Jurnal Ekonomi Malaysia 52(1) 2018 89 - 103
http://dx.doi.org/10.17576/JEM-2018-5201-8

Trade Linkages and Skill Demand: Empirical Evidence for the Malaysian Electrical and Electronics Industries

(Hubungan Antarabangsa dan Permintaan Buruh Berkemahiran: Bukti Empirik bagi Industri Elektrik dan Elektronik Malaysia)

Azmafazilah Jauhari
Noor Aini Khalifah
Universiti Kebangsaan Malaysia

ABSTRACT

This article empirically investigates whether trade linkages have any contribution to skill upgrading in the Malaysian electrical and electronics (E&E) firms by using establishment level data. The richness of data provided by Department of Statistics Malaysia (DOSM) enable us to explore the direct impact of each aspect of trade linkages, including exports of goods, imported inputs (outsourcing), and foreign ownership (FDI). More crucially, this research analyse the effects of the modern trade pattern, i.e. vertical trade which would best capture the current trend in the Malaysian E&E sector – high overlap in exports and imported inputs. The skill demand is analysed using dynamic skill share demand equation and GMM (generalised method of moments) estimator addresses both the endogeneity and firm fixed effect. Contrary to previous studies, results suggest that export and outsourcing do not significantly contribute to skill upgrading in Malaysian E&E establishments within the period under study. Plus, vertical trade and foreign share have significant negative impact on relative demand for skilled workers. These findings provide evidence that vertical trade as well as the presence of multinational corporations (MNCs) are associated with skill downgrading in Malaysian E&E sector. Empirical evidence does not uphold the conventional wisdom of the beneficial effects of trade especially ultra-vertical or export processing trade on skill upgrading.

Keywords: Vertical trade; empirical studies of trade and labour demand

ABSTRAK

Artikel ini mengkaji secara empirikal adakah hubungan antarabangsa menyumbang kepada peningkatan buruh berkemahiran bagi firma elektrik dan elektronik (E&E) Malaysia dengan menggunakan data peringkat pertubuhan. Kekayaan data daripada Jabatan Perangkaan Malaysia (DOSM) membolehkan pengkaji menganalisis kesan langsung setiap aspek hubungan antarabangsa, termasuklah eksport barangan, input yang diimport (penyumberan ke luar) dan pemilikan asing (FDI). Apa yang lebih penting, ini membolehkan pengkaji menganalisis implikasi bentuk perdagangan moden, iaitu perdagangan menegak yang mana paling sesuai untuk menggambarkan trend terkini sektor E&E Malaysia – iaitu pertindihan yang tinggi dalam eksport dan input yang diimport. Permintaan buruh berkemahiran ini dianalisis menggunakan persamaan dinamik dan kaedah penganggaran GMM digunakan untuk menangani isu endogeniti dan kesan tetap firma. Berbeza dengan kajian terdahulu, keputusan kajian ini merumuskan eksport dan penyumberan ke luar tidak signifikan meningkatkan buruh berkemahiran bagi pertubuhan E&E Malaysia dalam tempoh kajian ini. Tambahan lagi, perdagangan menegak dan pemilikan asing secara signifikan memberi kesan negatif terhadap permintaan relatif pekerja mahir. Penemuan ini memberi bukti bahawa perdagangan menegak dan kehadiran pertubuhan asing (MNC) sebenarnya boleh dikaitkan dengan berlakunya penurunan kemahiran dalam sektor E&E Malaysia. Bukti empirikal kajian ini tidak menyokong idea konvensional yang menyokong faedah perdagangan antarabangsa, terutamanya kesan perdagangan ultra-menegak atau pemprosesan eksport terhadap peningkatan buruh berkemahiran.

Kata kunci: Perdagangan menegak; kajian empirikal perdagangan dan permintaan buruh

INTRODUCTION

This study aims to document the relevance of trade linkages in shaping the landscape of Malaysian manufacturing, by focusing on its influence on employment, particularly skilled labour demand. We empirically test the significance of every aspect of trade, particularly vertical trade[1], international outsourcing (importing inputs), and export of goods as well as foreign ownership (FDI) as underlying forces for the changes in skill demand for the Malaysian electrical and electronics (E&E) industries within the period from 2000 to 2005. This study is crucial, particularly for policy implications regarding the association of Malaysian trade and the composition of labour demand in the manufacturing sector.

From 1990s to the present, the E&E sector has contributed more than 60% to the country's manufacturing exports. Based on data from Department of Statistics Malaysia (DOSM), exports of E&E sector from the manufacturing sector were 65.7% in 1995 and increased to 72.5% in 2000. The contribution remained high at 65% from 2005 onwards. The E&E industries have been the country's top import and export sector. In 2015, it constituted 35.6% and 29.4 % of total exports and imports, respectively of Malaysia. In comparison, in 2014, the products contributed 33.5 and 27.9 % to total exports and imports, respectively. Indeed, the large volume of overlapping exports and imports indicate the high intensity of vertical trade in these industries.

Vertical trade or international production sharing is a strategic action whereby firms disintegrate their productions by segmenting or slicing up the production process into several stages and relocating one or several fragments to another location or country (cross-border sourcing). The motivations are cost efficiency strategies, i.e. by relocating tasks where factor prices are relatively cheaper (Heckscher-Ohlin (H-O) theory), or where the skill-intensity is more suitable or appropriate for certain tasks due to skill differences across countries (Ricardian model).

Based on World Integrated Trade Solution (WITS) database, nearly 50% of Malaysia's total exports and imports are with the developed countries, namely Japan, US and EU. Within the cone of production with developed trading partners, according to the neoclassical trade, trade openness would raise the relative demand for Malaysia's unskilled labour, i.e. the country's relatively abundant factor. On the contrary, Feenstra and Hanson (1995) showed that trade in intermediate goods or vertical trade should have positive impact on skilled labour demand for both developed and developing countries. In addition, trade and FDI can act as channels for technological upgrading by providing access to technology and global markets, as well as spillover effects from interactions with more developed countries; which in turn increases the relative demand for skilled workers.

In early 2000s, data from DOSM showed that the intensity of skilled labour in E&E sector was still low, yet the relative demand for skilled labour had gradually increased. Therefore, how do trade linkages affect the skill demand for Malaysian E&E firms' labour market? The possible association of these two phenomena has not been well explored. Specifically, this article aims to analyse which aspect of trade matters in explaining the changes in relative demand for skilled workers within establishments of Malaysian E&E industries. Ultimately, we seek to provide the answer of whether trade linkages lead to skill upgrading or downgrading for E&E establishments in Malaysia.

Empirical evidences on the association of international trade and skills demand reveal both rising wage inequality and skill intensity in manufacturing industries for both developed and developing countries[2]. Opposing the prediction of H-O model that suggests sector-biased changes in relative demand, the changes in relative demand for skilled workers is characterised as factor-biased. As stated by Berman et al. (1994), Berman et al. (1998) and Strauss-Kahn (2004), the factor-biased changes reveal that changes in the relative demand for skilled workers occur *within* the industry or firms[3].

Studies on the skilled demand effect of international production sharing mainly focus on the manufacturing sector at a high level of aggregation[4]. Only recently, studies started to utilise the firm-level data (see Bernard & Jensen 1997; Head & Ries 2002; Görg & Hanley 2005). Moreover, previous studies on the issues mainly focused on developed countries. Current evidences show that all countries in the world are involved in vertical trade, including the developing countries. This new form of trade is more intensive in Asia, especially the East Asian countries, and has exceeded the growth rates of trade in final goods (Ahn et al. 2008; Athukorala & Menon 2010). Nevertheless, studies that investigated the association of international outsourcing and skill demand for developing countries were focused on the Latin American countries[5]. Recently, several authors are beginning to examine the skills effect of trade linkages using the Asian countries'[6] data. However, almost all the above mentioned studies focused only on imported inputs to measure the intensity of fragmentation trade. These studies seemed to ignore the trends of large volume of overlapping exports and imported inputs within the industries.

This article seeks to contribute to the empirical literature in the following ways. It will be presenting new empirical evidence at establishment-level data for developing countries, particularly within ASEAN region using most disaggregated level trade data[7]. We extend the previous literature by analysing the vertical trade effects on skilled workers demand in addition to other standard trade variables. The vertical trade of output (*VTQ*), establishment-level index, by Khalifah and Azhar (2014) is able to capture the overlapping of exports and imported inputs within the firms and improves the limitation of previous studies that relied on industry-level data and Input-Output Tables to estimate the share of imported inputs[8]. Furthermore, we are able to study the intensity of foreign ownerships effect on skill demand, while previous studies controlled for foreign ownerships status by using dummy variable due to limitation of data. Analysis in this article focuses on E&E sector which departs from previous studies that pooled data across industries; hence, ignoring trade linkages effect on relative skill demand within firms for specific industries. To the best of our knowledge, there are limited studies that empirically examine the effect of trade linkages on relative demand for Malaysian skilled workers focusing on E&E industries, particularly using establishment-

level data[9].

We specifically aim to examine (i) which type of trade is significant in explaining changes in skill intensity, and (ii) in what manner that particular trade types influence changes in the skill-intensity, induce skill upgrading or skill downgrading, and (iii), results in both (i) and (ii) enable us to *basically* identify whether the changes in skill intensity are characterised as sector-biased or factor-biased effects (Geishecker & Görg 2005).

The remainder of this paper is organised as follows: the next section reviews the theoretical and empirical literature on the association of trade linkages and relative labour demand. In Section 3 we discuss the data and measurement, while the empirical strategy is explained in Section 4. In Section 5 we present the empirical results. Finally, the last section discusses the conclusion of this study.

LITERATURE REVIEW

Feenstra and Hanson (1995) claimed that foreign investment and outsourcing activities by the developed MNCs have increased the relative wages for skilled workers in both developed and developing countries. Developed countries outsource the unskilled-intensive fragments to developing countries. The activities transferred to developing countries will be relatively more skilled worker intensive than those formerly produced in those developing countries. However, less skilled-worker intensive than those currently produced in the developed countries. The model also suggests that the changes in relative demand occur within-industries, towards factor-biased effects.

Using the traditional trade framework at a disaggregate level, Arndt (1997;1998) claimed that the effect of international outsourcing on relative wages depends on the factor intensity of the outsourced fragments. In this multi-sector model, sector-biased effects matter. If outsourcing occurs in some unskilled intensive industries, it will increase the relative wages for unskilled workers. On the contrary, if outsourcing activities involve high-skilled intensive industries, the relative wages for high-skilled workers would increase. Furthermore, rigidity in wages, immobility in inter-industries movements of workers as well as inadequate changes in outputs, act as restraints in the labour market to fully adjust to any structural change (Egger et al. 2001).

Empirical evidences on skills demand effect of outsourcing, measured by share of imported input in total inputs, provide a consensus on the positive association between the two variables. In general, studies show that outsourcing the low skill fragments of the production chain to the low-wage countries or less-developed countries reduces the relative demand or wages for unskilled workers in the developed countries. Feenstra and Hanson (1995; 1996; 1999) focused on U.S. manufacturing labour markets in 1980s. Using different measures of international outsourcing (respectively, import penetration ratio, share of imported intermediate inputs in the total purchase of non-energy materials, and the narrower index of outsourcing), results for all three studies found that international outsourcing increases the cost share of non-production (skilled) labour for U.S. industries.

Yamashita (2010) who replicated Feenstra and Hanson (1999), constructed a new measure of outsourcing based on trade in parts and components (P&C) in SITC trade data relative to total intermediate inputs. Estimation results using 48 U.S. manufacturing industries suggested that only import of intermediate inputs from developing countries was significant in increasing wage inequality in the U.S. for the period 1979-1990. Similarly, Anderton and Brenton (1999) found similar results for U.K.'s industries within the period 1970-1986. Using data for 4-digit textiles (unskilled intensive) and non-electrical machinery (skilled intensive) industries, estimation suggested that only the imported input from low-wages countries pushed down the relative demand for less-skilled labour. The study also implied that unskilled-intensive sectors are more affected by outsourcing than higher-skill sectors. Anderton, Brenton and Oscarsson (2002) also explored this issue on U.K. (1970-1986), USA (1970-1993), Sweden (1970-1993) and Italy (1973-1995). Results of the panel data analysis also confirmed that imports from low-wage countries significantly increased wage inequality and relative employment of high skill workers in those countries.

Recently, studies have diverted to developed countries in Europe and Asian countries. Strauss-Kahn (2004) studied the impact of vertical specialization on changes in relative demand for unskilled workers in France within the period from 1977 to 1993. Estimation result revealed that vertical specialization is significant in explaining the decline in the within-industry share of unskilled workers in French manufacturing employment. Helg and Tajoli (2005) suggested that outward processing trade, a narrow measure of production sharing, consistently increased the relative demand for skilled workers for Italy, but had no influence on Germany's labour demand in 1990s. Geishecker and Görg (2008), also focused on Germany within the period 1991-2000 and combined the household survey database and industry-level outsourcing activities to analyse the effects of outsourcing on wages. Estimation results also suggested that outsourcing has negative effects on unskilled workers.

Head and Ries (2002) employed 25-year (1965-1990) panel data set for over 1000 Japan manufacturing firms and specifically examined the electronics industry as a special case of extensive foreign production. Yamashita (2008), constructed a measure of fragmentation intensity using the trade data on P&C (focusing on SITC 7 and

SITC 8) over the period 1980-2000. The expansion of fragmentation trade with East Asia (developing countries) significantly upgraded the skills of Japanese manufacturing employment, while fragmentation trade with OECD (developed countries) had a skill downgrading effect. Agnese (2012) also focused on industry-level data. However, the study analysed both materials as well as services offshoring activities across occupation and across three major sectors of the economy (manufacturing, services and primary plus energy) for 1980-2005. The study concluded that, highly skilled occupation gains from the services offshoring, while production workers (unskilled) benefit from materials offshoring.

For the developing countries, studies on the relationship of standard trade measures and skilled workers demand are quite numerous[10], particularly for Latin American countries. Fewer studies focus on the impacts of the new forms of trade – international production sharing for Asian developing countries. Robertson (2004) and Feenstra and Hanson (1997b) focused on Mexico, Pavcnik (2003) on Chile, and Arcabche et al. (2004) on Brazil. For Peru, Mazumdar and Quispe-Anoli (2004) focused on input materials, domestic as well imported as determinants for rising wage inequality for the period within 1994-2000. In particular, the study focused on the within-industry increase in wage inequality. The paper showed that capital accumulation and not technology is responsible for increments in demand for skilled labour in Peru. Pavcnik (2003) focused on relative skilled demand within manufacturing plant in Chile for 1979-1986. Meanwhile, Meschi et al. (2011) utilized the plant-level data for Turkey. Both studies found positive association between trade measures and relative skilled workers demand. Thangavelu and Chongvailavan (2009) explored the effects of materials and services outsourcing for Thailand manufacturing industries. The study suggested that material outsourcing is skilled-biased.

Fajnzylber and Fernandes (2009) analysed the imported inputs, export and FDI effects on skilled labour demand. The study used data for Brazil and China and showed that imported inputs and FDI increase skilled worker demand for Brazil, but the opposite effect for China. Thus, for China, FDI and imported inputs are made to utilise the comparative advantages, the bulk of which is unskilled labour's assembly activities which hence increases relative demand for unskilled workers. For Brazil, FDI as well as imported inputs are skilled-biased or enhancing demand for skill.

Several studies have analysed the association of trade linkages and changes in labour demand or wages for Malaysian manufacturing sector. The earliest, Robbins (1996) found that the wage gap between educated and less educated workers had narrowed over the period 1973-1989 for exporting sectors. Berman and Machin (2000) focused on the effect of cross-border technological transfer (measured by U.S. R&D intensity and computer used) and found that cross-border technological transfer reduced the relative demand for skilled workers in Malaysia within 1980-1990; indicating that the technological transfers are unskilled biased. Using SITC trade data, Devadason (2005) focused on the effects of fragmentation trade on relative labour demand for Malaysian manufacturing industries. Also, Devadason (2011) used balanced panel of 19 major industry groups (3-digit SITC) within 1983-2004 and found that growth of imports reduced growth of skills share in these industries. McNabb and Said (2013) analysed the sources for the changes in skilled workers demand by focusing on trade and technical changes. The study matched trade data (3-digit SITC) with the Household Income Survey (for the year 1984, 1989, 1992, 1995, and 1997). The measures of wage inequality in the study (standard deviation of wage distribution, and the ratio of the 90 to 10 per cent deciles) showed decreasing trends over the period 1984-1997. Results suggest that trade liberalisation and TFP growth in Malaysian manufacturing industries are biased towards the less educated or unskilled workers. Even though the results are fairly conclusive, these studies suffer from several empirical issues including measurement problems as well as aggregation bias due to the nature of the database used.

Most of the studies on this issue presumed that imported inputs affect all industries equally by pooling the data across all industries. Only some studies focused on particular industry, for instance, the study by Anderton and Brenton (1999) focused on textiles and non-electrical machinery, Pavcnik (2003) study all manufacturing industries as well as focus on electronic, as done by Head and Ries (2002) for Japanese plants and Görg and Hanley (2005). Using plant-level data for the Irish electronic industry for the period 1990 to 1995, Görg and Hanley (2005) investigate the implication of international outsourcing on labour demand especially the short-run employment effects in outsourcing plants. Specifically, the study differentiated two types of outsourcing, i.e. materials and services outsourcing. Results showed that international outsourcing, both level and changes reduce plant-level labour demand for Irish electronic industry in the short run, and the outsourcing of materials has a stronger negative effect than the outsourcing of services.

Horgos (2009) examine the issue of measurement and aggregation bias when studying the impact of international outsourcing on German labour market, particularly wage differential between high-skilled and low-skilled labour for 1991-2000. To test for the potential of aggregation bias, the study use both aggregated and disaggregated-level industries. Empirical results in the study have shown that measurement differences as well as aggregation of data are crucial in determining the significant role of international outsourcing to German's labour markets.

METHODOLOGY

DATA AND MEASUREMENT

The data in this paper were retrieved from the Annual Survey of Manufacturing Industries (ASMI) provided by DOSM. We use establishment-level data of 5-digit Malaysia Standard Industry Classification (MSIC) 2000. The analysis focuses on the Malaysian electrical and electronics (E&E) industry for the period from 2000 to 2005 (2000 and 2005 are census years). The E&E industries include industries 30, 31 and 32 at the 2-digit level in the MSIC 2000. The data are balanced panel of 258 establishments with 1548 establishment-year observations[11]. The datasets contain basic establishment-level information on manufacturing, including number of establishments, number of employed workers, salaries and wages per annum, fixed assets, cost of inputs, gross output, value added, foreign equity share, value of imported raw materials, and value of exported products[12].

Recent production process of goods becomes disintegrated where each country specialises in a particular stage or process of a good's production sequence. The growing internationalization of production process and trade means that no single measure can capture the importance of trade linkages in a given industry. The uniqueness of our database provided by DOSM is that it gives information on broad trade activity, including imported inputs, goods that are exported as well as foreign share or FDI; hence, enabling this paper to examine the whole spectrum of international linkages, including international outsourcing, export and vertical trade as well as controlling the foreign ownership structure of the firms. Hence, the analysis in this paper involves an empirical investigation on the effect of 'a wide measure of international linkages' effects on skill demand, namely vertical trade, outsourcing (imported inputs) and export of goods.

Empirical studies proxy the international fragmentation of trade by computing the intensity of imported inputs[13]. However, these measures seem to be relatively broad when considering the trade composition for Malaysian E&E industries that have high share of imported inputs as well as high share of exported goods. Hummels et al. (2001) defined vertical specialization trade as when imported inputs are used by plants to make goods or goods-in-process that are in turn exported to other countries. Hummels et al. (2001) computed an index[14] to measure the vertical trade, which we refer to as the narrow or *true* measure of international outsourcing (Chen et al. 2005).

For our estimation, we use *the vertical trade intensity* (*VTQ*) measure of Khalifah and Azhar (2014) at the establishment-level. The index is based on the production box of establishment methodology (refer to Khalifah & Azhar 2014 for further explanation and Khalifah & Jaafar 2017 for an application of the effects of trade on technical efficiency of establishments in the E&E industries). According to this index, vertical trade (VT_i) is defined as the volume of overlapping exports (X) and imported inputs ($Minp$) as follows:

$$VT_i = 2 \min(X_i, Minp_i) \quad (1)$$

where i refers to establishment indexes and X_i is exports for establishment i and $Minp_i$ is imported inputs for establishment i. Hence, the intensity of vertical trade is measured by the share of vertical trade in the gross output (Q) of the establishment, as follows[15]:

$$VTQ_i = \frac{2 \min(X_i, Minp_i)}{Q_i} \quad (2)$$

where X_i and $Minp_i$ are defined as above; while Q_i refers to gross output of the establishment i. The index is expected to directly and accurately measure the intensity of vertical trade as opposed to commonly used indices in the previous literature which heavily relied on industry-level data and Input-Output tables (to estimate trade or foreign components of inputs).

In addition to the vertical trade intensity, we also use *outsourcing intensity* as a broad measure of international fragmentation trade as used in previous literature. For outsourcing intensity for each firm i at time t, we compute the share of imported inputs in total inputs. Additionally, we measure *export intensity* of firm i at time t by the ratio of exports to total output[16]. Imports are deflated using an import deflator at the 5-digit MSIC while cost of inputs is deflated using an intermediate input deflator at the 5-digit MSIC. The value of exported goods and outputs are also deflated using an output deflator at the 5-digit MSIC.

For *skill intensity*, two measurements are commonly used, i.e. share of wages of skilled workers in total wage bill and share of skilled workers in total employment. In this article, we compute skill intensity by employment share of skill workers, i.e. ratio of skilled workers in total employment. Total employment only considers the full-time paid employees. The database provides detailed information on occupational category (i.e. non-production and production workers) which we use to group the workers into skilled and unskilled workers. We follow most previous studies which refer to skilled workers as non-production workers in managerial, professional, technical and supervisory positions (among others: Berman et al. 1994; Devadason 2005; Feenstra & Hanson 1996; Head & Ries 2002). Meanwhile, unskilled workers refer to the sum of production workers, including production or operative workers directly employed as well as employed through contractors[17].

The DOSM database (made available to us) provides information on total amount paid by each establishment without classifying the data into occupation category. Therefore, we cannot construct the share of skilled to

total wages as well as share of unskilled to total wages. Hence, analysis in this study uses *the real average wages*. In this article we use four different proxies for firm's *scale*, interchangeably, i.e. value of gross outputs (value of sales of goods less the change in inventories), value added (value of gross outputs minus inputs costs) and the ratio of establishment's outputs (also value added) to 5-digit sub-industry's average outputs (value added).

Capital intensity is measured using the ratio of capital stocks to total outputs[18]. Most studies use dummy variable to control for foreign ownership status or skill-biased effect of FDI. The dataset provided by DOSM has the information on foreign share which enable the study to directly analyse the impacts of *foreign ownership intensity* on skill demand within firms. Most studies use the share of ICT (information and communication technology) capital stock or expenditure on R&D to measure technological change, or particularly SBTC. Due to the unavailability of data, we follow Baltagi and Rich (2005) and use the time trends to account for *technological change*.

The descriptive statistics for our database are within year 2000 until 2005 and presented in Table 1. The table shows the mean value, as well as the standard deviation, minimum and maximum values of our variables for domestic and foreign firms based on the database provided by DOSM within year 2000 until 2005. Table 2 shows the correlation matrix for our variables. Focusing on trade measures, negative associations are revealed between export intensity, outsourcing intensity and vertical trade with skill intensity. These preliminary analysis show that trade linkages tend to decrease skill share for Malaysian E&E establishments.

EMPIRICAL STRATEGY

In line with previous studies, we use the skill share equation derived from a translog cost function in our estimation procedure. The cost minimization and some parameter restriction yield a factor share equation that is usually estimated as the following expression:

$$E = \alpha_0 + \alpha_1\left(\frac{w_S}{w_U}\right) + \alpha_2 K + \alpha_3 Q + \alpha_4 T + \varepsilon \qquad (3)$$

TABLE 1. Descriptive statistics of the variables included in the model: (2000-2005 period)

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
Skill Intensity	1548	0.21	0.13	0	0.98
Average Wage	1548	18.31	8.51	0.86	74.66
Capital Intensity	1548	0.39	0.44	0	5.91
Outputs	1548	262953	528453	123	4386040
Foreign Share	1548	59.30	46.39	0	100
Outsourcing Intensity	1548	0.36	0.31	0	1.11
Export Intensity	1548	0.45	0.47	0	1.34
Trade Intensity	1548	0.72	0.62	0	2.05
Vertical Trade Intensity	1548	0.38	0.49	0	1.96

Source: Own estimation based on the panel data used for the study

TABLE 2. Correlation matrix

	Skill Intensity	Average Wage	Capital Intensity	Outputs	Foreign Share	Outsourcing Intensity	Export Intensity	Trade Intensity	Vertical Trade Intensity
Skill Intensity	1.00								
Average Wage	0.52	1.00							
Capital Intensity	0.20	0.10	1.00						
Outputs	0.18	0.36	–0.17	1.00					
Foreign Share	0.10	0.15	–0.02	0.45	1.00				
Outsourcing Intensity	–0.04	–0.10	–0.08	–0.14	–0.16	1.00			
Export Intensity	–0.07	–0.08	–0.09	0.03	0.00	0.11	1.00		
Trade Intensity	–0.01	–0.04	–0.17	0.13	0.11	0.51	0.21	1.00	
Vertical Trade Intensity	0.06	0.05	–0.16	0.42	0.31	0.12	0.08	0.50	1.00

Source: Own estimation based on the panel data used for the study

where E is share of skilled labour in total employment, w_S and w_U are wages for skilled and unskilled workers, respectively, Q is output, K is capital stock. T denotes the structural variables or technological shifter; comprising the observable measure of trade linkages as well as technological change and ε is unobserved technological components.

Using the establishment-level data we estimate the following equation:

$$E_{it} = \beta_0 + \beta_1 E_{it-s} + \beta_2 W_{it-s} + \beta_3 K_{it-s} + \beta_4 Q_{it-s} + \beta_5 F_{it-s} + \beta_6 O_{it-s} + \beta_7 X_{it-s} + \beta_8 V_{it-s} + \mu_i + \gamma Year_t + \varepsilon_{it} \quad (4)$$

where subscripts i and t denote 5-digit MSIC establishments and years, respectively; is the skilled workers employment share; is average wages, K is capital, Q is output, F is foreign share (FDI), O is outsourcing intensity, X is export intensity, and V is vertical trade intensity. u_i is establishment specific fixed-effect, *Year* is time trend and ε_{it} is observation specific error, and β parameters are estimated coefficient for explanatory variables. Logarithmic transformation has been applied to all variables, except for vertical trade intensity index.

In the estimation, we replace the relative wages with average wages due to the unavailability of wage data for skilled and unskilled labour. We estimate the dynamic version of skilled share equation and allow for labour adjustment costs by including the lagged dependent variable (LDV) as one of our regressors. The significance of parameter β_1 confirms the dynamic nature of our panel model. The coefficient for relative wages (β_2) is ambiguous, depending on the elasticity of substitution between skilled and unskilled labor. If the coefficient for the capital intensity variable is positively significant ($\beta_3 > 0$), we conclude capital-skills complementary (or capital substitutes for skilled workers if parameter $\beta_3 < 0$). Total output reflects firm's scale effect. If $\beta_4 > 0$ and statistically significant, as production increases, firm is predicted to increase demand for skilled labour. If parameter β_4 is not significant, then output growth is not related to skill-share growth.

Parameter β_5 is the estimated coefficient for foreign share or FDI variable. Devadason (2011) used FDI to measure the potential existence of foreign technology upgrading (indirectly). The positively significant sign of the coefficient of FDI ($\beta_5 > 0$) reflects skilled biased technological cross-border transfer when capital-skill complementarity exists as well. In Head and Ries (2002), the signage for statistically significant coefficient for FDI variables acts as a predictor for type of FDI, i.e. whether horizontal or vertical FDI. If $\beta_5 < 0$, FDI is mostly vertical where the extent of technological transfer is lower, i.e. the activities (or stage of production) shifted to developing countries are unskilled intensive, and hence lead to increase in demand for unskilled labour. If the FDI is mostly horizontal (replicate downstream activities – when trade cost is high and economics of scale low), then $\beta_5 > 0$.

Parameters β_6, β_7 and β_8 measure the effects of trade linkages on changes in skill demand; outsourcing intensity, export intensity and vertical trade intensity, respectively. The outsourcing intensity and export intensity are treated as broad measures for internationalisation. The changes in outsourcing intensity and export intensity will lead to increment in skill intensity (skill upgrading) if the coefficient for both measures is positively significant[19]. This is true when firms import unskilled-intensive inputs (outsource unskilled-intensive activities) and concentrate on skilled-intensive tasks, imported inputs are complementary to skilled workers. Additionally, the opposite sign is true if the firms outsourcing the skilled intensive inputs or tasks and domestic task concentrate on low-end value chain. Finally, the coefficient β_8 represents a measure for international outsourcing or vertical trade (import inputs to produce goods or goods in process that will be exported). If higher trade overlap (higher imported inputs and export) leads to a reduction in skilled workers demand, the coefficient for this variable (β_8) will be negative. This reveals that trade linkages involve unskilled labour intensive tasks. In addition, $\beta_8 > 0$, if the activities involved are complements to skilled workers. Coefficient γ in this study, measures the indirect effect of technological progress. Technological change is skill-biased if the coefficient for the time trend is positive and significant.

For estimation purposes, we take lagged 1 and 2 for LDV, while for our explanatory variables we take both the current (contemporaneous value) and lagged 1. Following Arellano-Bond (1991), it is expected that the adjustment in labour demand share due to the changes in the determinants (wages, capital, output, and trade measures) not being an immediate process. The adjustment towards its steady state is always delayed, depending on the passage of time as well as the deviation of previous year's actual level (employment) from its steady state level.

Endogeneity problem arises as the LDV is correlated with fixed effects and due to interrelationships among the regressors. Arellano and Bond (1991) proposed the GMM estimation to solve the problems; the first differenced equation is estimated using lagged levels of the DV as instrument, and the lagged level of regressors as instruments for the first-differenced regressors – *Difference* GMM estimator. However, the *Difference* GMM estimator of the autoregressive coefficient is often found to be downward biased in finite samples in particular, when the DV nears unit root properties. In that case, instruments in the first differenced equation are weak (Blundell & Bond 1998). Additionally, *Difference* GMM estimator is also to weak if cross section variability dominates times variability and there is strong persistence in the investigated time series (Bond et al. 2001). Efficiency improves when applying an extended GMM estimation method, the *System* GMM estimators.

In this analysis, we treat the relative wages, real capital and real outputs as predetermined variables which might also be correlated with unobserved firm specific effect, e.g. computer innovation. Also, the interconnection between the trade linkages within a firm might not be random for our data; hence, revealing a high correlation between imported inputs and exports which raises collinearity issues. Furthermore, outsourcing and export may also be correlated with time-invariant firm effect (e.g. productivity or managerial ability or financial constraint that affects the relative demand for skilled workers independent of technology use). Therefore, in this analysis, we treat all the three measures of our trade linkages as predetermined while the foreign share as exogenous (decision is made by the parent company).

We conduct the diagnostic test to assess the model and the validity of our *System* GMM estimator. First, since the first difference equation produces unbiased and consistent estimates under the assumption that there is no second order serial correlation of the error term, the Arellano-Bond (second order) autocorrelation, $AR(2)$ is used to test for no second-order serial correlation. The test for $AR(2)$ in first difference is more important than $AR(1)$. This is because it will detect autocorrelation in level.

Second, the Sargan test and Hansen test are used to test for the validity of the over-identifying restriction of the GMM with the null hypothesis of strict exogeneity of our instrumental variables, i.e. the overall validity of the instruments, not correlated with errors in the first differenced equation, or strictly exogenous. If the Sargan test or the Hansen test rejects the null hypothesis of no correlation, the instrumental variables estimator is biased and inconsistent. Third, the Difference-in-Hansen test which tests for the exogeneity of each instrument is conducted.

RESULTS AND DISCUSSION

Tables 3 and 4 present the one-step *System* GMM estimation results. We begin by analysing the relevance of each type of trade in affecting within firm's skilled workers demand for the E&E industry. Initially, we estimate the basic model which exclude all trade linkages measures and only control for foreign ownership in addition to other standard heterogeneous firm characteristics. The results are shown in Model 1.1 in Table 3. Models 1.2 to 1.5 in Table 3 report the results when we include the trade linkages measure interchangeably. From these results, we can conclude through which channel does trade relates to skill intensity. Including the trade measure into our basic model increases the power of the models, which consistently increases the value of Wald χ^2 test and is highly statistically significant. The highest value of Wald χ^2 is in model 1.5 when we estimate the vertical trade intensity. Table 4 reports estimation results for multiple measurements of trade linkages effect on skill intensity to solve the potentially omitted variables problems[20].

For the control variables, they will be discussed briefly. In Table 3 and Table 4, the coefficient for the average wage variable is significant at contemporaneous and the sign is positive. The results suggest that increases in the average wages do indeed promote the relative demand for skilled workers. As reported in all models in Tables 3 and 4, capital intensity has significant positive impact on skill–demand for both contemporaneous and previous time period. Hence, the results suggest that an increase in the capital intensity favours skilled workers in Malaysian E&E firms, holding other plant characteristics constant. This verifies the complementarities between capital and skills – capital-skills complementarity hypothesis. For scale effects, the results for models in Table 3 and Table 4 generally suggest that firm output or scale has no impact on the share of skilled workers. The results are robust; the coefficient of the variable output is not significant when we use different measures of outputs.

In this section, we will only discuss in depth the significance of trade linkages variable effect on skill share. As reported in the first row for all models in Table 3 and Table 4, we confirm the validity of the dynamic nature of our models with the highly significant coefficient of LDV for each model (positive association between skill-intensity in previous year and its current value). The results for our diagnostic test confirm the power of the models. For the Arellano-Bond (second-order) test, in all models (1.1 to 1.5 and 2.1 to 2.3) we fail to reject the null hypothesis which concludes no second order serial correlation (no original error term is serially uncorrelated). Both Sargan and Hansen tests pass the overall validity of the instruments hypothesis in all models. Additionally, all our models also pass the *Diff-in-Hansen* test, confirming the exogeneity of each instrument.

For Models 1.2 and 1.3 in Table 3, we identify the effect of outsourcing intensity and export intensity on skill intensity within firms, respectively. The results show that the estimated parameter for outsourcing intensity (ratio of imported inputs to total inputs) is positive and significant at 10% level. This indicates that outsourcing (broad measure) contributes significantly to skill upgrading for E&E firms[21]. The result is similar to the studies by Feenstra and Hanson (1995, 1996, 1999) for U.S. and Fajnzylber and Fernandez (2009) for Brazil. On the other hand, the estimated parameter for export intensity (Model 1.3) is statistically insignificant which suggests that exports activities are not relevant in influencing skill intensity within the firms. The results reflect the fact that, at least during this period, export does not impact skill demand for Malaysian E&E industries. Fajnzylber and Fernandez (2009) found a negative association of export intensity and employment share as

well as wage bill share of skilled workers in Brazil and China. However, due to the large volume of overlapping exports and imported inputs within Malaysian E&E firms, we should be careful in drawing conclusion regarding the role of international outsourcing and export activities in determining skill demand within firms in this sector. Therefore, we are unable to provide robust evidence to support the notion that imported inputs and exports of goods would increase the skill intensity within plants, at least for Malaysian E&E industry within the period under study. Our data do not support the skilled-biased outsourcing or the skill-enhancing trade (SET) hypothesis, particularly for E&E sector.

Following Meschi and Vivarelli (2009), Meschi et al. (2011) and McNabb and Said (2013), we also test whether the total trade intensity (trade openness), i.e. the ratio of total trade (export plus import) to total outputs, would significantly relate to skill-intensity. The result is shown in Model 1.4 for Table 3. The estimated coefficient for the trade openness variable is positive and significant at 5% level. However, based on the above results for the ratio of imported inputs as well as export intensity, we prefer to be careful in drawing general conclusion regarding the effect of total trade on skill upgrading for our E&E data.

Due the recent trends in the E&E trade structure, i.e. high percentage in both imported inputs and exports

TABLE 3. Impact of Trade Linkages on Skill Intensity – Single Measurement

	Model 1.1		Model 1.2		Model 1.3	
	Coefficient		Coefficient		Coefficient	
Skill Intensity (–1)	0.517***	(0.108)	0.503***	(0.107)	0.506***	(0.106)
Skill Intensity (–2)	0.070	(0.089)	0.076	(0.087)	0.064	(0.087)
Average Wages	0.255***	(0.088)	0.281***	(0.084)	0.247	(0.084)
Average Wages (–1)	–0.083	(0.068)	–0.061	(0.064)	–0.083	(0.066)
Capital Intensity	0.041	(0.044)	0.031	(0.041)	0.041	(0.042)
Capital Intensity (–1)	0.086***	(0.032)	0.079**	(0.032)	0.086***	(0.030)
Outputs	–0.041	(0.050)	–0.066	(0.043)	–0.046	(0.048)
Outputs (–1)	0.070	(0.046)	0.065	(0.043)	0.073*	(0.043)
Foreign Share	–0.007*	(0.004)	–0.006*	(0.003)	–0.006*	(0.003)
Foreign Share (–1)	0.009*	(0.005)	0.008*	(0.004)	0.007*	(0.004)
Outsourcing Intensity			0.069*	(0.040)		
Outsourcing Intensity (–1)			0.014	(0.028)		
Export Intensity					0.027	(0.037)
Export Intensity (–1)					-0.026	(0.025)
Trade Openness						
Trade Openness (–1)						
Vertical Trade Intensity						
Vertical Trade Intensity (–1)						
Time Trend	–0.007	(0.013)	–0.004	(0.011)	–0.003	(0.012)
Constant	–1.394**	(0.556)	–1.213***	(0.459)	–1.366***	(0.524)
Joint Significant tests						
Foreign Share	0.002(0 .0016)		0.002(0.0014)		0.001(0.0015)	
Outsourcing Intensity	-		0.083(0.0538)		-	
Export Intensity	-		-		0.0008(0.0464)	
Wald χ^2	88.58***		104.78***		111.70***	
Arellano-Bond (order 2)[a]	0.448		0.705		0.557	
Sargan test[b]	0.795		0.755		0.689	
Hansen test[b]	0.856		0.780		0.800	
Diff-in-Hansen	Pass		Pass		Pass	
Observation	1032		1032		1032	
Number of plants	258		258		258	
Number of instruments	19		23		23	

TABLE 3. (*Cont.*)

	Model 1.4		Model 1.5	
	Coefficient		Coefficient	
Skill Intensity (–1)	0.516***	(0.104)	0.513***	(0.107)
Skill Intensity (–2)	0.076	(0.088)	0.075	(0.085)
Average Wages	0.259***	(0.083)	0.260***	(0.077)
Average Wages (–1)	–0.071	(0.065)	–0.073	(0.066)
Capital Intensity	0.033	(0.041)	0.042	(0.043)
Capital Intensity (–1)	0.082***	(0.031)	0.087***	(0.030)
Outputs	–0.057	(0.045)	–0.051	(0.048)
Outputs (–1)	0.067	(0.043)	0.071	(0.045)
Foreign Share	–0.006*	(0.003)	–0.006*	(0.003)
Foreign Share (–1)	0.008*	(0.004)	0.008**	(0.004)
Outsourcing Intensity				
Outsourcing Intensity (–1)				
Export Intensity				
Export Intensity (–1)				
Trade Openness	0.073**	(0.033)		
Trade Openness (–1)	–0.026	(0.023)		
Vertical Trade Intensity			0.085	(0.065)
Vertical Trade Intensity (–1)			–0.099**	(0.046)
Time Trend	–0.002	(0.013)	–0.006	(0.013)
Constant	–1.234**	(0.480)	–1.325**	(0.523)
	Joint Significant tests			
Foreign Share	0.0017(0.0015)		0.0018(0.0014)	
Trade Openness	0.0474(0.0497)		-	
Vertical Trade Intensity	-		–0.0147(0.0913)	
Wald χ^2	125.8***		127.36***	
Arellano-Bond (order 2)[a]	0.765		0.660	
Sargan test[b]	0.760		0.910	
Hansen test[b]	0.795		0.897	
Diff-in-Hansen	Pass		Pass	
Observation	1032		1032	
Number of plants	258		258	
Number of instruments	23		23	

Note: The dependent variable is share of skilled workers in employment.
Dynamic panel equation (One-step System GMM) with robust standard errors in parentheses.
*, **, *** signify statistical significance at 10, 5 and 1 percent, respectively.
[a]H_0: no autocorrelation ($P > z$).
[b]Overidentifying restrictions where H_0: overidentified ($P > \chi^2$).
Trade linkage measures and wages treated as *pre-determined*.
Output (firm's scale effects) measured by normalized output ($Q_{n_i} = Q_i/Q_{average_n}$ where Q_i = output for firm i and $Q_{average_n}$ = average of outputs for 5-digit industry); capital intensity measured by capital-output ratio; outsourcing measured by imported input-total inputs ratio; export intensity measured by exports-output ratio; trade openness measured by the ratio of total exports and import to outputs ($TO_i = M_i + X_i/Q_i$ where M_i is imported inputs for firm i, X_i is exported goods for firm i, and Q_i = output for firm's i); and vertical trade intensity based on index by Khalifah & Azhar (2014).

Source: Own estimation based on the panel data used for the study

TABLE 4. Impact of Trade Linkages on Skill Intensity – Multiple Measurements

	Model 2.1		Model 2.2		Model 2.3	
	Coefficient		Coefficient		Coefficient	
Skill Intensity (–1)	0.493***	(0.106)	0.489***	(0.106)	0.517***	(0.102)
Skill Intensity (–2)	0.075	(0.086)	0.076	(0.083)	0.080	(0.086)
Average Wages	0.278***	(0.081)	0.276***	(0.073)	0.261***	(0.076)
Average Wages (–1)	–0.061	(0.064)	–0.059	(0.064)	–0.070	(0.064)
Capital Intensity	0.033	(0.041)	0.037	(0.042)	0.035	(0.040)
Capital Intensity (–1)	0.083***	(0.032)	0.089***	(0.031)	0.085***	(0.030)
Outputs	–0.069	(0.043)	–0.076*	(0.042)	–0.063	(0.044)
Outputs (–1)	0.069*	(0.042)	0.076*	(0.043)	0.071	(0.044)
Foreign Share	–0.005*	(0.003)	–0.005**	(0.002)	–0.006*	(0.003)
Foreign Share (–1)	0.007*	(0.004)	0.007**	(0.003)	0.007**	(0.004)
Outsourcing Intensity	0.074**	(0.036)	0.065*	(0.035)		
Outsourcing Intensity (–1)	0.021	(0.027)	0.030	(0.027)		
Export Intensity	0.039	(0.038)	0.043	(0.037)		
Export Intensity (–1)	–0.026	(0.026)	–0.022	(0.025)		
Trade Openness					0.066**	(0.033)
Trade Openness (–1)					0.000	(0.024)
Vertical Trade Intensity			0.064	(0.059)	0.025	(0.065)
Vertical Trade Intensity (–1)			–0.112**	(0.044)	–0.093*	(0.049)
Time Trend	–0.002	(0.011)	–0.004	(0.012)	–0.003	(0.013)
Constant	–1.220***	(0.455)	–1.191***	(0.443)	–1.175**	(0.474)
	Joint Significant tests					
Foreign Share	0.0021(0.0014)		0.0022(0.0012)*		0.0019(0.0013)	
Outsourcing Intensity	0.0943(0.0472)**		0.0955(0.0472)**		-	
Export Intensity	0.0132(0.0492)		0.0208(0.0485)		-	
Trade Openness	-		-		0.0666(0.0481)	
Vertical Trade Intensity	-		-0.0480(0.0833)		-0.0680(0.0905)	
Wald χ^2	117.89***		150.01***		140.49***	
Arellano-Bond (order 2)[a]	0.700		0.835		0.825	
Sargan test[b]	0.829		0.943		0.907	
Hansen test[b]	0.857		0.903		0.893	
Diff-in-Hansen	Pass		Pass		Pass	
Observation	1032		1032		1032	
Number of plants	258		258		258	
Number of instruments	27		31		27	

Note: The dependent variable is share of skilled workers in employment.
Dynamic panel equation (One-step System GMM) with robust standard errors in parentheses.
*, **, *** signify statistical significance at 10, 5 and 1 percent, respectively.
[a] H_0: no autocorrelation ($P > z$).
[b] Overidentifying restrictions where H_0: overidentified ($P > \chi^2$).
Trade linkage measures and wages treated as *pre-determined*.
Output (firm's scale effects) measured by normalised output ($Q_{n_i} = Q_i/Q_{average_n}$ where Q_i = output for firm i and $Q_{average_n}$ = average of outputs for 5-digit industry); capital intensity measured by capital-output ratio; outsourcing measured by imported input-total inputs ratio; export intensity measured by exports-output ratio; trade openness measured by the ratio of total exports and import to outputs ($TO_i = M_i + X_i/Q_i$ where M_i is imported inputs for firm i, X_i is exported goods for firm i, and Q_i = output for firm's i); and vertical trade intensity based on index by Khalifah & Azhar (2014).

Source: Own estimation based on the panel data used for the study

of E&E products, our main focus is on the vertical trade measure. As mentioned earlier, we used vertical trade index by Khalifah and Azhar (2014) that captures the large volume of overlapping exports and imported inputs in E&E firms. The estimated parameter for contemporaneous vertical trade index in Model 1.5 is insignificant. Nevertheless, holding other variables unchanged, previous year's changes in vertical trade have a negative significant effect (1% level) on current changes in skill intensity. Thus, using the narrower measure of vertical trade intensity, our empirical analyses infers that changes in vertical trade intensity have led to skill downgrading within the establishments in the E&E industry. Vertical trade is unskilled biased type of trade which leads to increasing demand for unskilled workers within the period 2000 to 2005.

Model 2.1 in Table 4 reports the results when we include both outsourcing intensity and export intensity. For model 2.2 we include all three types of trade linkages, i.e. outsourcing intensity, export intensity and vertical trade intensity. Meanwhile, for model 2.3 we include only the trade openness measure along with vertical trade intensity.

Similar to Fajnzylber and Fernandez (2009), our estimation using the single measures has been proven to be unbiased and robust. The results are consistent when we use the multiple measures (Table 4). The estimated coefficients for contemporaneous outsourcing intensity as well as total trade intensity are always significant for all models in Table 4. Estimated coefficients for export intensity are never significant for all models in Table 3 and Table 4. As in Table 3, the coefficient for lagged vertical trade index is significant (negatively) in both model 2.2 and model 2.3. The coefficient value for vertical trade index is consistently around 0.1 for model 1.5 (Table 3) and model 2.2 and model 2.3 (Table 4). Our analysis consistently suggests that, previous year vertical trade has led to skill downgrading for Malaysian E&E establishments within the period under study.

Furthermore, this study improves the previous literature by analysing the relationship between foreign ownership and skill upgrading. Most studies control for foreign ownership by using dummy variable. As reported in Table 3 and Table 4, estimated coefficient for the foreign share (FDI) variables is robustly significant at contemporaneous and previous year in all models. The sign for parameter is negative for contemporaneous FDI, and positive for previous FDI. The results suggest that contemporaneous FDI results in higher relative demand for unskilled workers within E&E firms. This finding is similar with Devadason (2011) that found negative association between FDI and skill demand (though not significant). Additionally, our study suggests that FDI takes one year lagged to positively affect the changes in skilled workers demand. Following Amiti and Wei (2005), we estimate the joint effects of contemporaneous and lagged FDI on skill demand. Estimation result suggests that contemporaneous and lagged FDI are jointly insignificant in determining skill demand for E&E industries. Therefore, based on both results we conclude that foreign ownership is unable to increase skill demand within the Malaysian E&E firms.

For robustness checks, we tested whether our results are consistent when re-estimating our equation using two-step *System* GMM. Our findings are robust across estimators. We also use dummy variables for export and import variables as well as FDI measures. The estimation results also show insignificant relationship between these regressors and skills intensity. The results provide evidence that exporters, importers and foreign firms, are unable to contribute to skill-upgrading within establishments for E&E industries.

CONCLUSION

This paper examines the relative importance of types of trade linkages in explaining the changes in skilled worker demand within firms in Malaysian E&E industries during the period from 2000 to 2005. Within this period, there is pronounced international production sharing, for Malaysian manufacturing industries, particularly in the E&E industries. This phenomenon is exhibited by the high sharing of imported inputs and exports of goods within the firms in these industries. Furthermore, the high ratio of imported inputs in total exports also shows significant vertical trade. Enhanced competition and interaction with developed countries are expected to induce skilled worker demand.

However, results show no robust significant association between both outsourcing intensity and export intensity with demand for skilled share employment. Furthermore, our empirical results suggest that vertical trade is unskilled biased or complements unskilled workers. This reveals that from policy point of view, concentration of Malaysian E&E firms in low-value added activities such as assembly tasks have led to skill downgrading within these firms. In conjunction with negative effects of changes in the foreign share on skilled worker demand, it is revealed that the presence of foreign direct investment or multinational corportations in the electrical and electronics industries does not contribute to skill upgrading within these industries as predicted by (Head & Ries 2002); whereby the extent of technological transfer for vertical FDI is low. Despite being major exporters of high-technology industries (Hatzichronoglou 1997) most of the Malaysian export oriented industries, including E&E industries, have been involved in stages of production consisting of unskilled assembly and labour intensive stages of production (Menon 1998; Devadason 2011), which are associated with skill downgrading within firms in these industries. Export intensity of establishments are unrelated to skill upgrading; questioning the conventional wisdom of

export-oriented industrialisation and technology or skill enhancement in the presence of pronounced international production sharing.

Since the E&E sector is characterized as highly skill-intensive (high technology industry group), our analysis *generally* suggests that factor-biased effects dominate the sector-biased effects. However, for the Malaysian E&E sector, the ratio of unskilled workers is higher, which is characterised as an unskilled-labour intensive sector. Hence, analysing using a multi-sectors framework would provide more precise conclusions regarding this issue.

ACKNOWLEDGEMENT

Research support from the Universiti Kebangsaan Malaysia, via GGP-2014-002 is gratefully acknowledged. We also thank the Department of Statistics Malaysia for providing the data. The usual disclaimer applies. This is an extended and revised version of a preliminary working paper uploaded in Forum for Research in Empirical International website (Jauhari, A. & Khalifah, N.A. Trade linkages and skills demand: Empirical evidence for the Malaysian E&E. Freit Working Paper No. 704, Forum for Research in Empirical International, San Rafael, CA)

NOTES

1 In this article, we define vertical trade as overlapping of export and imported inputs within firm level data, based on Hummels et al. (2001) and Khalifah and Azhar (2014).

2 Feenstra and Hanson (1995, 1996, 1997a, 1999), Anderton and Brenton (1999), Strauss-Khan (2004), and Agnese (2012) for developed countries; Wood (1997), Pavcnik (2003), Goldberg and Pavcnik (2004, 2007), Meshi and Vivarelli (2009), Meschi et al. (2011), and Gourdon (2011) for developing countries.

3 Several studies claim skill biased technological change (SBTC) and not trade as the main source for these trends in the labour market. For instance, studies by Berman et al. (1994) and Berman et al. (1998).

4 Feenstra and Hanson (1995, 1996, 1997a, 2001), Berman et al. (1994), Egger et al. (2001), Egger & Egger (2005), and Agnese (2012)

5 Feenstra and Hanson (1997b), Harrison & Hanson (1999), and Robertson (2004) for Mexico; and Pavnick (2003), and Gallego (2012) for Chile

6 Studies by Berman and Machin (2000) for developing countries including Asian developing countries, Devadason (2005, 2011) and McNabb and Said (2013) for Malaysia; Tangavelu and Chongvilaivan (2011) for Thailand, Fajnzylber and Fernandes, (2009) for China and Brazil.

7 Meschi et al. (2011) and Fajnzylber & Fernandes (2009) analysed the effects of both import and export, as well as the foreign share (FDI) of establishments.

8 Refer to Horgos (2009) for extensive clarification on the measurement issues

9 Studies by McNabb and Said (2013) and Devadason (2005, 2011) have matched the SITC (Standard International Trade Classification) trade data at 3-digit industry-level with the Household Income Survey and ASMI (provided by DOSM), respectively

10 Most studies on the impacts of trade on labour market concentrate on income inequality or wage inequality. However, increasing wage inequality also implies increasing in relative demand for skilled workers. Studies on trade and wage inequality relationship, among others, are Wood (1997), Goldberg and Pavcnik (2007), Meschi and Vivarelli (2009), and Gourdon (2011). Most of the studies focused on Latin America. Only several, specifically focused the analysis on Asian developing countries. For instance, McNabb and Said (2013) and Amiti and Davis (2012), and Devadason (2005).

11 Since 2008, DOSM is more stringent in providing the micro-data. For the cleaning process of datasets and construction of panel data used in this study, refer to Khalifah and Jaafar (2017).

12 The provided database does not capture the origin/destination of imported inputs and exported goods as well as the industrial classification of inputs.

13 Berman et al. (1994), Feenstra and Hanson (1996, 1997a, 1999), Strauss-Kahn (2004), Gorg and Hanley (2005), Helg and Tajoli (2005), Devadason (2005) focus on outsourcing or trade fragmentation; Head and Ries (2002) focus on offshoring which measures by investments; Bernard and Jansen (1997) focus on exports; Meschi and Vivarelli (2008) on trade openness and McNabb and Said (2013) focused on trade liberalisation (degree of import and export penetration), Meschi et al. (2011) focused on export and import. Fajnzylber and Fernandes (2009) represent one of the studies that takes into account the imported inputs, export and FDI – multiple international economic activity.

14 Primary or simple institution of vertical specialization based on Hummels et al. (2001) is described by formula: $VS_{ki} = (Minp_i/Q_i).X_i$; where k denotes country and i is goods. $Minp$ is the imported inputs, Q is the gross outputs and X is export of goods.

15 The VTQ_i is $(0 \leq VTQ_i < 2)$ with lower bound indicating no overlap between export and imported inputs value and values close to 2 showing massive overlap of exports and imported inputs relative to outputs.

16 We also use the share of imported inputs to total outputs, and value added and the ratio of export to value added, interchangeably.

17 McNabb and Said (2013) used educational categories to distinguish skilled and unskilled workers. Results in the paper are comparable with our empirical findings which show that our measurement can be inferred in the context of skill intensity and wage inequality between skilled and unskilled workers.

18 We also interchangeably estimate using the capital-labor ratio (the ratio of total capital stocks to the total employment (K/L)) as well as the share total capital stocks to value added (K/VA).

19 Several previous studies had used the imported inputs or goods measure as well as export as measures for foreign technology adoption. If the coefficients for these variables turn to be positively significant, there are skill-biased technological transfers through the import and export channels.

20 Fajnzylber and Fernandes (2009) suggest that estimating all the activities or measures concurrently lead to multicollinearity problems. Nevertheless, focusing on each activity separately may raise an omitted variables bias, i.e. may over- or under-estimate the effects of particular measure (Kraay et al. 2006).

21 However, when we use ratio of imported inputs to total outputs or value added, as alternative measurement for international outsourcing, the estimated coefficient became statistically not significant. This result is similar to Pavcnik (2003) who found the share of imported inputs – as a measure of technology adoption – is not significant in explaining skill intensity for Chilean plants when controlling the plant fixed effects. As proven in study by Horgos (2009) measurement differences are crucial in determining the significant of international outsourcing on skills demand.

REFERENCES

Agnese, P. 2012. Employment effects of offshoring across sectors and occupations in Japan. *Asian Economic Journal* 26(4): 289–311.

Ahn, S., Fukao, K. & Ito, K. 2008. Outsourcing in East Asia and its implication on the Japanese and Korean labour markets. *OECD Publishing* no. 65.

Amiti, M. & Davis, D.R. 2012. Trade, firms, and wages: Theory and evidence. *Review of Economics Studies* 79(1): 1–36.

Amiti, M. & Wei, Shang-Jin. 2005. Service offshoring, productivity, and employment: Evidence from the United States. *IMF Working Paper* no. WP/05/238.

Anderton, B. & Brenton, P. 1999. Outsourcing and low-skilled workers in the UK. *Bulletin of Economic Research* 51(4): 267–285.

Anderton, B., Brenton, P. & Oscarsson, E. 2002. Outsourcing and inequality. *CEPS Working Document* no. 187, Centre For European Policy Studies, 1–24.

Arcabche, J.S., Dickerson, A. & Green, F. 2004. Trade liberalization and wage in developing countries. *Economic Journal* 114: F73–F76.

Arellano, M. & Bond, S. 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies* 58(2): 277–297.

Arndt, S.W. 1997. Globalization and the open economy. *North American Journal of Economics and Finance* 8(1): 71-79.

Arndt, S.W. 1998. Super-Specialization and the gains from trade. *Contemporary Economic Policy* XVI: 480–485.

Athukorala, P.C. & Menon, J. 2010. Global production sharing, trade patterns, and determinants of trade flows in East Asia. *ADB Working Paper Series* on Regional Economic Integration 41, Manila, Asian Development Bank.

Baltagi, B. & Rich, D.P. 2005. Skill-biased technological change in US manufacturing: a general index approach. *Journal of Econometrics* 126(2): 549–570.

Berman, E., Bound, J. & Griliches, Z. 1994. Changes in demand for skilled labour within US manufacturing: evidence from the Annual Survey of Manufacturing. *The Quarterly Journal of Economics* 109(2): 367–397.

Berman, E., Bound, J. & Machin, S. 1998. Implications of skill-biased technological change: international evidence. *The Quarterly Journal of Economics* 113(4): 1245–1279.

Berman, E. & Machin, S. 2000. Skill-biased technology transfer around the world. *Oxford Review of Economic Policy* 16(3): 12–22.

Bernard, A.B. & Jensen, J.B. 1997. Exporters, skill upgrading and the wage gap. *Journal of International Economics* 42(1): 3–31.

Blundell, R. & Bond, S. 1998. Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics* 87(1): 115–143.

Bond, S., Hoeffler, A. & Temple, J. 2001. GMM estimation of empirical growth models. *Economics Papers*, 2001-W21, Economics Group, Nuffield College, University of Oxford.

Campa, J. & Goldberg, L.S. 1997. The evolving external orientation of manufacturing: A profile of four countries. *FRBNY Economic Policy Review* July 1997: 53–81.

Chen, H., Kondratowicz, M. & Kei-Mu, Yei. 2002. Vertical specialization and three facts about U.S. international trade. *North American Journal of Economics and Finance* 16: 35–59.

Chongvilaivan, A., Hur, J. & Riyanto, Y.E. 2009. Outsourcing types, relative wages, and the Demand for skilled workers: New evidence for U.S. manufacturing. *Economics Inquiry* 47(1): 18–33.

Devadason, E. 2005. International production fragmentation and the implications for relative labour demand: The Malaysian case. Working Paper presented in *2nd Global Labour Forum, India Habitat Center, New Delhi, India,* 13-14 December 2005.

Devadason, E. 2011. Product quality changes and the demand for skills: Evidence from Malaysia's trade in manufacturers. *Malaysian Journal of Economic Studies* 48(1): 1-21.

Egger, P., Pfaffermayr, M. & Wolfmayr-Schnitzer, Y. 2001. The international fragmentation of Austrian manufacturing: the effects of outsourcing on productivity and wages. *North American Journal of Economics and Finance* 12: 257–272.

Egger, H. & Egger, P. 2005. Labor market effects of outsourcing under industrial interdependence. *International Review of Economics and Finance* 14: 349–363.

Fajnzylber, P. & Fernandes, A.M. 2009. International economic activities and skilled labour demand: evidence from Brazil and China. *Applied Economics* 41: 563–577.

Feenstra, R.C. & Hanson, G.H. 1995. Foreign investment, outsourcing and relative wages. *NBER Working Paper* no. 5121, National Bureau of Economic Research, Cambridge, MA.

Feenstra, R.C. & Hanson, G.H. 1996. Globalization, outsourcing and wage Inequality. *American Economic Review* 86(2): 240–245.

Feenstra, R.C. & Hanson,G.H. 1997a. Productivity Measurement and the Impact of Trade and Technology on Wages: Estimates for the US 1972–1990. *NBER Working Paper* no. 6052, National Bureau of Economic Research, Cambridge, MA.

Feenstra, R.C. & Hanson,G.H. 1997b. Foreign direct investment and relative wages: evidence from Mexico's maquiladoras. *Journal of International Economics* 42: 371–393.

Feenstra, R.C. & Hanson,G.H. 1999. The impact of outsourcing and high-technology capital on wages: estimate for the United States, 1972–1990. *Quarterly Journal of Economics* 114(3): 907–940.

Feenstra, R.C. & Hanson,G.H. 2001. Global production sharing and rising inequality: a survey of trade and wages. *NBER Working Paper* No. 8372, National Bureau of Economic Research, Cambridge, MA.

Gallego, F.A. 2012. Skill premium in Chile: Studying skill upgrading in the South. *World Development* 40(3): 594–609.

Geishecker, I. & Görg, H. 2005. Do unskilled workers always lose from fragmentation? *The North American Journal of Economics and Finance* 16(1): 81–92.

Geishecker, I. & Görg, H. 2008. Winners and losers: a micro-level analysis of international outsourcing and wages, *Canadian Journal of Economics* 41(1): 243–270.

Goldberg, P. & Pavcnik, N. 2004. Trade, inequality and poverty: What do we know? Evidence from recent trade liberalization episodes in developing countries. *NBER Working Paper* No. 10593, National Bureau of Economic Research, Cambridge, MA.

Goldberg, P. & Pavcnik, N. 2007. Distributional effects of globalization in developing countries. *NBER Working Paper* no. 12885, National Bureau of Economic Research, Cambridge, MA.

Görg, H. & Hanley, A. 2005. Labour demand effects of international outsourcing: Evidence from plant-level data. *International Review of Economics and Finance* 14: 365–376.

Gourdon, J. 2011. Wage inequality in developing countries: South-South trade matters. *International Review of Economics* 58(4): 359–383.

Harrison, G., & Hanson, A. 1999. Trade liberalization and wage inequality in Mexico. *Industry and Labor Relations Review* 52: 271–288.

Hatzichronoglou, T. 1997. Revision of the high-technology sector and product classification. *OECD Science, Technology and Industry Working Paper* 1997/02, OECD Publishing.

Head, K. & Ries, J. 2002. Offshore production and skill upgrading by Japanese manufacturing firms. *Journal of International Economics* 58: 81–105.

Helg, R. & Tajoli, L. 2005. Patterns of international fragmentation of production and the relative demand for labour. *North American Journal of Economic and Finance* 16: 233–254.

Horgos, D. 2009. Labor market effects of international outsourcing. How measurement matters. *International Review of Economics Finance* 18: 611–623.

Hummels, D., Ishii, J. & Yi, K. 2001. The nature and growth of vertical specialization in world trade. *Journal of International Economics* 54: 75–96.

Kraay, A., Isidro, S. & Tybout, J. 2006. Product quality, productive efficiency, international technology diffusion: evidence from plant-level panel data. In: Hoeckman, B. & Beata, J. eds., *Global Integration and Technology Transfer*, New York: The World Bank and Palgrave Macmillan.

Khalifah, N. A. & Azhar, A. K. M. 2014. Vertical trade and export processing of establishments: Measurement matters. Forum for Research in Empirical International Trade (FREIT), Working Paper no.826.

Khalifah, N.A. & Jaafar,Z. 2017. Technical efficiency of establishments in Malaysia's electrical and electronics industries: Exporting or vertical trade? *Jurnal Ekonomi Malaysia* 51(1): 15–30.

Mazumdar, J. & Quispe-Agnoli, M. 2004. Can capital-skill complementary explain the rising skill premium in developing countries? Evidence from Peru. *FRB of Atlanta Working Paper* no. 2004–11.

McNabb, R. & Said, R. 2013. Trade openness and wage inequality: evidence for Malaysia. *The Journal of development Studies* 49(8): 1118–1132.

Menon, J. 1998. Total factor productivity growth in foreign and domestic firms in Malaysian manufacturing. *Journal of Asian Economics* 9(2): 251–280.

Meschi, E. & Vivarelli, M. 2009. Trade and income inequality in developing countries. *World Development* 37(2): 287–302.

Meschi, E., Taymaz, E. & Vivarelli, M. 2011. Trade, technology and skills: Evidence from Turkish microdata. *Labour Economics* 18: S60–S70.

Pavcnik, N. 2003. What explains skill upgrading in less developed countries? *Journal of Development Economics* 71: 311–328.

Robbins, D.J. 1996. Evidence on trade and wages in developing world. *OECD Developemt Working Papers* no. 119 OECD.

Robertson, R. 2004. Relative prices and wage inequality: evidence from Mexico. *Journal of International Economics* 64: 387–409.

Strauss-Kahn,V. 2004. The role of globalization in the within-industry shift away from unskilled workers in France. *NBER Working Paper* no. 9716, National Bureau of Economic Research, Cambridge, MA.

Thangavelu, S.M. & Chongvilaivan, A. 2011. The impact of material and service outsourcing on employment in Thailand's manufacturing industries. *Applied Economics* 43: 3931–3944.

Wood, A. 1997. Openness and wage inequality in developing countries: The Latin American challenge to East Asian conventional wisdom. *World Bank Economic Review* 11(1): 33–58.

Yamashita, N. 2008. The impact of production fragmentation on skill upgrading: New evidence from Japanese manufacturing. *The Arndt-Corden Division Economics*, Research School of Pacific and Asian Studies, ANU College of Asian and the Pacific, Working Paper no. 2008/06, 1–52.

Yamashita, N. 2010. The impact of foreign outsourcing on wage inequality in US manufacturing: New evidence. *Economics Letters* 107: 46–48.

Azmafazilah Jauhari*
Fakulti Ekonomi dan Pengurusan
Universiti Kebangsaan Malaysia
43600 UKM Bangi
Selangor
E-mail: azma@ukm.edu.my

Noor Aini Khalifah
Fakulti Ekonomi dan Pengurusan
Universiti Kebangsaan Malaysia
43600 UKM Bangi
Selangor
E-mail : na.khalifah@gmail.com

* Corresponding author