IS DEVELOPMENT OF ELECTRICAL AND ELECTRONIC (E&E) INDUSTRY IMPORTANT? A SPILLOVER STUDY

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ABSTRACT

Malaysia is a country that heavily depended on export activity since industrialization. In 2013, 32.9% of Malaysia total exports were from E&E industry, which accounted for RM236.76bil and was the largest exported product followed by Refined Petroleum Product and LNG. The contribution of this industry to economic development is huge, especially in job creation. Besides, E&E is named as one of the National Key Economic Area (NKEA). The development of this sector is presumed to have great impact on the sectors along its supply chain. However, the contribution of this industry to manufacturing value added and employment has been dropped. The benefaction of other industries has outpaced E&E. Large investment and development of this industry is believed to have some positive impacts on other industries. Therefore, this study has employed 3 digit level data of manufacturing sector from 2000 to 2012 to investigate the cross-industry spillover effect within the manufacturing sector. The result of this research suggests that, the development of E&E industry has positive, significant but little impact on other industries.

Key words: Spillover effect, E&E industry, manufacturing sector.

Introduction

In the early stage of industrialization, huge amount of investment is needed to increase the production of the manufacturing sector. This is because, new investment always associated by new knowledge and technology. Because of its huge positive impact on Malaysia economy, several incentives have been made to increase the investment inflows especially in the export industry. These incentives include the establishment of Malaysia Industrial Development Finance (MIDF), Malaysia Industrial Development Authority (MIDA), Investment Incentives Act 1968, Free Trade Zones (FTZs) and implementing the strategies of import liberalization, export promotion and Foreign Direct Investment (FDI). Malaysia also reduced its average tariff to 13% in 1985 and more in 1989 to attract inflows of investment. These efforts resulting in significant inflows of FDI in manufacturing sector in 1989. Most of the investments in manufacturing sector are for export industry, particularly in electrical and electronic product sector (E&E). E&E sector was the heart of industrialization. Huge amount of capital has been invested in this industry. Figure 1 shows the comparison of capital investment's share by major industries during the period of Eight and Tenth Malaysia Plan. In both periods, E&E was the largest recipient of capital investment with RM43.4 billion and RM49.1 billion, individually[2]. Although E&E was the largest recipient of capital investment, the increments of other sector's share were significant in both periods. Contribution of the E&E sector to total value added, however decreased to 24.2 percentages in 2013 from 30.1 percentages in 2000. In spite of decrement in E&E share in value added, other sector's share such as chemical and chemical product and petroleum has enhanced from 10 and 6.1 percentage in 2000 to 14.3 and 21 percentages in 2013.[3]

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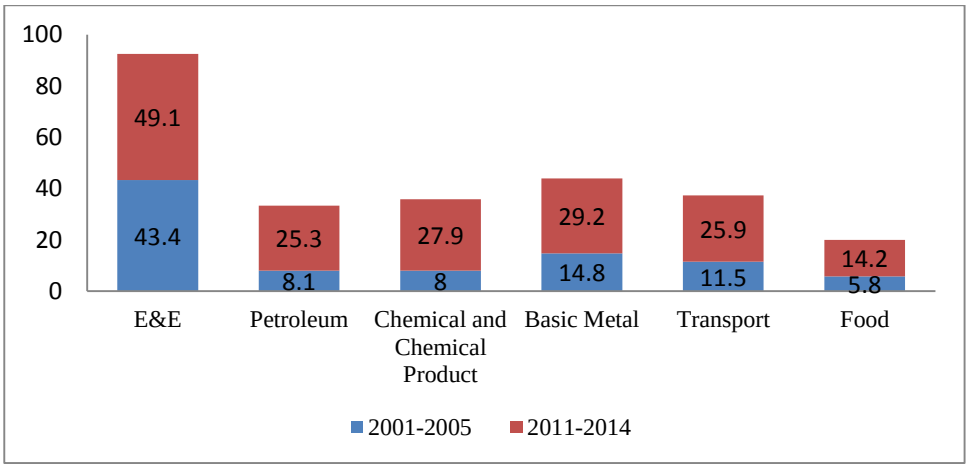
[2] All the information and data are gather from Malaysia Investment Performance Report for the year 2002, 2003, 2006, 2012 and 2014 published by MIDA
[3] Information was taken from Bank Negara Annual Report for 2014 and 2001. These reports were published by Bank Negara Malaysia

Figure 1: Share of capital investment by major industries (in billion)



E&E also is named as one of the National Key Economic Area (NKEA). The development of this sector is presumed to have great impact on the sectors along its supply chain. Product from E&E that utilized by other sectors might consist of high technology input that required skilled worker to operate with it. Therefore, the development of E&E sector might have a positive impact on other sector's performance. This is called external or spill-over effect. But, is development of E&E sector is really has spill-over effect on other sector's development? Thus this study is carried out to study the existence of spillover effect within manufacturing industry in Malaysia.

Three digit levels of MSIC data for Malaysia manufacturing sector from year 2000 to 2012 was used to accomplish this objective. Data was regressed using Generalized Method of Moment (GMM). Result showed that, the development of E&E industry has positive, significant but little impact on other industries. The rest of the paper is structured as follows. In the next section, some perspectives and issues of spillover effect will be discussed. Then, empirical framework and data will be specified. Section five discusses the estimation results, while concluding remarks will be in the final section.

Literature Review

There are many spills-over studies has been recorded, for example spill-over effect of R&D activities in Engelbrecht (1997), Frantzen (2000) and Madsen (2005), foreign direct investment in Khalifah & Adam (2009) and Ahmed (2012), openness and import in Keller (1988), human capital in Bauer and Vorell (2010) and to name a few.

In endogenous theory, cross firm spill-overs are one of the fundamental factors in creating increasing returns to scale (Romer, 1986) and localized spillovers are the cause of persistent productivity gaps in development literature (Feenstra, 1996). Human capital is always modelled in endogenous growth theory as a factor that subjected to increasing returns. Endogenous growth theory can be broadly divided into two groups; investment and R&D based growth model. Investment based growth model defined that, growth can be generated through positive externalities which are associated with either human or physical capital accumulation. This type of model is used in Romer (1986) and Lucas (1988). The second group has focussed on the role of technology progress that created from research and development (R&D) activities, for example in Romer (1990) and Aghion & Howitt (1992).

Peng & Hong (2013), in their study addressed labor productivity spillovers in three simple approaches; Economic Distance Approach, Infrastructure Driven Approach and Geographic Distance Approach. In Economic Distance Approach, economic sector grows at different rates based on resource endowment, consumer preferences, income elasticity of demand and path of economic growth. On the assumption that resources and sectoral transactions are nationally mobile and connected, goods that produced in one sector might be used as an input in the other sectors. So, it will have an important impact to the growth of other sectors. While, some countries used various methods to protect their infant industries. These countries might face some problems related to consumption distortions and price wedge. Therefore, key sectors are used to induce growth in related sectors and the rest of the economy gradually. However, this policy intervention strongly depended on the linkages among sectors. Baffes & Shah (1998) discussed that, despite of reallocate resources equally to all sectors, government can direct the resources to the key sectors such as, telecommunication, transportation and electronic. Through the intercorelation and linkages between sectors, private and public input interaction can help in sustaining and enhancing the development of manufacturing sector. Moreover, Peng & Hong (2013) found that productivity of a sector significantly depended on the sector that produced its input. This sectoral multiplier effect affects sectoral development in two ways; indirect and direct impact. Directly, growth in one sector induces growth to another sector and that sector itself, while indirect impact is the growth of one sector induces net growth in the overall economy.

Firms that have similarly disaggregated industry codes are probable to have greater advantages from each other technology activities in corresponding to firm that have a different industrial code. Random data of Taiwanese manufacturing sector in 1991 showed that spillover effects exist in the firms that have higher productivity rate. However, these firms should come from similar

industrial code, industry-wide Direct Foreign Investment (DFI) and R&D. In Taiwan, the electronics industry has the highest share of DFI which was at 3.5 percentage while, the other industries have less than one percentage (Aw, 2002). Suyanto, Bloch, & Salim (2012) used four variables interchangeably as dependent variables to capture the FDI spillover effects in garment and electronics industries in Indonesia. These variables are total productivity growth, technical efficiency change, technological change and scale efficiency change. FDI was found to have a negative effect on total productivity growth, technological change and scale efficiency change while no significant contribution on technical efficiency change of electronics industry in Indonesia. Firms that have similarly disaggregated industry codes are probable to have greater advantages from each other technology activities in corresponding to firm that have a different industrial code. Random data of Taiwanese manufacturing sector in 1991 showed that spillover effects exist in the firms that have higher productivity rate. However, these firms should come from similar industrial code, industry-wide Direct Foreign Investment (DFI) and R&D. In Taiwan, the electronics industry has the highest share of DFI which was at 3.5 percentage while, the other industries have less than one percentage. This result is parallel to the previous studies.

Empirical Approach

This section explains method that used in this study. Total factor of productivity is defined as below;

$$\text{TFP} = \frac{Y}{IxK \times L}$$

Where;
TFP: Total factor productivity
Y = Output
I = Intermediate input
K = Physical Capital
L = Labor

This calculation is based on Malaysia Productivity Corporation. To be more specific, modifying from Gehringer (2014), spillover effect from TFP is calculated as follows;

$$TFPS_{it} = TFP_{it} \times VA_{kt},\ i \neq k$$

Where;
$TFPS_{it}$ = TFP spillover of i^{th} industry
TFP_{it} = The different of i^{th} industry TFP
VA_{kt} = Value added of sector k

To study the cross-sector spillover effect, TFP of i^{th} industry is multiply to the other sector's value added. Because of this research is conducted to study the spillover impact of E&E sector, the i^{th} industry is the highest productivity in E&E sector. Model is written as;

$$TFP_{it} = \alpha_i + \gamma TFP_{it-1} + \beta_1 lnk_{it} + \beta_2 lnl_{it} + \beta_3 lni_{it} + \beta_4 lnw_{it} + \beta_5 tfps_{it} + \varepsilon_{it}$$

Where;
k = Capital
l = Labor
i = Input
w = wages

Generalized Method of Moment (GMM) is employed for estimation purpose. According to Arellano and Bond (1991), GMM is used to tackle the problem of country specific effect and potential endogeneity of explanatory variables. GMM eliminates country specific effect or any time-invariant variable through first differencing. Correlation between lagged dependent variable and disturbance term that exist after first differencing can be erased by using instrumental variables. This method is known as first difference GMM. First difference GMM can be divided into one and two step GMM. The difference between these two methods is independent error terms and homoscedastic error variance across countries and times. However, this method does not hold for the consistency of variance-covariance matrix which is constructed in two steps GMM. However the potential information in level and first difference has been neglected. Moreover, level variables are weak instruments for their first difference (Blundell & Bond, 1998). Therefore, system GMM has been introduced by Arellano and Bover (1995) to improve the first difference GMM. Both two-step system and first difference GMM are used for this research analysis. Result from these methods is recorded for comparison purpose. Sargan test and serial correlation in disturbances are considered for GMM consistency. The validity of instruments used is depended on Sargan test. Failure in rejecting null hypothesis would imply that instruments used are valid and model is correctly specified. Meanwhile, the null of absence first order serial correlation (AR1) should be rejected instead of the absence of second order correlation (AR2) in serial correlation test. Both of these tests are specification tests for GMM.

Data

We employ panel data of three digit manufacturing data level, which involved 54 industries for a period of 2000 to 2012. The data has been restructured because both MSIC 2000 and MSIC 2008 have been affected during the study period. All data are restructured following codes that stated in MSIC 2000. Because of unavailability of data, 10 industries have been dropped from the sample. Data are collected from the Department of Statistic Malaysia.

Empirical Finding and Discussion

This section discusses the main findings of the research. Table 1 contains results of both two steps and system GMM. Both estimation tests confirmed the positive impact of development in E&E sector. However the impact was relatively small but significant at 1 percentage level. The positive impact of this industry's productivity only range between $8.40e^{-09}$ to $8.42e^{-09}$ from both tests. This impact will be large if data from two digit level of manufacturing sector is used.

Table 1: Results

	Difference GMM	System GMM
Constant	1.2603 (0.000)***	1.2014(0.000)***
TFP_{t-1}	0.0777 (0.000)***	0.1135(0.000)***
Lnk	-0.1947 (0.000)***	-0.1951(0.000)***
Lnl	-0.0282 (0.000)***	-0.0044(0.246)
Lni	0.0938 (0.000)***	0.0953(0.000)***
Lnw	0.0913 (0.000)***	0.0742(0.000)***
Tfps	$8.40e^{-09}$ (0.000)***	$8.42e^{-09}$(0.000)***
Sargan Test (p-value)	0.4815 (0.000)***	0.7003(0.000)***
AR1: p-value	0.0134 **	0.0006***
AR2: p-value	0.5085	0.4899

Note: 1. Number in parentheses are p-values
2. *** indicates that values are significant at 1% level
3. ** indicates that values are significant at 5% level

From this result, we know that, productivity development of each industry largely depended on their own input and wages system. A percentage change in input leads to 0.000938 changes in industrial productivity when estimated using difference GMM and 0.000953 changes by system GMM. The positive impact of wages to industry's productivity ranges between 0.000742 and 0.000913 from both estimations. However, capital and labor are negatively affected industry productivity, which values can be referred in table 1. All results are significant at 1 percentage level.

Sargan test does not reject the over identifying restrictions. These results suggest that we have valid instruments. There is no second order autocorrelation as null hypothesis of serial correlation test cannot be rejected. However, the serial correlation test rejects the null of no-first order autocorrelation. The residual of level equation do not suffer from autocorrelation problems.

The positive spillover impact from E&E industry is similar to our expectation due to several reasons. First, this study employed three digit level of manufacturing sector data. Therefore the spillover effect might be large if we used a more concentrated or sectoral level data (two digits) data. Second, as stated in Gehringer (2014), the TFP spillovers show positive, significant but weak evidence of forcing the development of downstream sectors. This result was obtained only through fixed effect model and the researcher fails to demonstrate the spillovers effect by system GMM. Moreover, this research applied two digit or sectoral level data of manufacturing and services sectors.

However, the negative impact of capital to productivity growth is beyond our expectation but not the labor. According to Lee (2011), the Malaysian manufacturing sector is driven mainly by capital intensity and human capital. This statement makes sense as refer to available data, obtained from Department of Statistics Malaysia, in 2012, total employment of manufacturing sector was 1.99 million. Only 383, 346 persons of that is human capital, based on their level of education. Therefore, it suggested that the negative contribution of capital to manufacturing productivity happened because of human capital constraint. Human capital is important in operating new or some technology that incorporated in each of capital used (Yean, 1997). Our result is parallel to Norasiah (2012). Major source of TFP of manufacturing sector in Malaysia was intermediate input. The contribution of capital and labor are substantially low (Norasiah, 2012).

Besides, the relation between wages and productivity are already known. A huge body of researches has been conducted for this issue. For example, in Yellen (1984), wages or salaries have an important role in determining productivity improvement. Higher wages will make workers more motivated and productive, thus enhance the process of development. This can be an explanation for our positive relation between wages and manufacturing total factor productivity.

Conclusion

The E&E industry can be reported as having a positive effect on other sector productivity growth, but this effect is weak. However, the effect might be different if two digits or sectoral level data is used. Aside of this spillover effect, we can conclude that the growth of manufacturing productivity is depending on their input and wages. The negative effect of capital stock to the productivity growth is assumed to be related to labor constraint, specific human capital. This is because, each capital needs a

specific skill to be used effectively. Unskilled workers may lead to the ineffectiveness used of certain capital. These results confirmed that E&E industry has a positive effect on other sector development, although the effect is weak. The main constraint of this study is the availability of data.

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