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Product Quality Changes and the Demand for Skills: Evidence from Malaysia's Trade in Manufactures*

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Abstract: The competitiveness of the Malaysian manufacturing sector has become a major issue given recent arguments that Malaysia is being squeezed by low wage competitors and rich country innovators. Critical to competitiveness is product quality. The findings of the study indicate a less than favourable position for Malaysia due to lack of product differentiation coupled with severe trade-induced adjustments in the highly driven traded sector of machinery and transport equipment. Low quality varieties continue to dominate Malaysian exports. It is thus not surprising to note that exports do not influence skills upgrading in manufacturing, since the demand for labour is a derived demand, inherently derived from the products being produced. The higher utilisation of unskilled relative to skilled labour in manufacturing is therefore a reflection of high volume manufacturing of low quality varieties. Thus the findings of the study do not indicate an overall progression of the Malaysian manufacturing sector in terms of moving up the quality ladder.

Keywords: Product quality changes, skills, trade-induced adjustment, vertical differentiation
JEL classification: F14, F16, J23

1. Introduction

The importance of foreign trade in manufactures for the Malaysian economy cannot be disputed. The manufacturing sector contributed approximately 30 per cent to overall Gross Domestic Product (GDP) in 2007 (Central Bank of Malaysia 2008). Manufactured goods also accounted for a large percentage of Malaysian exports, approximately 78 per cent in 2007. Similarly, manufactured imports command a high share of total imports, due to the rising demand for capital, intermediate and consumer goods (Amir 2000; MITI 2006). Malaysia, however, remains a net exporter of manufactured goods.

The stellar performance of the manufacturing sector made it unequivocally the driving force in the country's transition to middle-income status. There is now renewed concerns on the role of the manufacturing sector as recent arguments allude to Malaysia being squeezed between low wage competitors that dominate in mature industries such as China (Lall and Albaladejo 2003) and rich country innovators that dominate in hi-tech industries such as the US and Japan (Gill and Kharas 2007; NEAC 2009). The country is caught in a middle-income trap where the performance of the manufacturing sector is deemed to be at odds with the objective of moving up on the value chain (NEAC 2009). The fact that

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manufactured exports have been leading in Malaysia's trade warrants a closer examination of the performance of this sector.

The basic idea of performance, as expounded in the paper, impinges on the fact that the scope for product differentiation is great in manufactures and therefore trade expansion may induce quality upgrading. Product differentiation, in turn, represents technological progress in a country's product (Kang 2007), and is able to proxy the quality of labour or workforce composition.

In terms of product differentiation, prior estimates portray considerably high levels of intra-industry trade (IIT) or matched trade in Malaysian manufactures. There are good reasons to believe that vertical fragmentation of production processes explain a substantial part of these IIT patterns given the large import content in manufacturing exports. In 2006, IIT for Malaysia as measured by the static Grubel-Lloyd (GL, see Grubel and Lloyd 1975) index was 47 per cent at the 5-digit-level of the SITC (Standard International Trade Classification) disaggregation (Brulhart 2009). Likewise the dynamic marginal intra-industry trade (MIIT, see Brulhart 1994) index which captures changes in trade patterns recorded a considerably high value of 0.34 for Malaysia's trade over the interval 1990-2006 (Brulhart 2009). Though IIT adjustment is found to be high since the 1990s; this has not rendered an increase in competitiveness of the manufacturing sector in general based on the MIIT index (Devadason 2007). The sophisticated measure of exports by Lall *et al.* (2006) further indicate that Malaysia continues exporting products in the world market segment where low-income economies predominate and therefore is likely to face acute competition. Based on scores ranging from 1 being the most sophisticated and 6 the least, their study shows that Malaysia has retained a relatively large level 6 exports between 1990 and 2000.

More important than the expansion of matched trade is therefore the quality improvement in differentiated products along with changes in the workforce composition, both of which are critical to Malaysia's performance and competitiveness as a net exporter. The key question is: 'Has the Malaysian manufacturing sector progressed adequately to face stiffer global competition *via* improvements in product quality and utilisation of higher skills'? The objectives of the paper are thus twofold. First, the paper documents the changes in product quality in Malaysia's trade flows for different intervals spanning the period 1990-2005. Previous estimates on quality-based differentiation of products largely focused on the criterion proposed by Abd-el-Rahman (1991) and Greenaway *et al.* (1994a), which measures quality of varieties for a particular point in time. This paper instead employs the more recent S and PQV measures that capture product quality *changes* for given intervals to appropriately track the progress of the manufacturing sector. Second, the paper estimates empirically the skills demand effects of trade in manufacturing to complement the analysis on changes in product quality, given that changes in skills composition of the workforce is a reflection of changes in quality of products traded.

The paper thus proceeds as follows. Section 2 reviews the theory on product differentiation, implication of IIT for labour adjustments and the links between trade and skills. This section will also present the measures used for examining dynamic IIT changes based on the S and PQV indices and the empirical specification for capturing the effects of trade on skills. Section 3 reports and discusses the qualitative findings on IIT changes in terms of adjustments and product quality changes. This is followed by Section 4 on the empirical results of the impending effects of trade on skills. Finally, Section 5 concludes.

2. Theory and Methodology

2.1 Trade-induced Changes

There is renewed interest in trade between countries in products that belong to the same sector, IIT. Prior to the 1990s, product differentiation centred on different varieties of a specific product that are of similar quality, horizontal intra-industry trade (HIIT). The distinction between HIIT and vertical intra-industry trade (VIIT, quality[2] based varieties) has now become critical given that the latter has grown in importance (Ernst 2003). VIIT is basically driven by differences in skills content, since high quality goods require a higher content of skilled labour relative to low quality goods (Widell 2005).

Trade expansion, alongside product differentiation in matched trade, is critical as it presents different implications for factor markets. The most accessible framework for a discussion of adjustment issues in the labour market is the specific factors model, expounded concisely by Neary (1985). It is hypothesised that industries with high levels of IIT undergo less structural change in response to trade than industries with low levels of IIT. The former involves a reallocation within industries while the latter implies a reallocation between industries. It is often argued that the adjustment costs are lower when new trade is of the IIT type because disruption is minimised when adjustment is internal to an industry. It is easier to transfer and adapt resources within firms or industries than to switch them from one industry to another. This proposition has become known in the literature as the 'smooth adjustment hypothesis' (SAH).

Brulhart (1999) was the first to establish the SAH hypothesis that is firmly rooted in the neo-classical thinking. The SAH simply implies that if offsetting contemporaneous import and export shocks (expanding and contracting activities) occur within a sector, adjustment costs will be lower or smoother than if those shocks affect separate industries. In the context of the specific factors model, the SAH implicitly either assumes that the mobility of labour is greater within than between industries. According to Brulhart (1999), the plausibility of labour mobility being higher within than between industries is more conceivable if skills requirements (factor mixes) are similar within industries with IIT (see also Brulhart 2009). Therefore trade shocks will result in an easier transferability of labour from contracting firms to expanding firms within an industry since the labour can be redeployed with minimal training to the latter. Several qualifications have been made by Greenaway and Hine (1991) to justify a smoother adjustment of IIT. First since much of the IIT is in parts and components (rather than in final goods), traded components are produced presumably in the same industry and rely upon similar skills to ensure smoother adjustment. Second, the issue of retraining is not the sole issue to ensure transferability since there is also geographical mobility. With the latter, they argue that expanding and contracting activities are more likely to be based in a given area in a setting of IIT than in inter-industry trade.

The nature of IIT further complicates the conceptualising of adjustment costs since varieties of VIIT have inherently different factor intensities, which then link to the relative factor endowments of the trading countries. Within the context of the SAH, labour might be relatively less mobile within VIIT than HIIT industries. Greenaway and Hine (1991) posit that factor mixes may alter in the process of specialisation, particularly for VIIT. This results

[2] Product quality was first emphasised in international trade by Linder (1961) (cited in Hallak 2006).

in complete retraining before transferability ensues. Following this logic, VIIT implies more severe adjustments since the transferability of labour from the contracting sector to the expanding sector may not be with comparative ease.

Given the expansion of product differentiation and quality improvements in international trade, recent contributions link IIT with the demand for labour, particularly high skilled (Manasse and Turrini 1999; Duranton 1999; Grossman 1999; Beaulieu *et al.* 2004). The reasons for the links between IIT and skills are as follows: First, assuming skilled labour determines the quality of goods produced and that the opportunities for greater trade rests with industries that are basically producing high quality products, the demand for high skilled labour would increase much faster. Second, to employ advanced technology to produce high quality goods, the pool of highly skilled labour will have to increase. Third, specialisation in a smaller variety of products leads to a higher scale of operation in production of each variety, which then relates to skill intensity of production. In this context, trade can be perceived as a cause for adjustment pressures (Greenaway *et al.* 1994a; 1994b; Brulhart 1999). Adjustments occur because of the following: (i) temporary inefficiencies when markets fail to clear instantaneously in response to changes in demand; (ii) changes in trade flows between different time periods; and (iii) changes in factors of production.

Another dimension of understanding trade and labour markets is the trade inducing technological change, as suggested by Acemoglu (1999). The developing country is assumed to rely on imported technology mainly through foreign direct investment (FDI) rather than directly creating technology. Acemoglu argues that if the imported production technology is skills-biased (Robbins 1996), trade may increase the demand for skilled labour. An additional channel of trade-labour links is the outsourcing of production activities abroad, an idea mooted by Feenstra and Hanson (1995). Moving low skilled activities abroad reduces the relative demand for unskilled labour at home within each industry, which produces the same effect as skills-biased technological change. Outsourcing can also induce technological change if the success of outsourcing depends on new inventory methods and rapid and sophisticated communication techniques. Productivity gains associated with the new techniques may result in labour reallocation within industries rather than between industries. Therefore employment may well rise and not fall, after some time lags in import competing industries.

In summary, trade may induce competitive and efficiency effects in product markets, resulting in product differentiation. These factors alluded to as ‘trade-induced changes,’ represent the indirect effects of trade. Trade-induced changes and adjustment pressures of trade on the labour market may therefore translate into changes in skills, with the precise magnitudes depending on conditions in the labour market.

2.2 Measure of Product Quality Changes

The method adopted is that which has been recently proposed by Azhar and Elliott (2006). It involves a two-stage approach. In Stage 1, the S index[3] (Azhar and Elliott 2003) is used to

[3] The S index satisfies four criteria (see Azhar and Elliott 2003): monotonicity (increasing function of the net change in trade); consistency (adjustment costs associated with an industry expansion equal that with an industry contraction); country specificity (adjustment costs associated with expanding or contracting industries) and matched trade changes that do not involve resource reallocation costs.

measure dynamic IIT. This index, also labeled as an index of trade-induced adjustment, is used to measure products that may have experienced large increases or decreases in matched trade over the period of analysis. The S index is given as:

$$S = 1/2L\,(\Delta X - \Delta M) = (\Delta X - \Delta M)/\,2[\max\{|\Delta X|_t, |\Delta M|_t\}]$$

where

L = largest change in exports (X) and imports (M) over the period studied

For the study, to infer the adjustments posed by matched trade, products with little IIT change and those that represent inter-industry trade are removed. Therefore the *S* index values are taken to be $-0.4 < S < 0.4$. An S index of 0 means that changes in X and changes in M are exactly matched. At the extremes, changes in X and changes in M move in exact opposite directions, beneficial for the home country or *vice versa*, with *S* indices of +0.4 and –0.4 respectively.

In Stage 2, each product identified in Stage 1 is split into vertical and horizontal components using the product quality value (PQV)[4] index (Azhar and Elliott 2006; Azhar *et al.* 2008). The PQV index is a measure of the dispersion of product quality in IIT flows. The basis for the PQV index is the calculation of crude unit values (UV) by dividing the monetary value of trade by the quantity. The PQV is given as:

$$PQV = 1 + [(UVX - UVM)/\,(UVX + UVM)] \text{ where } 0 < PQV < 2$$

where

UVX = unit value of export
UVM = unit value of import

From the PQV index, the extent of quality differences at the product level associated with the various bilateral trade relationships are quantified. The products are considered as HIIT or of similar quality if the X and M share at least 85 per cent[5] of their costs (reflected in the price). Thus,

$$0.85 < PQV < 1.15, \text{ HIIT}$$

When all two-way trade is equal in quality (VIIT = 0), the PQV index is equal to unity. When imports and exports of a product share only 50 per cent of their costs, they are classified as VIIT. Products that are VIIT are further decomposed into those that are high quality (VIITH) and those that are low quality (VIITL) as follows:

$$PQV \geq 1.15, \text{ VIITH}$$
$$PQV \leq 0.85, \text{ VIITL}$$

The data are sourced from the UN COMTRADE database that records imports and exports in quantities and values. Merchandise imports and exports recorded in millions USD are deflated by the US consumer price index (CPI) at 1990 constant prices. This study

[4] The *PQV* index exhibits proportionate scaling which is country invariant and thus less prone to distortions in product quality measurement, unlike that of the GHM (Greenaway *et al.* 1994a) and FF (Fontagne and Freudenberg 1997) approaches (see Azhar and Elliott 2006; Azhar *et al*. 2008).

[5] The cut-off point, however, does involve a certain degree of arbitrariness.

will be based on highly disaggregated data, compiled at the 5-digit SITC (Standard International Trade Classification), Revision 3, to minimise composition problems. The total number of products considered is 2,090 manufactured products (Sectors 5-8). Product quality changes in matched trade are tracked over three sub-periods: 1990-1995, 1995–2000 and 2000–2005.

A caveat to the PQV measure is that it is dependent on price (or rather UVs). Price is considered an indicator (albeit imperfect) of quality, that is higher quality goods command higher prices (see Widell 2005; Azhar and Elliott 2006; Hallak 2006; Shahid and Nabeshima 2009). There are concerns that UVs may also pick up other influences such as production costs, efficiency and compositional changes[6] (Hallak 2006; Silver 2007; Fabrizio *et al.* 2007).

2.3 Estimation of Trade Effects

The study will take the labour perspective in analysing the skills upgrading implications of trade flows. Generally, demand for labour is taken as being a derived demand – derived from the demand for the products produced by firms and hence affected by the product market conditions under which products are sold. The relative effects (factor input shares) of trade on labour demand are estimated using skills share equations derived from a standard translog cost function that has been widely used in the literature, such as studies by Machin *et al.* (1996) and Anderton *et al.* (2001). The translog function is considered appealing in that it provides a second order approximation to any cost function and it does not impose any restrictions on the substitutability of imports. The variable cost function in translog form that assumes capital to be a fixed factor of production is as follows:

$$lnC_i = \alpha_0 + \alpha_q lnQ_i + \tfrac{1}{2}\,\alpha_{QQ} ln(Q_i)^2 + \beta_k lnK_i + \tfrac{1}{2}\,\beta_{KK} ln(K_i)^2 + \Sigma_j \gamma_j lnW_{ij} +$$
$$\tfrac{1}{2}\,\Sigma_j \Sigma_k \gamma_{jk} lnW_{ij} lnW_{ik} + \Sigma_j \delta_{Qj} lnQ_i lnW_{ij} + \Sigma_j \delta_{Kj} lnK_i lnW_{ij} + \rho lnQ_i lnK_i + \lambda_T T_i +$$
$$\tfrac{1}{2}\,\lambda_{TT}(T_i)^2 + \lambda_{QT} T_i lnQ_i + \lambda_{KT} T_i lnK_i + \Sigma_j \varphi_{TWj} T_i lnW_{ij}$$

where

C_i = variable costs in industry i
Q_i = output in industry i
K_i = capital stock in industry *i*
W_{ij} = price of variable factor *j*
T_i = technology in industry *i*

Cost minimisation of the above generates the following linear equations for the factor shares (L):

$$L_{ij} = \gamma_j + \delta_{Qj} lnQ_i + \delta_{Kj} lnK_i + \Sigma_k \gamma_{jk} lnW_{ik} + \varphi_{TWj} T_i \qquad (1)$$

Differencing (denoted by d) the above with respect to factor prices generates:

$$dL_{ij} = \varphi_{TWj} dT_i + \delta_{Qj} dlnQ_i + \delta_{Kj} dlnK_i + \Sigma_k \gamma_{jk} dlnW_{ik} \qquad (2)$$

[6] The author is grateful to an anonymous referee for highlighting this critical point.

Assuming homogeneity of degree one in prices imposes:

$$\Sigma_k \gamma_{jk} = \Sigma_j \gamma_{jk} = \Sigma_j \delta_{Kj} = \Sigma_j \delta_{Qj} = 0 \tag{3}$$

This generates

$$dL_{ij} = \varphi_{TWj} dT_i + \delta_{Qj} dlnQ_i + \delta_{Kj} dlnK_i + \gamma dln(W_j/W_k) \tag{4}$$

with two variable factors *j* and *k*.

Machin *et al.* (1996) and Anderton *et al.* (2001) define the above two variable factors of production as skilled (S) and unskilled (U). The skills share equation is thus defined in the above as the proportion of skilled employment to total employment.

Since there is no technology data available and given that technologies are mostly foreign sourced and embodied in imported capital, foreign direct investment (FDI) is used as an indirect measure of technology. Theoretically, skills upgrading occurs when FDI causes technological spillovers that are skills-biased and when capital-skills complementarities exist. The other demand shifters considered for the study are the effects of foreign competition, captured by trade flows.

The skills-share equation is differenced to transform out the industry specific fixed effects. The static equations estimated in the panel analyses are as follows:

$$d(S/N)_{it} = \Omega - \Sigma\varphi_0 dln(SW/USW)_{it} + \Sigma\varphi_1 dln(VA)_{it} + \Sigma\varphi_{2j} dK_{it} + \Sigma\mu_1 d(FDI/CI)_{it} + \tag{5}$$

$$\Sigma\mu_1 dlnM_{it} - \Sigma\mu_2 dlnX_{it} + \varepsilon_{it}$$

$$d(S/N)_{it} = \Omega - \Sigma\varphi_0 dln(SW/USW)_{it} + \Sigma\varphi_1 dln(VA)_{it} + \Sigma\varphi_{2j} dK_{it} + \Sigma\mu_1 d(FDI/CI)_{it} + \tag{6}$$

$$\Sigma\mu_1 dlnM_{it} {*} d(US/N)_{it} - \Sigma\mu_2 dlnX_{it} {*} d(US/N)_{it} + \varepsilon_{it}$$

where

i = industry
t = time
Ω = constant
(S/N) = ratio of skilled employment to total employment
(SW/USW) = ratio of skilled wages to unskilled wages
VA = real value-added
K = real capital intensity
(FDI/CI) = share of foreign direct investment in total capital investment
M = real imports
X = real exports
(US/N) = ratio of unskilled employment to total employment

ε represents the error term that picks up random measurement errors in skills share and the effects of labour demand shocks on relative employment, which are not picked up by the included independent variables.

The empirical analysis is based on a specially constructed database, established by integrating trade, labour and industry statistics. The dataset involves consistent yearly and industry coverage of a panel of 19 major industrial groups (at the 3-digit aggregation level) spanning the period 1983 to 2004, to facilitate empirical enquiry. Thus the unit of observation in the data is industry. The dataset, a balanced panel of 418 observations, is informative in that it includes all manufacturing industries.

3. Adjustments and Product Quality Changes

The manufacturing sector had already undergone substantial and rapid structural changes in the commodity mix of exports and imports by the 1990s. The commodity mix of trade as shown in Table 1 broadly conforms to *a priori* expectations of a shift towards a higher level of industrial sophistication, which are industries that exhibit high growth in world markets.

The largest sector contributing to total manufacturing exports is SITC 7, which is also the sector with the highest recorded level of IIT in global trade (Brulhart 2009). The exports of electronics, electrical machinery and appliances represent the largest share (66 per cent in 2005) in total manufacturing exports. This, however, does not imply that Malaysia has moved into industries requiring skills- and capital-intensive production processes and thus no longer specialises in exporting unsophisticated, labour-intensive manufactures. In fact, within the skills- and capital-intensive industries, Malaysia is still involved in relatively labour intensive segments of component production and assembly activities. The high concentration in the exports of electronics, electrical machinery and appliances (SITC 7) also indicates that the composition of manufactured exports is narrowly based. Likewise, the SITC 7 group again constitutes the largest share of total imports. The electrical and electronic products and machinery manufacturing remain the dominant sub-sector within manufacturing imports since 1990. The other remaining industries do not reflect significant changes in their export and import composition shares.

It is obvious that sectors that are enjoying high and growing export shares have also high import shares. It is claimed that the modern and growing sectors of manufacturing in particular are highly dependent on imported components. This is either a reflection of the low level of linkages to other industries or that component production and assembly within

Table 1. Composition of Malaysia's trade (1990 – 2005)

	SITC 5	SITC 6	SITC 7	SITC 8	SITC 5	SITC 6	SITC 7	SITC 8
Year	Exports				Imports			
1990	2.96	14.38	64.59	18.07	10.59	19.70	62.63	7.09
1995	4.02	11.66	72.80	11.51	8.29	16.21	69.81	5.69
2000	4.71	8.50	76.93	9.86	8.40	12.24	72.77	6.59
2005	7.18	9.75	72.03	11.05	9.66	13.62	70.29	6.43

Note: SITC 5 – chemicals and related products; SITC 6 – manufactured goods classified chiefly by material; SITC 7 – machinery and transport equipment and SITC 8 – miscellaneous manufactured articles.
Source: Calculated from the UN COMTRADE.

vertically integrated production systems are typically more import intensive (Athukorala and Yamashita 2005). In the latter case, Athukorala and Rajapatirana (2000) assert that there is difficulty in influencing procurement practices of firms in component production and assembly since the import structure is determined as part of the overall process of international production. Therefore any dynamic changes in the import structure of these industries can be identified with changes in their export structure and *vice versa*. For example, when exports decrease, imports contract even faster (Amir 2000; Mahani 2002).

The high concentration of trade in SITC 7 in particular therefore implies a plausibility of high levels of matched trade. The following therefore adopts a more recent method to assess the dynamic changes in matched trade, adjustments and quality changes over three sub-periods. Table 2 reports the number of products with significant changes in matched trade for three different intervals between 1990 and 2005.

From Table 2, it can be seen that though the number of products identified having significant changes in matched trade has increased between 1990 and 2005, the export value shares of these products in total exports has indeed decreased. Further, the percentage of products with a positive S index at the 5-digit level at 42 per cent between 1990 and1995 increased to 56 per cent between 1995 and 2000 and thereafter recorded a decline to 47 per cent in the most recent period. By sector, generally the majority of products traded had a negative S index. This implies a less than favourable position for the Malaysian manufacturing sector in terms of international exchanges (see also Brulhart and Thorpe (2000) for a lack of support for the SAH for Malaysia for the period 1970-1994). To further assess the adjustment implications, the S index for Malaysian manufactures from 1990-2005 is aggregated from the 5-digit level. Table 3 reports the results.

On aggregate, the S index suggests benign trade-induced adjustment implications, which has indeed reduced succinctly over the three sub-periods. By sector, trade in SITC 6 and 7 imposes severe (contracting) adjustment pressures for the period 2000-2005. The negative adjustments in SITC 7 are worth noting given that it is the largest contributing sector to Malaysia's trade. Amir's (2000) study using the Revealed Comparative Advantage

Table 2. Number of products with positive S Index (1990 – 2005)

	1990-1995		1995-2000		2000-2005	
Sector	TOTAL*	S > 0	TOTAL*	S > 0	TOTAL*	S > 0
	(39.98 - 43.88)		*(33.17 – 34.99)*		*(20.88 – 25.54)*	
SITC 5	89	33	80	43	118	56
SITC 6	198	89	176	103	185	95
SITC 7	188	60	152	96	206	95
SITC 8	148	78	125	59	146	67
TOTAL	623	260	533	301	655	313

Note: (1). *Total number of products that have experienced significant changes in matched trade for the period based on the S index (-0.4 < S < 0.4). The S index is calculated at the 5-digit level and reported at the 1-digit level. (2). Figures in parenthesis refer to the percentage of two-way trade in total trade for the various bilateral relationships based on the start and end-year for the period.
Source: Calculated from the UN COMTRADE.

Table 3. S index for Malaysian manufactures (1990 – 2005)

Sector	1990-1995	1995-2000	2000-2005
SITC 5	-0.005	0.190	0.057
SITC 6	-0.100	0.190	-0.161
SITC 7	0.094	0.068	-0.010
SITC 8	0.082	-0.388	0.213
TOTAL	0.078	0.057	0.010

Note: The S index in the above table is aggregated from the 5-digit SITC level.
Source: Calculated from the UN COMTRADE.

(RCA) index reveals a decline for the entire telecommunication and sound equipment division (SITC 76) between 1994 and 1998, attributing the disadvantage to rising global competition that affects price and non price determinants. Recent trends indicate that within the SITC 7, the performance of the electrical and electronics products in particular is affected by the transition from old products like cathode-ray tube televisions and VCD players to higher value-added products like high definition LCD televisions, DVD recorders and Blu-ray players (Central Bank of Malaysia 2008). The product compositional changes within SITC 7, however, do not necessarily imply improvements in product quality.

The competitive position of the manufacturing sector is thus further analysed *via* shifts in product quality. Previous work using the static GL and MIIT indices indicate that product differentiation, particularly VIIT rather than HIIT, has increasingly dominated trade patterns in Malaysian manufacturing. Furthermore, it has been ascertained that Malaysia specialises in VIITL vis-à-vis VIITH (Devadason 2007). Figure 1 reflects the PQV index for three sub-periods to track dynamic shifts in product quality.

Figure 1 shows that more products experienced IIT changes when comparing sub-periods 2000-2005 with that for 1990-1995. There has also been an increase in the export value shares of VIITH from 13 per cent to 39 per cent in 2000-2005, unlike that for the earlier two sub-periods. With the exception for 2005, the total number of products classified as VIITH is consistently less than VIITL for manufacturing (see data for 1990, 1995 and 2000 in Appendix 2). There is generally no clear indication of quality improvements in matched trade at least for the earlier sub-periods, based on export value shares and number of products.

The trends in the most recent sub-period of 2000-2005 should not be misconstrued to reflect an overall progress in the manufacturing sector in terms of product differentiation and improvements in product quality. Of the total of 2090 product lines traded, only 528 products record significant IIT changes within this period. One can argue the case that by 2000, the Malaysian manufacturing sector had already reached high IIT levels and therefore it is not surprising that the number of products with IIT changes remains limited. Having said that, the number of products with significant IIT changes in the earlier sub-periods, also pales in comparison to the total number of products traded. Furthermore, only 29 per cent and 41 per cent of the products that record IIT changes within the most recent sub-period are classified as VIITH for 2000 and 2005 respectively (see Appendix 2). Figure 1

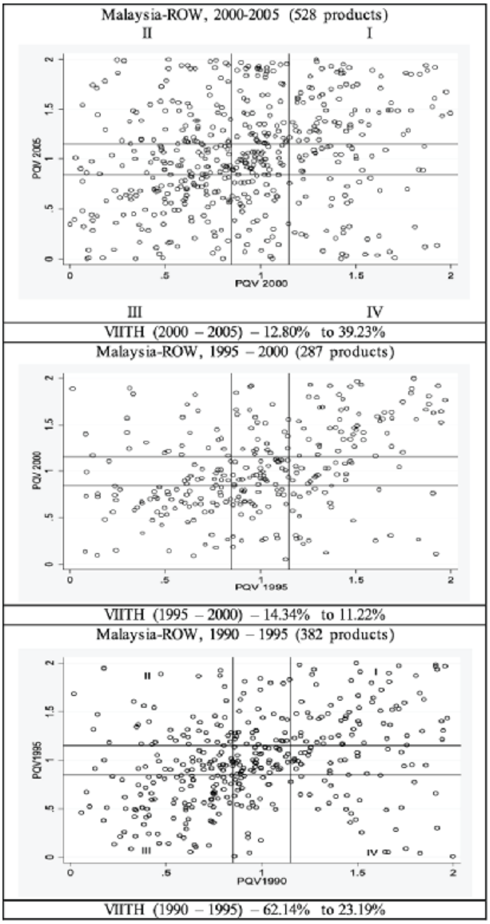

Figure 1. *PQV index for Malaysian manufactures (1990-2005)*

Note: (1). Data below the respective diagrams indicate the share of export value in matched trade that is of VIITH for the start- and end-year of the sub-period.
(2). Products that fall within the t-zone represent HIIT. Quadrant I represents products that have remained as VIITH over the relevant sub-period, quadrant II refers to products that shifted from VIITL to VIITH, quadrant III to products that have remained as VIITL and quadrant IV represents products that shifted from VIITH to VIITL.

Source: Calculated from the UN COMTRADE.

clearly indicates no concentration of products either in quadrant 1 (products that have remained as VIITH) or quadrant II (products that have graduated from VIITL to VIITH) for the sub-period 2000-2005.

By sector, vertical specialisation again dominates in Malaysian trade with the rest of the world. Figure 2 presents the PQV index for the four sectors within manufacturing. The

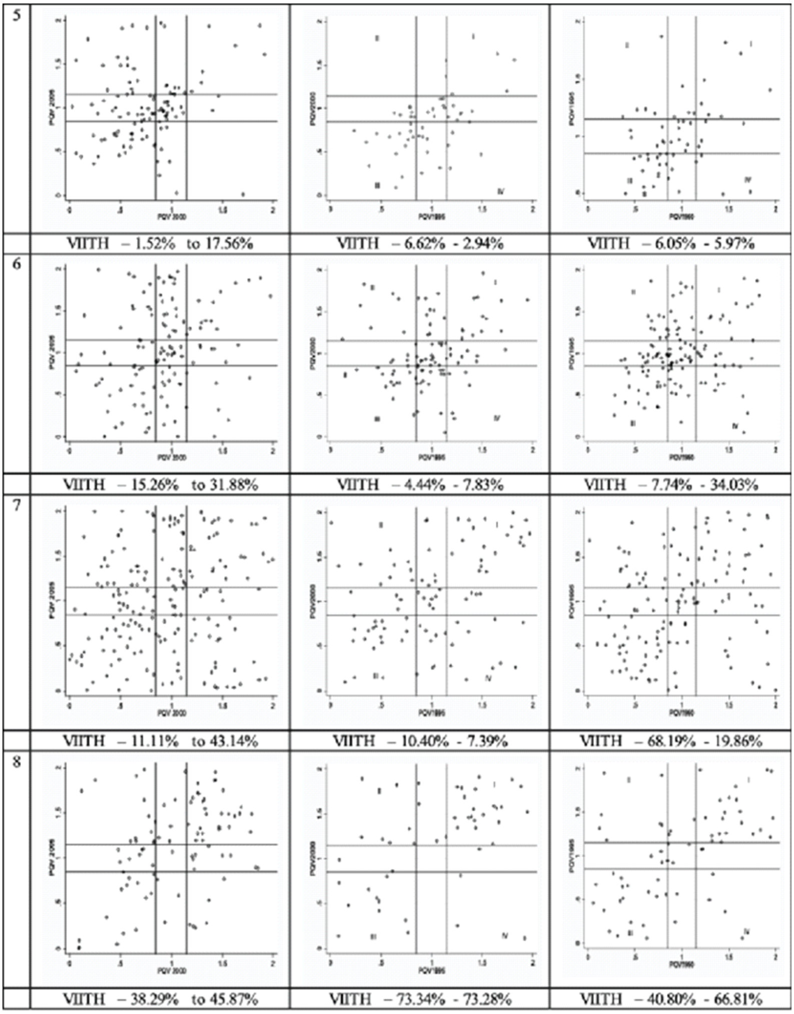

Figure 2. *PQV index by sectors 5-8 (1990-2005)*

Note: The explanation of Figure 1 holds.
Source: Calculated from the UN COMTRADE.

broad trends in terms of quality improvements noted for overall manufacturing appear to hold for the individual sectors. There is consistent improvement in product quality in terms of export value shares across all sectors for the sub-period 2000-2005. Despite the improvement in product quality, it is worth mentioning here that the export value shares of VIITH still remain below 50 per cent of total exports in matched trade.

More importantly, the number of SITC 7 products classified as VIITH does not differ substantially from that of VIITL based on the recent period 2000-2005 (see Appendix 2).

This aspect of upgrading in terms of product quality can be compared directly with that of another level of upgrading, indicated by the capacity to move within a value chain into more sophisticated products and economic activities (that reflect higher prices). The combination of low and high quality varieties of SITC7 products from the PQV analysis in fact mirror previous findings of a dualistic structure for the electronics and electrical industry; a relative strength in capital-intensive automated operations but a structural weakness in labour intensive assembly line operations (see Amir 2000; Ernst 2003; Doner and Ritchie 2006).

The following contrasting evidence from previous work provides some indications on the dualistic structure. The strengths of the electrical and electronics industry are expounded by MITI (2006) and Norlela and Figueiredo (2004). Both studies cite a steady progression in the electronics industry of Malaysia, involving the production of complex and higher value products since 2000. Norlela and Figueiredo (2004) further emphasise that there is a move from assembly of electronic and semiconductor devices to sub-assembly and component assembly of more complex devices. Contrary to the above, existing developments in the Penang cluster, which is identified under the Second Industrial Master Plan (1996-2005) to move beyond assembly and testing to design and development, proved to be instead rather disappointing (Shahid and Nabeshima 2009) despite recording some impressive developments in the past (Doner and Ritchie 2006). The NEAC (2009) stress that only a handful of multinational corporations (MNCs) have upgraded their operations in Penang by investing in R&D, whilst a large majority continue to focus only on assembly operations. Following which, the Penang cluster has created a large number of component manufacturers essentially locked into original equipment manufacturing (OEM) relationships. The firms engaged in OEM derive low profit margins, which in turn hinders investment in research and development (R&D) that is necessary for moving into higher value-added products. Shahid and Nabeshima (2009) further point out that the variety of products exported from the Penang cluster is much smaller relative to that from Malaysia and the shares of exports with RCA are on the decline. It may thus be inferred that any quality improvements or shifts to higher value-added products observed within SITC 7 in the past are mere isolated events,[7] which are arguably insufficient to justify an overall upgrading of the sector.

The general findings from the S and PQV indices point to a possible lack of progress in the manufacturing sector in terms of low product differentiation relative to the number of product lines traded, severe trade-induced adjustment pressures in key sectors (namely SITC 7) and less marked improvements in product quality. Given the afore-mentioned findings on the lack of product quality improvements in manufactures, the next section examines the impending changes in skills share following trade.

4. Empirical Findings

One implication of trade-induced adjustments following product differentiation as discussed in Section 2 is the ensuing changes in factor shares. The skills share in Malaysian

[7] There are export-oriented MNCs in Malaysia, for example OSRAM, Intel, Motorola and Altera (NEAC 2009), engaging in local R&D and other forms of technological effort, but these are limited to the larger subsidiaries (Clarke *et al.* 2003).

manufacturing though considerably low at 19 per cent in 2004, rose from 13 per cent in 1983. Despite the low level of skills in manufacturing, the skill shares vary considerably across industries, ranging from 6 per cent to 64 per cent.

Table 4 reports the results of the links between trade and skills using the Generalised Method of Moments (GMM)[8] estimator of Arellano and Bond (1991) for Equations (5) and (6). The results of the one-step model are reported though the null hypothesis of no first-order correlation in the difference residuals is rejected for all specifications, since Arellano and Bond (1991) recommend the one-step results instead of the two-step standard errors for inference on coefficients. The one-step results are found to be free of second order autocorrelation for all specifications. For ease of exposition, the resulting estimates of other explanatory variables are not discussed below.

The results indicate that the growth of imports reduced the growth of skill shares in manufacturing. This is not surprising given that previous studies indicate that Malaysia's aggregate imports comprise a higher skills content (Ernst 2003) than that of exports. Similarly, export growth has a negative but statistically insignificant coefficient. This concurs largely with the results displayed in Figure 1, which shows that VIITH remains low. Thus the low quality varieties that dominate exports, in turn, do not require excessive skilled labour in the production process. It is noted that approximately 80 per cent of the manufacturing workforce is low to mid-skilled (Central Bank of Malaysia 2010).

The results in Table 4 are not statistically different when unskilled labour shares in each industry are used as an additional instrument (see Equation 5(b)). However, since a lack of skills upgrading is evident with trade expansion, the export and imports variables are interacted with unskilled labour shares in each industry (see Equation 6) to assess the impact on unskilled intensive industries. On aggregate, imports significantly caused larger declines in the growth of skills shares in unskilled intensive industries. It appears that trade expansion over the past two decades cannot explain the rise in skills shares in manufacturing. Given that product quality is related to skills, the low quality varieties that continue to dominate Malaysian exports (as discussed in the previous section) plausibly explain the lack of skills upgrading. The only case of a skills upgrading noted thus far is in the electrical and electronics industry of the Penang cluster that saw an increase in skills intensity from 17 per cent in 1990 to 45 per cent in 2007 (NEAC, 2009). The rise in skills is attributed solely to the nucleus of innovators in that cluster *per se*. Whilst products produced and exported by Malaysia are high-tech (with specific reference to SITC 7) as pointed out in Table 1, the processes that make up the domestic part of the supply chain contribute less value-added and are still not innovation-intensive. Following which, most industries have yet to move up the quality ladder to produce higher value-added goods. Low-end assembly operations, that are generally unskilled intensive, continue to dominate (Ernst 2003; Rasiah 2006; Doner and Ritchie 2006; UNDP 2006a; b).

To illustrate further on the lack of quality upgrading, it is worth examining the key underlying features of the Malaysian manufacturing sector. The manufacturing sector is

[8] As relative labour demand is likely to show inertia leading to first-order correlation in the errors, the lagged dependent variable is included as an explanatory variable. Further, the potential endogeneity of relative wages and capital intensity is addressed by using the first, second and third lagged values of an additional instrument, which is unskilled labour shares in each industry.

Table 4. GMM estimates of skill share equations for manufacturing (one-step results)

Independent variables	(5a) Coefficient	(5a) Std.err.	(5b) Coefficient	(5b) Std. err.	(6) Coefficient	(6) Std. err.
Constant	0.676**	0.179	0.680**	0.179	0.663**	0.193
$d(S/N)_{t-1}$	-0.304**	0.023	-0.303**	0.023	-0.310**	0.043
$d(S/N)_{t-2}$	-0.174**	0.021	-0.173**	0.021	-0.195**	0.044
$d(SW/USW)_t$	-0.016**	0.002	-0.016**	0.002	-0.012**	0.002
$dln(VA)_t$	-0.854	0.467	-0.862	0.471	-0.248	0.26
dK_t	0.128*	0.062	0.128*	0.062	0.073*	0.034
$d(FDI/CI)_t$	-0.002	0.002	-0.002	0.002	-0.005	0.003
$dlnM_t$	-0.758*	0.222	-0.770*	0.363		
$dlnX_t$	-0.041	0.362	-0.060	0.216		
$dlnM_t*d(US/N)_t$					-0.762**	0.126
$dlnX_t*d(US/N)_t$					-0.048	0.085
2nd order serial correlation	-0.124		-0.137		1.232	
Wald test	695.53 (8)		723.25 (8)		1365.57 (8)	
No. of observations	342		342		342	

Note: 1. The standard errors reported are the robust standard errors.
2. The Wald test is a test of the joint significance of the independent variables asymptotically distributed as a chi-square under the null of no relationship. The figures in parenthesis represent the number of coefficients estimated (excluding time dummies).
3. The additional instrumental variable used in Equation 5(b) is the shares of unskilled labour in each industry.

** significant at 1%'; *significant at 5%.

heavily dependent on FDI (Central Bank of Malaysia 2010) and this is underscored by the significant contribution of large MNCs to exports. The major recipient of FDI is the electrical and electronics sector, which constitutes around 60 per cent of Malaysian exports. Despite the large presence of foreign establishments with access to advanced technology and the exposure and integration of the electrical and electronics sector to global production networks, domestic industrial upgrading has been rather minimal for the following reasons. In the past, the government has not been selective in attracting quality-based FDI[9] to ensure the transfer of technology and know-how to local suppliers (Doner and Ritchie 2006; Shahid and Nabeshima 2009). Further, the domestic R&D gap (Clarke *et al.* 2003; NEAC 2009; Central Bank of Malaysia 2010) and the shortages in skilled workers, particularly specialised skills, have not provided an adequate supplier structure required for value-added production by MNCs (Mahadevan 2002; Ernst 2003). Apart from MNCs, the leading higher-tier local suppliers are also facing problems in sustaining and expanding their upgrading efforts given the low quality of human resources (Ernst 2003). For example,

[9] Recent records show that the government has been successful in attracting FDI into higher value-added activities and those that will bring in new technology such as medical equipment and renewable energy (Central Bank of Malaysia 2010).

electronic firms in Penang that account for 49 per cent of total Malaysian electronic exports, claim that shortages of specialised skills impede product/ process development (Shahid and Nabeshima 2009; see also Central Bank of Malaysia 2010).

5. Conclusion

The study has shown that the prominence of IIT does not conform to *a priori* expectations. Previous work on IIT using traditional measures such as the GL index that focused on levels instead of *changes* in IIT, may have grossly overstated the increase in two-way trade between Malaysia and the rest of the world. In fact, the relatively low IIT changes with respect to total number of product lines traded for all sub-periods between 1990 to 2005, appear to suggest that Malaysia may in fact be losing an edge in terms of product variety (see also Shahid and Nabeshima, 2009) or product differentiation.

The type of IIT during the period was due, fundamentally to two-way trade of vertically differentiated products. Further disaggregation of the VIIT into ranges of quality shows that Malaysia continues to specialise inherently in low quality products. The empirical results on the effects of exports on skills shares further lend support to the qualitative findings on product quality changes within manufacturing. Exports, albeit insignificant, are found to hinder skills upgrading. This follows logically from the derived nature of the demand for labour, which is derived from the products being produced. The exports of low quality varieties obviously do not make excessive demands for skilled labour.

The study therefore contends that product differentiation, more specifically improvement in product quality, is lacking in the manufacturing sector. Product upgrading requires adding more value in all segments of manufacturing and by all factions of firms (MNCs and local suppliers). Malaysia can no longer just depend on a nucleus of innovators to propel the economy to move into higher value-added activities. Critical to these value-added process (that is, quality improvements), is the pool of talent workers to build capacities in areas such as product development and design. In this respect, there is a need to address some immediate concerns pertaining to the extensive use of unskilled workers in manufacturing. The Central Bank of Malaysia (2010) notes that the easily available and relatively cheap unskilled (foreign) workers hinder the adoption of greater automation as 60 per cent of the jobs undertaken by the former can be replaced by automation. The intensive use of unskilled workers will therefore derail the move up the value chain, resulting in a continuous trap of producing low quality varieties.

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Appendix 1. Data Description

Trade data for the panel analysis has been compiled for industries at the 3-digit Standard International Trade Classification (SITC level, Revision 3). The data on imports (M) and exports (X) for the period 1983 to 2004 is derived from the *Malaysia: External Trade Statistics* publications. Exports do not include re-exports. Exports are valued f.o.b. while imports c.i.f. Exports and imports are in ringgit Malaysia at current prices. Manufacturing imports and exports are deflated with the import price and export price index (1980=100) for the entire economy respectively.

Labour data has been drawn from industrial surveys conducted annually by the Department of Statistics (DOS) Malaysia. The study only considers full-time paid employees, as they represent 98-99 per cent of the total number of persons engaged in the Malaysian manufacturing sector. Employment (N) is measured in terms of numbers employed (and not the total man-hours worked due to data unavailability), which excludes working proprietors and active business partners, unpaid family workers and part-time paid employees. Since part-time employees are excluded, variance in hours of work is expected to be small.

Similarly, only annual salaries and wages (W) of full-time paid employees are taken into account. Salaries and wages paid refer to cash payments, including bonuses, commissions, over-time wages and cost of living allowances. Bonuses are included to reflect differences in wages as the determination of salary and allowances are quite structured in Malaysia. The amount of bonuses paid is decided upon an annual negotiation between firm management and labour union according to the profit of the firm and performance of individual workers. The employees' contribution to the social security schemes or to other provident or superannuating funds is also included in wages but the employer's contribution is excluded. Salaries and wages are deflated by the consumer price index at 1980 constant price. The wage measures used for the study are real average annual wages, calculated as the real annual full-time wages divided by the number of full-time employees.

The definition of skills used for the study is solely based on occupational groupings governed by the availability of data. The study defines skills (S) to include categories of managerial, professional, technical and supervisory workers. Unskilled (US) refer to production/ operative workers. Likewise, the skilled wages (SW) and unskilled wages (USW) are measured as the real average annual wages of skilled and unskilled employees respectively.

Other industry measures employed comprise real output (Q), real value-added (VA), capital intensity (K) and the share of foreign direct investment in total capital investment (FDI/CI). Output and value-added are deflated by the GDP deflator at 1980 constant prices. Capital intensity is measured as fixed assets deflated by the consumer price index at 1980 constant prices and then divided by real output. Capital intensity, in this context, does not only capture the concentration ratio, but also other factors such as profit rate, different levels of substitution between capital and labour and bargaining power. It has been argued that capital intensity may proxy for bargaining power since it is more likely for workers to be better organised in capital intensive industries for a variety of reasons.

Appendix 2. Product quality (number of products)

Sector	1990 - 1995						1995 – 2000						2000 - 2005					
	1990			1995			1995			2000			2000			2005		
	VIITL	VIITH	HIIT	VIITL	VIITH	HIIT	VIITL	VIITH	HIIT	VIITL	VIITH	HIIT	VIITL	VIITH	HIIT	VIITL	VIITH	HIIT
SITC 5	30	15	16	25	16	20	22	15	17	26	6	21	63	11	37	36	34	42
SITC 6	48	36	46	50	46	51	40	30	52	40	31	32	52	36	50	44	56	37
SITC 7	59	45	28	53	55	27	37	36	22	39	37	16	81	58	41	79	81	27
SITC 8	29	27	8	26	32	9	20	28	7	16	36	5	36	46	10	25	48	18
TOTAL	166	123	98	154	149	107	119	109	98	121	110	74	232	151	138	184	219	124

Note: The total number of products in the above table does not match that which is indicated in Table 2 given that for some products, the unit values could not be calculated either due to missing data on quantity or different units of quantity measurement for exports and imports.

Source: Calculated from UN COMTRADE.