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The Impact of Globalization on Total Factor Productivity of the Manufacturing Sector in Malaysia

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ABSTRACT

This paper examines the impact of globalization on total factor productivity (TFP) performance of the Malaysian manufacturing sector. The motivation for this study is bring due to the need to present the impact of globalization on the TFP estimates of the manufacturing sector. In this study, we observe the globalization impact by taking into account the variables that representing globalization economy. The variables comprise of foreign labour, technology, foreign direct investment and the openness of the economy. Apart from that, outputs and capital intensity are also taken consideration. This study utilizes data from the Industrial Manufacturing Survey, Department of Statistics Malaysia, which cover the period from 1990 to 2008. The analysis comprises of two parts; the manufacturing sector and 15 industries of the manufacturing sector. The findings show that the FDI and openness of the economy are statistically significant and positively contribute to the performance of TFP of the manufacturing sector. On the other hand, foreign labour and the number of technology agreement are not statistically significant. Both variables do not contributed to the TFP performance of the manufacturing sector. In terms of analysis by industry, three industries indicate the effects on the TFP performance are at the highest. These are industries of the manufacturing machinery and equipment products, industry scientific and measuring equipment products and industry of electronics and electrical products.

Key words: globalization, total factor productivity and manufacturing sector.

INTRODUCTION

The term globalization refers to the integration of economies of the world through uninhibited trade and financial flows, also through mutual exchange of technology and knowledge. Ideally, it also contains free inter-country movement of labour. In context of Malaysia, this implies opening up the economy to foreign direct investment by providing facilities to foreign companies to invest in many sectoral economic activities. Since globalization involves the increasing integration of countries into the world economy, firms have an advantage to plan their production on a worldwide basis and allowing them to achieve economies of scale through exporting. The study in Asia reveals that FDI facilitate growth in the economy of many Asian countries during the decade of 1970s and 1990s (Oguchi et.al, 2002). By examining the role of FDI intensity on the achievement of productivity, FDI has positively contribute to the performance of TFP, in terms of contribution per unit labour of growth in 5 ASEAN countries (Malaysia, Indonesia, Philippines, Singapore and Thailand), including South Korea and China (Elsadig, 2008).

Demand for foreign labour is increasing in Malaysia, especially for the manufacturing sector. The impact of foreign workers on labor productivity is positive and significant, and this effect will lead to increase the production of output level (Zaleha et al, 2011). In contrast, Abdul Kadir et.al (2005) find that foreign labour and shortage in domestic labour shows that the effects of foreign labour on the growth in TFP is very small, even though it is positive. The participation of foreign labour in terms of FDI inflows is not important and their presences have contributed to a huge difference of skills with local labour. The quality of foreign workers found to be important for skill differences. The high-skilled of foreign labour is significantly increase the relative demand for labour, while unskilled foreign labour have the opposite effect and it is not significant, (Evelyn and Chan, 2009). Many studies consent that in long-run, the immigrants do not reduce the rate of participation of local workers, but they can improve productivity and the average income in the economy (Nikolaj et al, 2011; Peri, 2010; Evelyn and Chan, 2009; Ottaviano and Peri, 2008; Mahadevan, 2006) and Abdul Kadir et al, 2005).

There are number of studies that analyze the impact on the productivity/total factor productivity (TFP). Although many studies examine the impact on productivity/TFP, the studies however investigate an indicator of globalization independently, which is on the particular aspect such as foreign direct investment, foreign labour, exports, technology and trade liberalization. The FDI shows a positive impact on the TFP (Pessoa, 2005). The finding is supported by studies from other findings that obtained a similar result that FDI positively and significantly affect growth in TFP (Nadiri, 1999; Luiz, 1999; Girma, 2005; Miyamoto and Liu, 2005; Ng, 2006; Subaran Roy, 2009; and Hong and Sun, 2011). However, several studies obtain an opposite results that FDI has no significant impact on TFP in Canadian manufacturing sector from the period of 1976-2008 (Parviz, 2011). Study by Kawai (1994) also points out that FDI may not be a good determinant of TFP growth, due to the fact, that foreign production may occur in oligopolistic sectors.

From the results from past studies, it is undeniable that technology has a significant contribution on the productivity/TFP for a country. Study Savvides and Zachariadis's (2005) reveals that technology has a positive and the biggest impact on the domestic productivity and the value added growth for the manufacturing sector of 32 countries. The study covers for low and middle income economies during the period of 1965-1992. Recent study also verifies that foreign research and development, and technology have increased an aggregate productivity in developing countries (Abdoulaye, 2011). The evidence also highlights that the dramatic growth of information communication technology (ICT) and technology in India had a significant effect on the performance of productive manufacturing, both at TFP level and technical efficiency level (Mitra and Sharma, 2011). The impact of technology spillovers on TFP of the manufacturing sector in Pakistan shows that technology increases the level of total productivity (Ali et al, 2012).

Many studies have given attention on the openness of the economy, which analyze the impact of exports and imports on the productivity/TFP/growth in TFP. In many cases, past studies concern about tariff to reflect exports and imports volume under trade liberalization. The impact of trade liberalization on the TFP growth shows the result of lowering tariff/tariff reforms and relative adjustment of real effective exchange rate has contributed positively to productivity growth (Goldar and Anita, 2003; Armita and Paramita, 2010). Another study tests for causality between TFP/TFP growth and the variable of openness of the economy (Serpil, 2010; Edwards, 1998; Mohamed, Patrick and Dora, 2005). They obtain a significant result for the Tunisian manufacturing sector, while an opposite appear for the OECD countries. On the other hand, Hwang and Wang (2004) examine data from 45 industries of the Japanese manufacturing sector over the period of 1973-1998 show that openness to trade does not show a positive relationship with TFP growth. The finding is similar with Kim, Lim and Park's (2007) findings on the study of Korea manufacturing sector from the period 1980-2003.

The characteristics of globalization removes protection against imports, allowing firms to achieve economies of scale through exporting, free capital flows of inward and outward, migration/mobility of foreign labour, and increase in technology agreement through licensing and knowledge expertise. Based on the above circumstances, the motivation of this study is to analyze the impact of globalization on the TFP, which focuses on the manufacturing sector in Malaysia. Furthermore, this study is furthered examine the impact of globalization on the industries/sub-sectors of the manufacturing sector by classifying production into 15 industries of the manufacturing sector.

To address the issue of globalization and its impact on the TFP, this study taking into account some indicators to highlight the presence of the globalized economy. In this study, we use the proxies of globalization; that is openness of the economy as share of exports and imports to GDP), the foreign direct investment inflows, the ratio of foreign labour to locals and the number of technology agreements. The more globalize the economy, especially for small open-economy like Malaysia, it is expected that all variables investigated in this study will affect TFP directly and indirectly, particularly in the manufacturing sector. The transform/change in all variables that mentioned above would be expected to change/affect TFP of the manufacturing sector and TFP among industries of the manufacturing sector.

The remainder of this paper is organized as follows. Section two provides the literature review. Section three structures the methodology, which consists of source of data, TFP measures and the specification of the model. Section four presents the results of the study and discusses determinants of TFP by examining the indicators of globalization economy. Finally, section five contains the summary and conclusions.

THE LITERATURE REVIEW

Foreign Direct Investment

Pessoa (2005) study the effects of FDI on the aggregate TFP in 16 OECD countries from the period of 1985-2001. By using panel data approach, the empirical test found that FDI has a positive impact on TFP, possibly because FDI is a channel through which technologies are transferred internationally. The result shows that 1 percent increase in FDI, TFP will increase by 0.019 to 0.023 percent. This research finding is supported by other studies findings that similarly obtain FDI have positively and significantly affect growth in TFP (Nadiri, 1999; Luiz, 1999; Girma, 2005; Miyamoto and Liu, 2005; Ng, 2006; Subaran, 2009; and Hong and Sun, 2011).

Herzer (2011) examines the long-run relationship between outward FDI and TFP on the 33 samples of developing countries over the period of 1980-2005. Using the technique of panel co-integration, the results discovered two prominent findings. First, the outward FDI has a positive effect on the TFP performance in developing countries, and, second, the effect is larger in the long-run. On the other hand, Peter's (2006) study investigates the impact of inward FDI on the host country using industry-level data for 11 OECD countries from 1987 to 2003. The results show that the effect of FDI on the productivity is significant and positive, particularly the contribution of capital to productivity, specifically for high-technology industries that use technology intensively. As a results, the larger the FDI, the larger the impact on the productivity in large OECD countries compared to small OECD countries.

Another study that utilizes panel data of 23 industries of the manufacturing sector from the period 1995-2005 shows that FDI facilitates a positive and significant impact on the TFP in the Vietnamese economy, in terms of backward linkage (Anwar and Nguyen, 2011). Furthermore, industries with larger stock of human capital gain more benefits from FDI spillovers through backward linkage, and hence, these industries experienced higher level of technology transfer than the other one.

The impact of FDI (Japan and the United States) on the TFP growth in Indian manufacturing firms between the sub-period of 1993-94 and 1999-2000 show that Japanese affiliation has a significant and positive impact on the firms' productivity, while the impact of US affiliation is not found to be significant (Rashmi, 2004).

Although there are many findings support that FDI has a positive impact on the TFP performance and TFP growth, but several studies obtain an opposite results from the former one. For instance, Parviz's (2011) study obtain that FDI has no significant impact on TFP in Canadian manufacturing sector from the period 1976 to 2008. Kawai (1994) also points out that FDI may not be a good determinant of TFP growth, due to the fact, that foreign production may occur in the oligopolistic sectors.

Technology

Savvides and Zachariadis (2005) evaluate the simultaneous contribution of several channels of technology diffusion to the TFP growth performance of the manufacturing sector in low and middle-income group economies. Foreign technology typically has the biggest positive impact on the domestic productivity and value added growth in the manufacturing sector of 32 countries during the period of 1965-1992.

Abdoulaye (2011) point out that technology spillovers and mechanisms involve a great opportunity for the economic growth in developing countries. The results that based on the non-stationary panel of 55 developing countries indicate that 10 percent increase in foreign research and development, and technology, have increased more than 2 percent the aggregate productivity. The result is supported by Emmanuel (2000) that obtains radical technology innovation is significantly affect growth in TFP.[1]

Schiff and Wang (2008) examine the impact on TFP growth in the North-South and South-South trade-related technology diffusion and FDI. The findings show that both North-South and South-South trade-related research and development have a positive impact on the TFP growth in South and the impact on the TFP of trade-related technology diffusion increases with the level of education in the case of North-South trade, but not in the case of South-South trade. Mitra and Sharma (2011) find the core infrastructure indicates a TFP level at around 0.32 is considered high, while the technical efficiency are relatively smaller, at around 0.12, but still acceptable. The evidence also highlights that

[1] Radical technology innovations are made by firms that used formal research and development and codified external sources of knowledge, which includes patents and licenses.

the dramatic growth of information communication technology (ICT) and technology in India had a significant effect on the performance of productive manufacturing, both at the TFP level and technical efficiency level.

Ali et al (2012) study the impacts of technology spillovers on the TFP of the manufacturing sector in Pakistan. All manufacturing groups show the presence of both horizontal and vertical spillovers in petroleum and tobacco sector, while it is limited in textile and food sub-sectors. The results show that an increase in technology, FDI, imports, exports, and research and development, TFP will also increase. This is similar to Almas and Subal's (2010) findings that technology transfer has a positive impact on the TFP growth in China.

Openness of the Economy

Satish (1999) study the impact of the change in trade on the economic efficiency by utilizing industrial data. The empirical analysis shows that 1 percent decline in the nominal rate of assistance leads to between 0.58 and 0.56 percent gain in TFP, the latter our measure of economic efficiency. Using the Malmquist-Productivity Index from Data Envelopment Analysis, the impact of trade liberalization on the TFP growth in Indian manufacturing sector shows the result of lowering tariff and relative adjustment of real effective exchange rate has contributed positively to the growth in productivity. Out of 17 industries, several industries experience favourable effects of effective-protection, import-coverage-ratio, import-penetration-ratio, and real effective exchange rate have declined the productivity growth. Increase in productivity growth decline by raising in firm-size, increase in rate of real wage and lowering the number of employees (Armita and Paramita, 2010).

Study by Goldar and Anita (2003) using the industry-level data and incorporating some trade-related variables explicitly conclude that tariff reforms have favourable and significant effects on the TFP growth. Furthermore, Mohamed et al (2005), test the causality between TFP growth and the variables that reflect openness of the economy using panel data in six Tunisian manufacturing sub-sectors and in OECD countries from the period of 1983 to 1990. They obtain that the variables of the openness of the economy are significant to growth in TFP in Tunisian manufacturing sector, while the result is opposite for the OECD countries.

By using a measure of real economic openness, Alcal and Ciccone (2004) study the causal effect of foreign trade on the productivity across countries. The results show an international trade has statistically significant and the effect on the productivity is positive. These finding are similar with findings from Edwards (1998) that also find a positive result of the economic openness on the TFP growth in 93 countries from the year 1960 to 1990. Study in Turkey also indicates that the impact of the openness economy on the TFP is also positive and significant (Serpil, 2010). The TFP increased by 0.56 percent for the entire manufacturing industry, while the public sector and private sector accounted for 0.51 percent and 0.60 percent, respectively over the period of 1985 to 2001.

Hwang and Wang (2004) examine the effects of openness to trade on the TFP growth using data from 45 industries of the Japanese manufacturing sector over the period of 1973-1998. The results exhibit that the openness to trade does not show a positive relationship with the growth in TFP. Consider to these findings, trade expansion has insignificant and ambiguous effect on the TFP growth. The finding is similar with Kim et al's (2007) finding on the study of Korean manufacturing sector from the period 1980-2003. Another study is supported by Mahadevan's (2002) study that the impact of trade liberalization on the productivity has a positive and significant effect on the technological progress, but it has no significant effect on the technical efficiency in the case of Australian manufacturing industries from 1968-69 to 1994-95.

Foreign Labour

Many studies have examine the relationship and effect of foreign workers on the TFP growth such as study by Zaleha et al (2011); Nikolaj et al (2011); Peri (2010); Evelyn and Chan (2009); Ottaviano and Peri (2008); Mahadevan (2006); and Abdul Kadir et al (2005). These studies conclude that in long-run, the immigrants do not reduce the rate of participation of local workers, but they can improve productivity and the average income of the economy. The study is consistent with studies done by Peri (2010) in the United States. Meanwhile, study conducted by Nikolaj et al (2011) shows a significant and positive relationship of the effect of foreign experts on the TFP, wages, and profit of the local firms in Denmark. Moreover, it has also increased the chance to hire more foreign experts. This study is supported by the finding of the study by Coury and Lahouel (2011), Ottaviano and Peri (2008) and Mahadevan (2006).

THE METHODOLOGY

Sources of Data

This study utilizes data from Industrial Manufacturing Survey (IMS) published by Department of Statistics Economy (DOS). Since the study employs panel regression analysis, this work has to combine data of time series and cross section. The time series covers 19 observations from the period of 1990 to 2008, and the cross section contains 15 industries of the manufacturing sector that that compose the amount of 285 observations. By utilizing both data, this study classifies analysis into the impact of globalization on the TFP of the manufacturing sector and on the TFP's industries of the manufacturing sector. The classifications of 15 industries of the manufacturing sector are at 3 digit-level of the Malaysian Standard Industrial Classification (MSIC) (see TABLE 1). A multi regression model is used to investigate the relationship between TFP performance and several independent variables, namely; total output industry, capital intensity of industry, the ratio of local labour to foreign labour of industry, technology, foreign direct investment, and the openness of the economy. All data of the variables are gathered from various sources. These include Malaysian Industrial Development Authority (MIDA) for FDI, Ministry of International Trade and Industry (MITI) for technology, exports, imports, and GDP, Immigration Department for foreign labour.

For the TFP measures, the value-added is used for output industry. Value-added, labour and capital were unpublished data taken from the IMS (DOS). Labour data are expressed in total salary and wages, bonus, cash allowances and overtime pay. Capital data obtains from the value of net fixed assets as at the end of a calendar year (gross fixed asset - depreciation rate + gross fixed capital formation/capital expenditure). The capital consists of building and other construction, machinery equipment, transport equipment, and ICT tools such as computers. The variables were deflated using the domestic producer prices, which is based on 1990 as its base year.

TFP Measures

Estimation of TFP is based on the Cobb Douglas Production function with the assumption of constant return to scale.

$$Y=AK^{\alpha} L^{\beta} \tag{1}$$

Then equation can be expressed in log-linear form as follows:

$$lnY = lnA + \alpha\, lnK + \beta \ln L + \mu \tag{2}$$

Where, Y is gross output, K is capital, L is labour, α is parameter for capital, β is parameter for labour and μ is an error term.

Model Specification

The relationship between TFP and independent variables in the multivariate model can be specified as follows:

$$TFP_{it} = f(Y_{it}, K/L_{it}, FL/LC_{it}, TEA_{it}, FDI_{it}, OPN_t, D_t) \tag{3}$$

For the econometric analysis, equation (3) is expressed as a semi log-linear regression, where lowercase variables are the natural log of the respective uppercase variables. The empirical model for TFP in the multivariate model can be summarized as follows:

$$lnTFP_{it} = \alpha + \beta_1 lnY_{it} + \beta_2\, K/L_{it} + \beta_3\, lnFL/LC_{it} + \beta_4 lnTEA_{it} + \beta_5 lnFDI_{it} + \beta_6 OPN_t + D_t + \varepsilon_{it} \tag{4}$$

$$i = 1, \ldots . n; \quad t = 1, \ldots . t$$

Where

TFP_{it} = denotes total factor productivity of industry *i*;
Y_i = vector of value-added by industry;
K/L_i = capital intensity by industry;
FL/LC_i = ratio of foreign labour to local labour by industry;
TEA_i = number of technology agreement by industry;
FDI_i = foreign direct investment by industry;
OPN_t = openness of the economy;
D_t = dummy time period and;
ε_{it} = an error term.

α and β are the parameters and vectors of the parameters to be estimated. i is an industry divided into fifteen industries of the manufacturing sector (see Table 1). t is a time. Dt is a dummy variable of time period, which is 1 refers to the time period after 2000 and above and, 0 is the time period before 2000 and below.

RESULTS AND DISCUSSION

TABLE 2 shows the statistics of the variables use in this study. From the table, all indicators show an increasing amount of the value from 1990 to 2010, except for the variable of FDI and the number of technology agreement. It is not surprisingly that the amount of FDI and the number of technology agreement drop between 1995 and 2000 due to the crisis of financial economy during the period. The economy has recovered after this period when all variables exhibit a huge increase from 2005 to the year of 2010 (see TABLE 2).

The descriptive statistics of the variables use in this study can be seen in TABLE 3. The explanatory variable of labour is computed by taking into account the ratio of foreign labour to local labour. This is to obtain the information of foreign labour for everyone local labour in the manufacturing sector. Based on the TABLE 4, the ratio of foreign labour to total labour for skill category of managerial and professional is at 0.005 in 1990 and both at 0.003 in 1995 and 2000, respectively. This is higher than the technical and supervisory category, which is indicated at 0.003 in 1990 and 0.002 in 1995 and 2000, respectively. This ratio of technical and supervisory category however increased in 2005 and 2008 leading to be the same with the managerial and professional. This reflects that the labour workforce of the foreign labour for the category of technical and supervisory has increased during the period.

TABLE 7 shows the results of globalization and TFP of the manufacturing sector based on the estimation of the three models; these are pooled least square model (PLS), fixed-effect model (FE) and random effect model (RE). All variables have tested for the stationary test of level. The unit root test of the Philips Peron shows that all variables are stationary at 1 percent level of significant at the first-order difference (see TABLE 5).

For the purpose of panel regression model, this study has to verify a few tests in order to choose which models are fit to be analyzed in this study. The panel regression model has to verify the test of multicolinearity and autocorrelation. The multicollinearity problem is the existence of the perfect or high linear relationship among several or all explanatory variables of a regression model and it will be test by correlation pair-wise correlation. The autocorrelation problem is a correlation between members of series of observations ordered in time (in time-series data) or space (in cross-sectional data).

Based on the TABLE 6, the variance inflation factor (VIF) value are less than 10 for pooled least squared (PLS) model, fixed effect (FE) model and random effect (RE) model at 4.27, 7.91, and 2.98, respectively. This indicates that all the explanatory variables are free from the multi-collinearity problem. These three models are free from the multi-collinearity problem to verify that each regressor is not high correlated. We also check for autocorrelation and the results show that autocorrelation exist from the estimation. To overcome this problem we run autoregressive model and the problem solved at AR(1).

From TABLE 6, the Wald test is used to identify which models are going to be selected between PLS and FE. Based on the test, the p-value of Wald test is statistically significant at 1 percent level of significance, meaning that, the FE model can be selected. The LM test uses for the selection between the PLS and RE model. It is found that the result of the LM test is significant at 1 percent level of significance in order to choose the RE model. Finally, the Hausman test shows that the FE model is

preferred for this study due to the rejection of null hypothesis of the RE model. Therefore, the FE model is an appropriate model to employ in this study. The result of the FE model is presented in the equation below as follows (see Table 7):

$$lnTFP_t = 1.974 + 0.106lnY + 0.001K/L + 0.018FL/LC + 0.012lnFDI + 0.001lnTEA + 0.230PN - 0.132D_t$$

From the result, the R^2 value registered at 0.874. This shows that all explanatory variables explain about 87.4 percent the performance of TFP of the manufacturing sector during the study. The result shows that the variable of output, capital intensity, ratio of foreign labour to local labour, foreign direct investment, technology agreements and the openness of the economy has positively and statistically significant at 1 percent and 10 percent level of significance. The variable of output shows the elasticity is 0.106. It reflects that 1 percent increase in the output, TFP of the manufacturing sector will increase nearly by 0.106 point. Furthermore, the results show that 1 percent increase in capital intensity, the TFP of the manufacturing sector will increase by 0.001 point.

On the other hand, the variable of globalization like ratio of foreign labour to local labour, FDI, technology agreements and economic openness show positive and significant relationship with TFP growth in Malaysian manufacturing sector. It shows that an increase of 1 percent increase in ratio of foreign labour to local labour will increase TFP by 0.0018 point. FDI and technology agreements have significant at 10 percent level of significance and the TFP of the manufacturing sector will increase by 0.012 point and 0.001 point respectively. Openness of the economy indicates the positive coefficient at 0.229 shows that increase in 1 percent in this variable, TFP will increase by 0.230 point. Dummy variable shows that the year after 2000 negatively influence the performance of TFP of the manufacturing sector.

Table 8 shows the results of the regression model in fifteen industries of the manufacturing sector. The results show that three industries have affected the most on the TFP based on the cross section effect. These are manufacturing of machinery and equipment industry (I11), manufacturing of electronics and electrical products industry (I13) and manufacturing of basic metal products (I10). These industries indicate the effect on the TFP of the manufacturing sector is at 94.8 percent, 81.7 percent, and 79.1 percent, respectively. The variables of output and capital intensity positively and statistically significant at 1 percent and 10 percent level of significance in most industries of the manufacturing sector (see TABLE 8). The output and capital intensity have contributed to the performance of TFP of the manufacturing sector during the study. The higher the ratio of capital to labour and the number of technology agreement, the higher the TFP increased in most industries of the manufacturing sector. This result is supported by Abdoulaye's (2011) study indicate that 10 percent increase in research and development, and technology, has increased more than 2 percent in aggregate productivity in 55 developing countries.

CONCLUSION

From the results as discussed above, this study concludes that in general, globalization has influenced the TFP performance of the manufacturing sector. This is shown by the variables used in this study that represent the indicators/proxies of the globalization are obtained significant and positively contribute to the performance of TFP of the manufacturing sector. The ratio of foreign labour to local labour, FDI, technology agreements and openness of the economy are statistically significant and positively contribute to the TFP performance of the manufacturing sector. From the result, the number of foreign labour has increased gradually for the manufacturing sector during the study, this shows that foreign labour contribute to the performance of TFP of the manufacturing sector. Variables of FDI, technology agreements and openness of the economy are inter-related each other. This is because Malaysian government provides incentive to foreign investor in terms of exports performance. In this case, the higher the exports of the multinational companies, the more incentives benefit to them.

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TABLE 1: Descriptions of Industry of the Manufacturing Sector

Industries	**3-digit level of classifications**	**Descriptions of Industry**
I1	151, 152, 153, 154	Manufacturing of food products
I2	155, 160	Manufacturing of beverages and tobacco products
I3	171, 172, 181, 182	Manufacturing of textile and textile products
I4	201, 202	Manufacturing of wood and wood products
I5	210, 221, 222, 223	Manufacturing of paper, printing and publishing
I6	231, 232, 233	Manufacturing of petroleum products
I7	241, 242, 243	Manufacturing of chemical and chemical products
I8	251, 252	Manufacturing of rubber and plastic products
I9	261, 269	Manufacturing of non-metallic mineral products
I10	271,272,273	Manufacturing of basic metal products
I11	291, 292, 293,	Manufacturing of machinery and equipment
I12	300	Manufacturing of scientific and measuring equipment
I13	311, 312, 313, 314, 315, 319, 321, 322, 323	Manufacturing of electronics and electrical products
I14	341, 342, 343, 351, 352, 353, 359	Manufacturing of transport equipment
I15	361, 369	Manufacturing of furniture and fixtures

Source: MSIC, 2000

TABLE 2: Growth Rate of the Selected Indicators of the Manufacturing Sector, 1990-2010

Indicators	**1990**	**1995**	**2000**	**2005**	**2010**
Employment (‘000 people)	844 733	1 389 418	1 574 797	1 675 163	1 895 365
Value added (RM ‘000)	24 530	59 629	88 240	655 520	870 981
Capital intensity	0.1055	0.1348	0.2224	0.3207	0.1321
Foreign direct investment (RM million)	17 629	9 143	19 848	17 882	27 547
Foreign labour (‘000 people)	85 704	110 096	307 167	581 379	836 711
Number of technology agreement	906	898	805	1 027	1 293
Export (RM million)	79 646	184 987	373 270	536 234	640 044
Import (RM million)	79 117	194 345	311 459	432 871	505 531
GDP (RM million)	119 081	222 473	356 401	522 445	765 965

Sources: [External Trade Statistics; Malaysia Economic Statistics-Time Series, (DOS)];
Economic Report and Malaysian Industrial Development Authority (MIDA).

TABLE 3: Descriptive Statistics of the Variables

Variables	**Mean**	**Median**	**Maximum**	**Minimum**	**Standard Deviation**	**N**
TFP	0.812	0.835	1.000	0.128	0.179	285
Y	6636148	3853077	79700000	184008	9535747	285
K/L	2.509	2.512	582.793	7.089	0.156	285
FL/LC	10.307	3.254	146.247	0.257	20.705	285
TEA	911.000	895.000	1391.000	686.000	157.793	285
FDI	16344257	4478091	436830770	1300.745	39736478	285
OPN	1.651	1.690	1.920	1.330	0.186	285
Dsc	0.429	0.000	1.000	0.000	0.496	285

Notes: Y = Actual value of gross output of the manufacturing sector (RM ‘000)
K/L = Capital intensity (RM’000)
FL/LC= Ratio of foreign labour to local labour.
TEA = Number of technology agreement of the manufacturing sector.
FDI = Actual value of foreign direct investment of the manufacturing sector (RM ‘000)
OPN = Exports + Imports/GDP

TABLE 4: Ratio of Local and Foreign Labour by Category of Skills

Category of skills	**Ratio of labour**	**1990**	**1995**	**2000**	**2005**	**2008**
Managerial and professional	LC/TL	0.0371	0.0456	0.0514	0.0692	0.0792
	FL/TL	0.0053	0.0032	0.0031	0.0027	0.0031
Technical and supervisory	LC/TL	0.0816	0.0935	0.1091	0.1113	0.1109
	FL/TL	0.0027	0.0016	0.0018	0.0027	0.0029

Notes: i. LC/TL: ratio of local labour to total labour.
ii. FL/TL: ratio of foreign labour to total labour.

TABLE 5: Philips Peron (PP) Unit Root Test at Levels and at First Differences

Variables	**Philips Peron test statistic**			
	At level I(0)		**At First-order Difference I(1)**	
	Constant	Constant+ trend	Constant	Constant+ trend
TFP	56.533***	81.512***	1018.970***	234.064***
LnY	71.103***	28.402***	171.189***	136.997***
K/L	66.844***	60.233***	678.129***	252.546***
FL/LC	27.639**	46.338***	117.621***	188.964***
LnFDI	162.211***	150.376***	1899.900***	280.430***
LnTEA	80.568***	110.195***	751.721***	312.989***
OPN	21.254**	37.435**	285.818***	193.727***
D_t	18.036*	20.454**	152.177***	103.924***

TABLE 6: Test of the Panel Regression Models

Tests	**PLS model (Pooled least squared)**	**FE model (Fixed effect)**	**RE model (Random effect)**
DW-Statistic AR(1) test ρ-value VIF	1.9182 0.000 4.2662	1.9711 0.000 7.9114	2.1711 0.000 2.9771
Wald test: F-Wald test 1%		Pooled vs Fixed reject H_o (F critical > F table) (49.747) (2.700)	
LM test: χ^2 test 1%	Pooled vs Random reject H_o (χ^2 critical > χ^2 table) (72.485) (20.090)		
Hausman test: χ^2 test 1%			Random vs Fixed reject H_o (χ^2 critical > χ^2 Table) (369.640) (18.475)

TABLE 7: Results of the Analysis

Dependent Variable : TFP	**Pooled Least Squared**	**Fixed Effect**	**Random Effect**
Independent Variable			
C	2.6600 (7.9586)***	1.9740 (4.7125)***	2.4335 (7.5813)***
LNY	0.0319 (1.6547)*	0.1058 (3.6095)***	0.0655 (2.9564)***
K/L	0.0023 (16.0981)***	0.0014 (17.0324)***	0.0015 (18.9043)***
FL/LC	0.0064 (6.0184)***	0.0176 (3.7310)***	0.0017 (2.5166)**
LNFDI	0.0118 (1.0912)	0.0122 (1.7209)*	0.0120 (1.7461)*
LNTEA	0.1313	0.0007	0.0509

	(7.1705)***	(1.8927)*	(3.0439)***
OPN	0.2616 (2.1648)**	0.2299 (3.1065)***	0.2798 (4.0808)***
Dsc	-0.1228 (-0.25934)**	-0.1319 (-4.7233)***	-0.1165 (-4.4485)***
R Squared **F-Statistic** **ρ-value**	0.7656 115.7490 0.0000	0.8736 173.4456 0.0000	0.6441 64.1209 0.0000
No. Observation	285		

Notes: i. Figure in parentheses is t value of coefficient β.

ii. *** significant at level 0.01

** significant at level 0.05

* significant at level 0.10

^{ns} not significant.

TABLE 8: Results by Industries of the Manufacturing Sector

Variables	**I1**	**I2**	**I3**	**I4**	**I5**	**I6**	**I7**	**I8**
Constant	3.2882 (22.7468)***	3.4532 (8.1822)***	3.2395 (15.5881)***	-265.0527 (-15.7453)***	2.8075 (15.7542)***	3.4134 (17.6855)***	3.3415 (13.4622)***	3.636 (6.1292)***
LNY	0.0413 (5.2332)***	0.0274 (0.8817)	0.0408 (3.0465)**	-4.1155 (-3.8708)***	0.0726 (6.3640)***	0.028 (1.9886)*	0.0394 (2.4967)**	0.0319 (0.8636)
K_L	0.0138 (19.3782)***	0.0122 (23.9738)***	0.0168 (15.6467)***	82.3647 (34.5841)***	0.0117 (41.5713)***	0.0144 (23.7088)***	0.0146 (13.2783)***	0.00098 (21.0672)***
FL/LC	0.0155 (1.4307)	0.0001 (0.4653)	0.0098 (1.6672)	-0.2076 (-0.3029)	0.0013 (1.17430	0.0017 (1.1001)	0.0072 (1.5405)	0.0052 (0.7897)
LNFDI	-0.0015 (-0.3842)	0.0006 (0.2811)	0.0025 (1.7816)	-0.0714 (-0.1653)	-0.0023 (-1.5029)	0.0012 (0.5740)	0.0002 (0.0619)	-0.0080 (-1.3587)
LNTEA	-0.0045 (-1.4767)	-0.0037 (-0.5781)	-0.0002 (-0.0367)	0.5218 (0.3929)	0.0259 (2.4197)**	-0.0025 (-0.2829)	-0.0042 (-0.4732)	-0.0063 (-0.3755)
OPN	0.0209 (1.4065)	0.0711 (1.9246)*	0.0265 (1.3947)	-1.5918 (-0.6609)	0.0331 (2.2243)**	0.0372 (1.1410)	0.0064 (0.3223)	0.0632 (2.2952)**
Dsc	0.0069 (0.4247)	0.0135 (0.4925)	0.0224 (2.8907)**	-0.4799 (-0.3306)	-0.0213 (-2.6200)**	0.0186 (1.3776)	0.0148 (1.3829)	-0.0416 (-2.1063)
R^2	0.9945	0.9932	0.9719	0.9955	0.9981	0.9943	0.9951	0.9963
F-statistic	285.2891	229.1436	54.30488	347.3413	832.0766	273.0172	320.5891	427.4621
Cross section effect	-0.2065	0.1224	-0.1608	0.0478	0.0131	-0.2168	-0.1765	0.0661

Contd.

Variables	**I9**	**I10**	**I11**	**I12**	**I13**	**I14**	**I15**
Constant	3.2882 (22.7468)***	3.4532 (8.1822)***	3.2395 (15.5881)***	-265.0527 (-15.7453)***	2.8075 (15.7542)***	3.4134 (17.6855)***	3.3415 (13.4622)***
LNY	0.0413 (5.2332)***	0.0274 (0.8817)	0.0408 (3.0465)**	-4.1155 (-3.8708)***	0.0726 (6.3640)***	0.028 (1.9886)*	0.0394 (2.4967)**
K_L	0.0138 (19.3782)***	0.0122 (23.9738)***	0.0168 (15.6467)***	82.3647 (34.5841)***	0.0117 (41.5713)***	0.0144 (23.7088)***	0.0146 (13.2783)***
FL/LC	0.0155 (1.4307)	0.0001 (0.4653)	0.0098 (1.6672)	-0.2076 (-0.3029)	0.0013 (1.17430	0.0017 (1.1001)	0.0072 (1.5405)
LNFDI	-0.0015 (-0.3842)	0.0006 (0.2811)	0.0025 (1.7816)	-0.0714 (-0.1653)	-0.0023 (-1.5029)	0.0012 (0.5740)	0.0002 (0.0619)
LNTEC	-0.0045 (-1.4767)	-0.0037 (-0.5781)	-0.0002 (-0.0367)	0.5218 (0.3929)	0.0259 (2.4197)**	-0.0025 (-0.2829)	-0.0042 (-0.4732)
OPN	0.0209 (1.4065)	0.0711 (1.9246)*	0.0265 (1.3947)	-1.5918 (-0.6609)	0.0331 (2.2243)**	0.0372 (1.1410)	0.0064 (0.3223)
Dsc	0.0069 (0.4247)	0.0135 (0.4925)	0.0224 (2.8907)**	-0.4799 (-0.3306)	-0.0213 (-2.6200)**	0.0186 (1.3776)	0.0148 (1.3829)
R^2	0.9945	0.9932	0.9719	0.9955	0.9981	0.9943	0.9951
F-statistic	285.2891	229.1436	54.30488	347.3413	832.0766	273.0172	320.5891
Cross section effect	0.0743	0.7906	0.9478	-0.3657	0.8172	-0.2429	-0.1301

Notes: i. Figure in parentheses is t value of coefficient β

ii. *** significant at level 0.01
** significant at level 0.05
* significant at level 0.10
^{ns} not significant