Policy that aims to expand Malaysia's gross expenditure on R&D by at least 2 percent prior to the year 2020.**

***Keywords*—** *Job creation, manufacturing sector, R&D, GMM-system, Malaysia*

1. Introduction

Practically, job creation is not well pronounced in labour market analysis, compared to employment. Usually, labour market analysis uses employment as the tool to measure the performance of the labour market, including the Malaysian manufacturing sector. While, according to [1], job and employment are the difference, that is job referring to position and employment referring to the labour force who filled the position. In his study, 'job' reflects the demand for labour, while 'employment' reflects the supply of labour. He claims that the concepts of job and employment are therefore different and the measurement of jobs is frequently overshadowed by the measurement of employment.

[2-4] claim that it is inaccurate to explain job market performance by measuring employment growth. In their study, they explained that the concept of job creation describes employment growth according to the change in the size of the industry. As noted by [5], it is important to understand the differences between job creation and employment growth. If job creation is measured based on employment growth, the performance of the labour market will be underestimated.

A growing interest among researchers on job creation is in identifying the determinants of job creation. Studies by [6-8] had identified factors that influence the firm's decision to perform job creation. But their studies used the conventional measurement of employment growth as a proxy of job creation, not the calculated rate of job creation.

Malaysia has deployed an economic transformation programme (ETP) in 2010, that is one of the goals is to accelerate innovative outputs. Although, the manufacturing sector is not fully involved in this programme, there are several major sub-sectors in the manufacturing sector involved such as sub-sector of Petroleum and Energy-based, Natural-based and Plastics and chemicals. Through the ETP, the main approach is by increasing the R&D expenditure to the sectors, to promote production volume of innovative output (Performance and Delivery Unit, 2013).

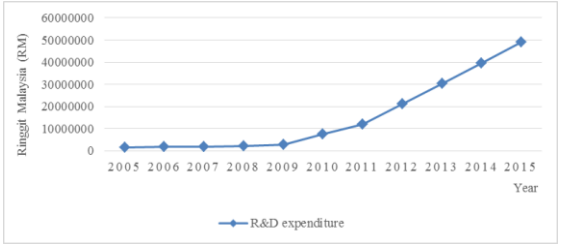

Figure 1. Research and development (R&D) expenditure in the manufacturing sector in Malaysia, 2005-2015

As can be seen in Figure 1, the graph shows the R&D expenditure in the Malaysian manufacturing sector from 2005 to 2015. The graph appears to be curved upwards from 2010 to 2015. This proves that the growing in R&D expenditure inflows into the manufacturing sector after the ETP is implemented.

Besides being driven to the high volume production of innovative output, the R&D is also predicted to multiply jobs in the manufacturing sector. As reported in the Report of Manufacturing Sector Investigation Survey (2015), the types of R&D in the Malaysian manufacturing sector is labour-friendly, that is R&D and labour are jointly used by firms to improving the output productivity. R&D led to an increase in job creation as firms act to expand their production volume [9].

However, there has been little study investigating the role of R&D on job creation, specifically in the Malaysian manufacturing sector. Thus, since R&D plays a significant role in the ETP, with regard to job creation, the present study is a contribution to the literature and the Malaysian government. Since the decision of firms to create jobs is important, the findings of this study can serve as a guide to policy makers to evaluate the role of R&D in the labour market through job creation.

In contrast to previous studies such as [10] and [11] that measure innovation based on the growth of innovation and period of implementing the innovation, this study uses Research and Development (R&D) expenditure to represent innovation. The method of Generalized Method of Moment (GMM) regression is applied. This study determines that the types of innovation used in the Malaysian manufacturing sector are a substitution to the labour in the production process. High R&D expenditure encourages firms to shift from labour to innovation in order to increase the production level.

Therefore, this study forecasted that Malaysia will face higher unemployment rate if the situation is permanent. So, this study suggests that Malaysia need to review the types of innovation used in the production process to ensure that the unemployment rate is under control

In addition to this introduction, this paper is comprised of five sections. Section 2 discussed some related literature review. Section 3 presents the data and the empirical method to be employed in this paper. Findings of the study are analysed in Section 4. While Section 5 is the conclusion.

2. Review of related literature

A number of previous studies have been conducted such as [10], [11], [7], [12] in various countries with the aim to investigate the relationship between innovation and job creation. Apparently, R&D expenditure is one types of innovation.

[10] proposed to inquire on the influence of innovation on a firm's decision to create jobs in the Spanish manufacturing sector. The study collects and divides the data of firms in the manufacturing sector into two groups: a group of innovated firms and a group of less innovated firms, from the year 1990 to the year 1997. The study measures innovation based on the time taken by firms to implement the innovations. A firm is included in the group of innovated firms if it is able to carry out innovations in the production process within a period of four months. While a firm is considered as a less innovated firm if it takes a longer period to implement innovation in the production process. The result of this study suggests that innovated firms contribute to a higher magnitude of job creation than less innovated firms in the sector. This is applicable Spain manufacturing sector because firms there implement labour-friendly innovation types in the production process to ensure an increase in the output level as well as to maintain the unemployment rate in the country.

[11] studies the relationship between innovation and the firm's decision to create jobs. This study was conducted in Italy over the past 6 years, from the year 1992 to 1997. This study measures innovation as growth in the value of innovation in 318 firms in the manufacturing sector in Italy. Despite using descriptive analysis, this study uses econometric techniques known as Generalized Method of Moment (GMM) estimator to identify the type of relationship between innovation and job creation in the sector. The analysis suggests a complementary relationship between innovation and job creation in the Italian manufacturing sector. Positive growth in the value of innovation encourages firms to increase job creation at the firm level if the innovation and labour force are being used together in the production process. This result is true regardless of the firm's demographic features such as size, age and ownership of the firms. So, a firm's decision to create jobs is not influenced by the characteristics of firms, but by the types of innovation used. In this case, the types of innovation used in the Italian manufacturing sector is categorized as labour-friendly.

[12] in 16 European countries from the year 1996 to 2005, focused on 25 industries in the manufacturing and services sector. This study measures innovation as development and upgrading of technology in the production process in both sectors. The result of this study shows the demand for labour increases upon the improvement of technology in the firms. The improvement of technology encourages firms to create jobs equivalent to the technology level, so that the technology can be used optimally. In conclusion, this study determines the positive relationship between innovation and job creation in 16

European countries. Furthermore, technology is used together with the labour force in the production process in both sectors.

Based on a literature review on this area, it is noted also that the determinants that usually used are size, age, and ownership of the firms [13-15] also output [6], [11], [16], [17] and wages level; [18], [19] and economic situation such as transition economy [20], [13] and economy cycle [21].

3. Data and empirical method

3.2 Data

The data collected was a set of secondary data obtained from the Annual Manufacturing Sector Survey Report released by the Malaysian Department of Statistics, was also used as it is presented the performance of major indicators of the Malaysian manufacturing sector. The Economic Report released by the Bank Negara Malaysia was also used in this study, aims to ensure that the data used is accurate. The cross-section data and time series data were combined to form a set of panel data. Panel data used in this study took into account 54 industries groups in Malaysia's manufacturing sector for a period of 11 years, from 2005 to 2015. The selection of industry groups is based on the Malaysian Industrial Standard Classification (MSIC) 2010. The information used in this study is the number of employment (to calculate job creation), output (refer to the sector's output), wages, assets, R&D expenditure from 2005 to 2015.

The formula of the job creation rate at sub-sector is shown in equation (1)

$$JC_{st} = \sum_{+st} \frac{x_{est}}{g_{st}} \quad (1)$$

Where

JC_{st} denotes the rate of job creation in sub-sector. x_{est} is employment gained at sub-sector. g_{st} is growth rate at sub-sector.

4. Methodology

Job creation is calculated using a formula that has been formed by [22], further used in the several studies oversea such as [23] and [15]. The general model specification for job creation is as follows:

$$jc_{it} = \alpha + \beta_1 jc_{it-1} + \beta_2 logry_{it} + \beta_3 logrw_{it,} + \beta_4 loga_{it} + \beta_5 logrd_{it} + \beta_6 logrd_{it-1} + \varepsilon_{it} \quad (2)$$

Table 1. Operational Definition of the variables

Symbol	Operation definition
jc_{it-1}	Value of job creation in the previous year
$logry_{it}$	The log value of real output manufacturing sector produced.
$logrw_{it}$	The log value of real wages paid to the employees in the manufacturing sector.
$loga_{it}$	The log value of assets, consists of machinery, fixed asset etc. after deducting the depreciation value.
$logrd_{it}$	Research and development expenditure consists of a systematic study of the new process, technique and application of the product n producing product.
$logrd_{i(t-1)}$	Value of research and development (R&D) in the previous year

The Model above is known as a dynamic model of job creation and it is described the expected relation of output, wages, asset, R&D expenditure on job creation is greater than zero (HA: $\beta > 0$). In addition, this study also included elements of lag(1) job creation and lag(1) R&D expenditures as variables affecting job creation. This is due to job creation is a continuous phenomenon because of one of the characteristics of job creation is persistent trend [21] and the impact of R&D expenditure cannot be seen immediately [16].

5. Empirical finding

Table 2 shows the regression results of GMM two-step estimator. The result of GMM-SYSTEM twostep is selected in this study. The coefficient of job creation rate in the previous year (JCit-1) is 0.0616, real assets (LRait) is 0.2096 and real research and development (R&D) expenditure in the previous year (LRlagR&Dit-1) is 0.0321. These determining factors are significant (at 0.001) and influenced the job creation rate in a positive direction. These findings are similar to the finding in Greek manufacturing sector by [24], Uthopian manufacturing sector by [25], South Africa by [26], Spain manufacturing sector by [10], Italy manufacturing sector by [11] and European countries by [12].

Table 2. GMM analysis for determinants of job creation in the Malaysian manufacturing sector, 2005-2015

Variables	GMM-System Twostep
Constant (α)	0.0616 (0.06) [1.09]
JC_{it-1}	0.0686*** (0.001) [72.32]

LRy_{it}	-0.0634*** (0.007) [-8.95]
LRw_{it}	-0.1927*** (0.005) [-42.24]
LRa_{it}	0.2096*** (0.013) [15.63]
$LRR\&D_{it}$	-0.0414*** (0.009) [-4.48]
$LRlagR\&D_{it-1}$	0.0321*** (0.008) [4.23]
Sargan test	0.4476
AR(1)	0.0006
AR(2)	0.5891
N	54
T	11
n	594

Notes: ***indicate significant at 1%, ** indicate significant at 5% and * indicate significant at 10%. Standard error are in parantheses ( ) and the t-stat are in parentheses [ ].

In contrast, real output, real wages and real research and development (R&D) expenditure are significant but influenced the job creation of the Malaysian manufacturing sector in a negative direction. The regression coefficient of the real output (LRyit) is -0.0634, real wages (LRwit) is -0.1927 and real research and development (R&D) expenditure (LRR&Dit) is -0.0414. This result is equal to the finding found in several studies such as in Ireland by [14], the US manufacturing sector by [27] and the Malaysian manufacturing sector by [7].

Subsequently, the job creation rate at the previous year (JCit-1) influenced 0.0686 of the current year job creation rate (JCit) in the Malaysian manufacturing sector. The result also shows that an increase in the use of real assets (LRait) by 1% in the Malaysian manufacturing sector resulting in 0.0021% increase in job creation rate. Similarly, a 1% increase in real research and development (R&D) expenditure in the previous year (LRlagR&Dit-1) promotes 0.0000% job creation rate in the Malaysian manufacturing sector.

For real output, the result shows that 1% increasing in real output (LRyit) led to a decrease in 0.0006% job creation rate in the Malaysian manufacturing sector. This opposite relationship between real output and job creation suggests that the production activity in the Malaysian manufacturing sector increase but job creation decrease. This is due to the shift from labour intensive to capital intensive process.

Although a 1% increase in real wages, this study highlights that job creation rate decrease by 0.0021% in the manufacturing sector. Lastly, an increase in real research and development (R&D) expenditure (LRR&Dit) by 1% reduced 0.00041% job creation rate in this sector. Overall, the GMM-system twostep estimator results show that real assets are the most significant factor influencing job creation ($\beta = 0.2096$), while the real research and development (R&D) in the previous year has the least influenced on job creation in the current year.

The goodness of the GMM system twostep estimator result is also supported by the Sargan and Auto-regression test, recorded in Table 4.6. The Sargan test under the null hypothesis is over-identifying restriction of instrument validity in the model. According to [28], if the null hypothesis is rejected, the Sargan test shows there is no serious problem with the validity of the instrument variable and the model is good. But, referring to Table 4.6, the value of the Sargan test is 0.4476, which indicate that the null hypothesis is accepted. In other word, alternative hypotheses are rejected. Hence, the model used in this study is over-identified and the model faced the validity problem of instrument variable. Therefore, the GMM system was used.

6. Conclusion

In summary, the test results provide significant evidence that real asset, lag real R&D expenditure (R&Dt-1) and lag job creation (JCt-1) influenced positively the job creation. This implies that if the government wishes to create more jobs in the manufacturing sector, it should put efforts to increase these two (2) factors, namely assets, and R&D expenditure. The result supports the hypotheses of this study.

The present finding is in agreement with [10-12] who found a positive influence of R&D expenditure on job creation rate in the Malaysian manufacturing sector. It is therefore likely that such influence exists between R&D expenditure and job creation suggest that, although industries in Malaysian manufacturing sector technology in the production process, the small to the moderate magnitude of job creation is performed with the purpose to maintain their operations, with the requirement of the skilled labour force through skilled job creation. An important policy of increase in technology would decrease job creation and increase the unemployment rate. Decreasing job creation is due to the limited supply of skilled labour. Therefore, policymakers should try to strike a balance between using technology and innovation and job creation capacity.

A reasonable approach to tackle this issue in the future could be that the Malaysian government and industries in the manufacturing sector should be in need to enhance collaboration between industries

and training institution to nurture the relevance technical skill of domestic labour force, so it would be in line with the job requirement.

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