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Developmental gains from export-oriented industrialisation: Does domestic value added matter?

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Abstract

Is the emphasis placed on the share of domestic value added ('value added ratio') of exports in trade and industry policy making in developing countries consistent with the objective of achieving economic development through export-oriented development strategy? This paper examines rationale behind this policy emphasis by first revisiting the conventional case for using value added ratio as policy guidance and then undertaking an input-output analysis of the manufacturing industry in Thailand with emphasis of employment generation and equity. The findings do not support the widely shared view among policy makers that industries with high value added ratio have more potential to create employment. The results also suggest that an increase in value added ratio is associated with a decrease in the ratio of wage and total value added and the ratio of wage to profit, which are inconsistent with the objectives of poverty reduction and reducing income inequality.

JEL Classification Codes: O19, D57, F13, F16

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1. Introduction

Since the 1980s, several developing countries have undergone a decisive policy shift from import-substitution industrialisation (ISI) to export-oriented industrialisation (EOI). After several waves of efforts towards liberalisation, recent decades have witnessed a surge in international trade, especially in developing countries. One important aspect of trade openness is that it allows developing countries to import better quality, cheaper intermediate goods and capital equipment. With such advantages, a developing country, where unskilled labour is the abundant factor, can focus on producing labour-intensive goods in line with its comparative advantage. As such, the structure of the export basket has gradually shifted away from primary products to manufactured products, resulting in a fall in the share of domestic value added ('value added ratio') of gross export earnings.

This decline in value added ratio has been driven by the current feature of economic globalisation. Since the 1990s, international trade has been powered by cross-border dispersion of production processes within vertically integrated global industries, which we label 'global production sharing (GPS)' in this study.[1] The resultant global production networks (GPNs) open opportunities for a country to specialise in different slices (tasks) of the production process in line with its relative cost advantages, instead of producing a given product entirely within its national boundaries (Antràs, 2016; Athukorala, 2014; Feenstra,

[1] This phenomenon is variously known as 'global production sharing,' 'international production fragmentation,' 'vertical specialisation,' and 'slicing up the value chain'. Henceforth, global production sharing (GPS) is used throughout the paper.

2009; Helpman, 2011; Jones, 2000; Jones & Kierzkowski, 2004). Therefore, value added ratio tends to fall in this era of economic globalisation.

Policy makers in many countries are seeking to increase the domestic value added ratio in exports by formulating a number of policy instruments (Dollar, Khan, & Pei, 2019). For instance, the Thai government launched a new economic model named 'Thailand 4.0' in 2016 aimed at transforming the Thai economy into a value-based economy. A key focus of this is the promotion of a set of high value-added industries (e.g., robotics, aviation, and biofuels) through tax and other non-tax incentives (Kohpaiboon, 2020; OECD, 2019). As in Thailand, other developing countries have recently embarked on value addition in production process, for example, Indonesia's medium-term development plan (RPJMN), Malaysia's national policy on industry 4.0 (Industry4WD), and India's grand vision of 'Make in India.' The justification of these policies is that an increase in value added ratio will boost economic growth and create more employment.

The emphasis on value added ratio has received renewed attention from a new wave of literature dealing with the measurement of international trade. With the emergence of GPS, analysis of trade data based on Customs records ('gross' trade data) leads to a misleading perception of trade imbalances among countries and the transmission of external shocks (Johnson, 2014; Lamy, 2013). A famous case study of an Apple iPod, showing that Chinese value added is less than 10% of total value of that product, supports this view (Dedrick, Kraemer, & Linden, 2010). This concern has led to the invention of a new measure of bilateral trade known as 'trade in value added' computed using global input-output tables. The well-known databases are, for example, Trade in Value Added (TiVA) and World Input-Output

Table Database. A number of recent studies have examined trade patterns in a world of GPS using value-added trade data (Kee and Tang, 2016; Nielsen, 2018; Pahl & Timmer, 2019). This case for using value added trade rather than customs record based trade for analysing bilateral trade imbalances in this era of GPNs is impeccable (Lamy, 2013). However, using value added ratio as a guidance for industrial policy can lead to misleading policy inferences.

The purpose of this paper is to examine the rationale behind using value added ratio as a policy guidance to promote economic growth in the era of economic globalisation by using Thailand as a case study. The hypothesis is that, in the context of the increasingly importance role of global production sharing, industries characterised by high value added ratio do not have the potential to generate greater gains from export-oriented industrialisation. Developmental gains are captured by three indicators: export-induced employment, labour share of income, and wage to profit ratio. These three indicators are central to the development objective of achieving economic growth with equity.

Thailand provides an excellent case study of this subject given the pivotal role of engagement in GPNs in export-oriented industrialisation and structural shifts in export structure in the economy, and the availability of data covering a period of sufficient length for the empirical analysis. The analysis is based on value added ratio and gains from export-oriented industrialisation calculated by applying the input-output technique to the input-output tables of Thailand covering 74 manufacturing sectors for 1990, 1995, 2000, 2005 and 2010.

This paper finds no empirical support for the view that value added ratio is associated with export-induced employment. At the same time, the results suggest that an increase in value added ratio is associated with a decline in labour share of income (a proxy for poverty) and wage to profit ratio (a proxy for inequality), which can run counter economic development. The findings, however, shed light on the importance of a global production network orientation as a crucial determinant of export-induced employment.

The paper is structured as follows: Section 2 discusses an emphasis on value added ratio as policy guidance. Section 3 briefly summarises Thailand's engagement in global production sharing. Section 4 shows methodology. Section 5 reports the results. Section 6 summarises the key findings.

2. Value added ratio

After World War II, import-substitution industrialisation (ISI) became the basic tenet of development strategies. The purpose of ISI was to achieve economic growth through developing domestic capabilities of an economy to produce manufactured goods to replace imports, so trade barriers can be erected for that purpose. The underlying policy agenda was to turn inward and stimulate greater interaction between domestic industries while ignoring economic efficiency gains from resource allocations.

The emphasis on domestic value added (alternatively known as 'domestic content' and 'domestic retained value') was central to the policy debate in the era of ISI. An unbalanced growth strategy proposed by Hirschman (1958) provided theoretical support to this emphasis. This involves promoting selected industries that have strong forward- and backward linkages ('key sector'). The strength of linkages depends essentially on interdependence among domestic industries (Acharya & Hazari, 1971; Hazari, 1970; Rasmussen, 1956; Yotopoulos & Nugent, 1973). The commonly held view at the time was that a key sector is more capable of delivering high economic growth and creating greater employment. This superiority of key sector provides the justification for erecting trade barriers or imposing strategies aimed at utilising domestic industries.

However, the ISI policy advocacy has lost its dominance from around the 1980s as the conventional thinking shifted away from ISI to export-oriented industrialisation (EOI). The experiences of the newly industrialised economies (NIEs) in East Asia in the 1960s and 1970s in achieving rapid economic growth, together with the balance-of-payment crises in the 1980s, have inspired policy makers in many developing countries to follow this development strategy. Much empirical evidence also suggests that, in contrast to ISI, EOI is more efficient in promoting resource allocation and fostering economic growth. More importantly, EOI has recorded an impressive rate of labour absorption through manufacturing expansion, resulting in massive poverty reduction (Bhagwati, 1978; Krueger, 1978; Lal & Myint, 1996; Little, Scitovsky, & Scott, 1976).

Recent years have, however, witnessed the revival of an emphasis on domestic value added. This is because of the decline in value added ratio driven by the structural shift in export basket towards manufactured products and the rise of global production sharing. Policy makers in many developing countries are concerned about this trend and are aspiring to increase value added ratio. This concern originates from the view that a lower value added ratio will result in a smaller total value added of exports and thus a smaller Gross Domestic Product (GDP) (Dollar et al., 2019). However, tariff and non-tariff barriers are among policy instruments commonly used to increase value added ratio. This policy emphasis on value added harks back to the era of ISI under which domestic industry is promoted through trade protection and other measures (e.g., local content requirement and export ban).

Attempts to increase value added ratio through direct policy intervention in this era of economic globalisation are questionable for a number of reasons. First, under export-oriented industrialisation, the key to the success of a developing country depends on its ability to produce goods and services that international buyers demand. A developing country endowed with abundant labour can reap gains from greater economic integration by focusing on labour-intensive goods (e.g., clothing, footwear, toy, and sporting goods) and assembly activities. In general, the production process relies heavily on imported inputs in order to meet high quality standards and global competition. As such, value added ratio is low in this traditional export-oriented manufacturing production. Policy intervention to increase value added ratio will stifle this development strategy.

Second, the production of intermediate goods is in general more capital intensive compared to the assembly of final goods (Riedel, 1975). Since developing countries are relatively labour abundant, shifting the domestic production towards intermediate goods production can run counter country's comparative advantage. In addition, the importation of intermediate inputs implicitly substitutes labour for relatively capital-intensive intermediate input. This will increase the labour intensity and magnify employment creation in the economy.

The experiences of the NIEs cast doubt on the validity of the use of value added ratio as policy guidance. Little (1999, 234) writes: 'Some critics have used the pejorative term 'shallow' to describe the development [in the 1960s and 1970s] of Korea and Taiwan, by which it is meant that there are relatively little backward linkages from exports. In that case, development in depth mush be declared the enemy of employment and equity. All labour-intensive sectors have their K/L [capital-labour] ratios raised by backward linkages [that is, an increase in domestic content], because all the intermediaries—petrochemical, artificial fibre, steel, non-ferrous metals, etc.—are highly capital intensive. These intermediaries are the curve of developing countries.'

In the past three decades, the structural feature of economic globalisation has changed as international trade has been driven by GPS (Bems, Johnson, & Yi, 2011; Krugman, 1995; World Bank, 2020b). This phenomenon has been brought about by a surge of trade in tasks instead of trade in goods (Grossman & Rossi-Hansberg, 2008; Johnson & Noguera, 2012). An implication of the rise of GPS is that it expands the choice of country to pursue export-oriented industrialisation. Without GPS, countries have to be proficient in all components of production in order to compete in the global market. GPS, therefore, allows developing countries to join production networks and reap gains from export dynamism by specialising in a few tasks in the production process.

The emphasis on value added ratio can hinder opportunities for a country to gain from joining global production network for several reasons. In general, the import content of vertical specialisation is higher than that in horizontal specialisation (Brumm, Georgiadis, Gräb, & Trottner, 2019). In many cases, there is no possibility of local substitution of intermediate inputs. This results in low value added ratio. Even though value added ratio is low, superior employment effects from GPS can be high due to two factors. First, GPS opens up opportunities for countries to specialise in a given slice/task within vertically integrated global industries that fits with its relative cost advantage (Antràs, 2016). In labour abundant countries, tasks undertaken within production networks tend to be relatively more labour intensive compared to producing goods from beginning to end within its national boundaries (Barrientos, Gereffi, & Rossi, 2011; Head & Ries, 2002; Timmer, Erumban, Los, Stehrer, & de Vries, 2014). Low-linked industries can therefore have greater employment potential. Second, employment generation can be substantial due to the volume effect. Most of the GPS productions have a larger market compared to traditional products based on horizontal specialisation. Therefore, low value added ratio should not be viewed as a 'disappointing' outcome from deeper economic integration through joining GPNs.

To summarise, policy guidance based on value added ratio—that is, to produce more at home and rely less on imported intermediate for exports—is not pertinent to a country's comparative advantage in this era of economic globalisation.

3. Export-oriented industrialisation in Thailand

During the post-war period until about the mid-1970s, Thailand pursued import substitution development strategy under a protectionist trade regime (Myint, 1967; Warr, 1993). It maintained significantly high tariffs and an extensive array of non-tariff measures (Rock, 1995; Siriprachai, 1998). From the mid-1980s, Thailand significantly liberalised its trade policy regime and increasingly participated into the world economy. The outcome was impressive. The economy grew rapidly with double-digit economic growth for three consecutive years from 1988 to 1990.

This remarkable economic progress was primarily driven by rapid growth in exports, accompanied by a remarkable shift in the export composition away from primary products towards manufactured exports (Athukorala & Suphachalasai, 2004). The share of primary products in total exports fell dramatically from about 75 percent in 1970 to less than 30 percent in early 1990s. During this period, the share of manufacturing rose from less than 5 percent to over 70 percent by the mid-1990s (World Bank, 2020a). The surge in manufacturing exports reflected the expansion of processed foods and traditional light manufactured goods, especially clothing and footwear. Thailand experienced an export contraction in 1996 due to the sharp appreciation of the real exchange rate against the yen and an increase in real wage, thereby eroding international competitiveness driven by (Warr, 2000). After the 1997 Asian Financial Crisis, manufacturing exports have been dominated by the broader category of machinery and transport equipment (Table A1 in the Appendix).

The rapid growth of machinery and transport equipment exports has been driven by rapid integration of the Thai manufacturing industry in GPS in automobiles, and electrical and electronics products. Thailand's engagement in GPS began in the early 1980s with head-stack assembly (HSA), the most labour-intensive part of the hard disk drive (HDD), after Seagate Technology moved its HSA operation out of Singapore. After that, other HDD makers (e.g., IBM and Fujisu) set up their affiliates in Thailand. These HDD makers have attracted many parts suppliers (i.e., Magnetric, Nidec and K. R. Precision) to stay close to their customers (Flamm, 1985; Kohpaiboon & Jonhwanich, 2013; Nidhiprabha, 2017). Today, the HDD industry is one of the major industries in Thailand with exports accounting for 7% of total manufacturing exports. Also, Thailand became a major player in automobile assembly in the late 1990s. By the early 2000s, it has become the premier automobile assembly centre within the automobile production networks in Asia ('Detroit of Asia').

Recently, Thailand's engagement in production network trade has expanded to the aerospace and aviation industry. Boeing sources metal and composite parts and trolley carts produced in Thailand. Exports of these products have grown faster than total exports, thanks to the presence of several well-known international companies such as Triumph Group, Rolls-Royce, and Senior Aero Space (Board of Investment, 2018). These manufacturers have attracted several suppliers such as C.C.S. Advance Technology and Jinpao Precision Industry. These suppliers sell less-customised products not only to Boeing but also Airbus, Bombardier, and other aircraft manufacturers.

Table 1 shows that, from 1990-1991 to 2010-2011, average annual growth rate of exports of parts and components was higher than that of manufactured products. The share of total network trade stood at 66% of total manufacturing exports in 1990-91 and increased to more than 70% in 2005-06. This share dropped to 63% in 2010-11. Parts and components accounted for 61% of total network exports in 2010-11, up from 46% in 1990-91. In addition, there was a significant shift in the composition of network exports during the period under study (Table 2). The share of clothing and footwear in total GPN exports fell from 30% in 1990-91 to only 7% in 2010-2011. During this period, there was a heavy concentration of network exports in electronics and electrical goods and automobiles.

"Table 1 about here"

"Table 2 about here"

4. Methodology

This section first describes the methodology of calculating value added ratio and export-induced employment. This is followed by the specification of the regression model used to investigate the relationship between value added ratio and export-induced employment.

4.1 Input-output model

The standard input-output framework is used to examine the relationship between value added ratio and developmental gains from export-oriented industrialisation (Leontief, 1936). Input-output (I-O) tables fall under two categories: 'non-competitive type' that shows domestic and import transactions in two separate matrices of inter-industry flows of goods and services and 'competitive type' that lumps together the two types of inputs as a single inter-industry matrix (Miller & Blair, 2019). In this paper, the non-competitive I-O framework is used because the focus is domestic input-output linkages in determining the selected performance indicators. For a non-competitive input-output system, the Leontief balance equation can be written as

$$\square = (\square - \square^{\square})^{-1}\square \qquad (1)$$

where $\square$ is a matrix of gross output, $\square^{\square}$ is a matrix of the domestic I-O coefficient, and $\square$ is a matrix of final demand.

Final demand can be decomposed to

$$\square = (\square - \square^{\square})^{-1}(\square^{\square} + \square) \qquad (2)$$

where $\square^{\square}$ is a vector of domestic final demand and $\square$ is exports of domestically produced goods. $(\square - \square^{\square})^{-1}$ is an output multiplier. It shows the total value of production in all sectors throughout the economy that is required to satisfy an increase in a unit of output of sector $\square$.

The sum of the $\square^{\square\square}$ column of $(\square - \square^{\square})^{-1}$ gives a value of total backward linkages when domestic final demand or foreign final demand for the $\square^{\square\square}$ commodity increases by one unit. Backward linkage for sector $\square$ is

$$\square\square\square_{\square} = \sum_{\square=1}^{\square} \square_{\square\square} \tag{3}$$

Import intensity

Industry uses both domestically produced input and imported input in its production process. A diagonal matrix of imported input coefficients is

$$\square = [\square_{\square}], \square_{\square} = \frac{\square_{\square}}{\square_{\square}} \tag{4}$$

where $\square_{\square}$ is import used by sector $\square$ and $\square_{\square}$ is thus imported input coefficient. It can be written in a matrix form:

$$\square = \begin{bmatrix} \square_{11} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \square_{\square\square} \end{bmatrix}$$

To quantify the total imports as a part of the production, it gives

$$\square = \square(\square - \square^{\square})^{-1} = \begin{bmatrix} \square_{11} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \square_{\square\square} \end{bmatrix} \begin{bmatrix} \square_{11} & \cdots & \square_{1\square} \\ \vdots & \ddots & \vdots \\ \square_{\square 1} & \cdots & \square_{\square\square} \end{bmatrix} = \begin{bmatrix} \square_{11} & \cdots & \square_{1\square} \\ \vdots & \ddots & \vdots \\ \square_{\square 1} & \cdots & \square_{\square\square} \end{bmatrix}$$

where $\square$ is the total import requirement matrix of domestic production. An element of matrix $\square$, $\square_{\square\square}$, is the total amount of imports $\square$ needed to produce one unit of commodity $\square$. As sector

□ uses imported intermediates from several industries, the total import required to produce a unit of commodity □ is therefore

$$□_{□□} = \sum_{□=1}^{□} □_{□□} \quad (5)$$

Value added ratio

Let $□_{□}$ be a value of total exports from sector □. It is assumed that there is no difference in using imports in producing a unit of output whether the product is sold within the economy or exported to the foreign market.

Thus, each unit of export of commodity □, $□_{□}$, is embodied with imports used by sector □, $□_{□□}$. It yields

$$□_{□□}^{□} = □_{□□} □_{□} \quad (6)$$

where $□_{□□}^{□}$ is the total value of imports embodied in the export of commodity □.

Let $□_{□}^{□}$ be net-export earnings of sector □. This is estimated by:

$$□_{□}^{□} = □_{□} - □_{□□} □_{□} = (1 - □_{□□}) □_{□} \quad (7)$$

Lastly, dividing (7) by gross exports yields per-unit domestic value added of export (value added ratio) as the following:

$$□□□ = □_{□}^{□} / □_{□} \quad (8)$$

This is the domestic content of exports as a percentage of gross exports. It is important to distinguish between value added as a share of gross exports (value added ratio) and total value added in exports (net-export earnings).[2]

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[2] For detailed discussion and alternative calculation of value added ratio, see Hummels, Ishii, & Yi (2001), Koopman, Wang, & Wei (2012), Timmer, Miroudot, & de Vries (2019).

Export-induced employment

Define a diagonal matrix of employment coefficient as a proportion of employment to total output in each industry as:

$$\square = \begin{bmatrix} \square_{11} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \square_{\square\square} \end{bmatrix}$$

where $\square_{\square}$ is a number of employed persons in sector $\square$ and $\square_{\square}$ is an employment coefficient (the ratio of employment to total output). In matrix form, it can be written as:

Total employment as a part of the production can be quantified as:

$$\square = \square(\square - \square^{\square})^{-1} = \begin{bmatrix} \square_{11} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \square_{\square\square} \end{bmatrix} \begin{bmatrix} \square_{11} & \cdots & \square_{1\square} \\ \vdots & \ddots & \vdots \\ \square_{\square 1} & \cdots & \square_{\square\square} \end{bmatrix} = \begin{bmatrix} \square_{11} & \cdots & \square_{1\square} \\ \vdots & \ddots & \vdots \\ \square_{\square 1} & \cdots & \square_{\square\square} \end{bmatrix}$$

where $\square$ is the total employment requirement matrix of domestic production.

An element of matrix $\square$, $\square_{\square\square}$, is the total amount of worker in sector $\square$ that sector $\square$ needs to produce one unit of commodity $\square$ in the economy. Total required employment from all sectors to produce a unit of commodity $\square$ is thus

$$\square_{\square\square} = \sum_{\square=1}^{\square} \square_{\square\square} \qquad (9)$$

We can delineate further how exports can lead to an increase in employment by reproducing an expression of net export earnings. Let assume that employment required in production is identical whether the product is sold domestically or exported. The total value of employment embodied in exports, $\square_{\square}$, is given by

$$\square^{\square}_{\square\square}=\square_{\square\square}\square_{\square} \quad (10)$$

where $\square^{\square}_{\square\square}$ is the total value of employment embodied in the export of commodity $\square$. Thus, the total export-induced employment of the economy, $\square_{\square}$, is therefore

$$\square_{\square} = \sum_{\square=1}^{\square} \square^{\square}_{\square\square} \quad (11)$$

4.2 Regression model

The following model is estimated to investigate the relationship between value added ratio and export-induced employment. The regression model takes the following form:

$$\square\square\square\square_{\square\square} = \square + \square_1\square\square\square_{\square\square} + \square_2\square\square\square_{\square\square} + \square_3\square\square\square\square_{\square\square} + \square_4\square\square\square_{\square} * \square\square\square_{\square\square} + \square_5\square\square\square_{\square} * \square\square\square\square_{\square\square} + \square_{\square} + \square_{\square} + \square_{\square\square} \quad (12)$$

where $\square\square\square\square$ is export-induced employment, the subscripts $\square$ and $\square$ refer to industry and year.

The explanatory variables are listed below, with the postulated sign of the regression coefficient for the explanatory variables in parenthesis.

$\square\square\square$ (+/-)	Value added ratio
$\square\square\square$ (+)	Global production network orientation
$\square\square\square\square$ (+/-)	Productivity
$\square$	A constant term
$\square$	Industry fixed effects

- □ Year fixed effects
- □ An error term

The key explanatory variable of interest is value added ratio (□□□). The widely held view among policy makers is that industry with high value added ratio is capable of employment generation. However, as discussed in the previous section, industry with high value added ratio does not necessarily to have greater employment generation compared to those with those with low value added ratio, especially in this era of GPS. The expected sign of the coefficient on □□□ is thus ambiguous. Productivity (□□□□) is included to capture the effect of productivity improvement on export-induced employment. On the one hand, productivity improvement in a given industry can pull resources from other industries to be used in production process. On the other hand, it can push or release labour to other activities. The expected sign of the coefficient on □□□□ can be positive or negative. Global production network orientation (□□□) is included to investigate whether industry with greater participation in GPN can generate employment higher than other industries. In the context of developing country, participation in GPN in line with country's comparative advantage is expected to create employment. The expected sign of the coefficient is positive.

4.3 Data

The model is estimated based on a balanced panel dataset covering 74 manufacturing sectors for a period of 5 years (1990, 1995, 2000, 2005, and 2010).

Engagement in global production network (□□□) is measured in terms of the share of exports of parts and components and final assembly within production network to total manufacturing exports of each industry. Trade based on GPN is trade in parts and components, and assembled end products within the production networks. The data are compiled at the 5-digit level of the Standard International Trade Classification (SITC) based on SITC Revision 3. Lists of parts and components are derived by mapping parts and components in the intermediate products subcategory of the UN Broad Economic Classification (BEC) with SITC Rev. 3.[3] Exports of assembled end products are estimated as the difference between exports of parts and components and total exports of that product categories. According to Athukorala (2019), product categories involved in final assembly are office machines and automatic data processing machines (SITC 75), telecommunication and sound recording equipment (SITC 76), electrical machinery (SITC 77), road vehicles (SITC 78), other transport equipment (SITC 79), travel goods (SITC 83), clothing and clothing accessories (SITC 84), professional and scientific equipment (SITC 87), photographic apparatus (SITC 88), and toys and sport goods (SITC 894).

Export-induced employment is measured in natural logarithm. Thailand's I-O tables are taken from the National Economic and Social Development Council (NESDC) and were originally published in Thai Baht. In the regression analysis, variables calculated from the input-output table are deflated using GDP deflator from the World Bank. Employment data come from the annual labour force survey from the National Statistics Office. Employment data (originally coded using Thailand's Standard Industrial Classification) are matched with the input-output table using the concordance table provided by NESDC. Tables A2 and A3 in

[3] For details on the methods of data compilation, see Athukorala (2014). The complete data set and the list of parts and components are available on request.

the Appendix provide the definitions of I-O industries and summary statistics of export-induced employment.

Productivity (□□□□) is measured by the real value added per worker. It captures both total factor productivity (TFP) and capital deepening. Unfortunately, data are not available to estimate TFP at the required level of industry disaggregation. Productivity is measured in natural logarithm.

Table 3 presents summary statistics. On average, value added ratio decreased over time from 64.39% in 1990 to 60.23% in 2010. This suggests a decreasing role of domestically produced intermediate (domestic content) in production process. Table A4 in the Appendix reports value added ratio in each sector. The coefficient of variation (CV) illustrates the variation in value added ratio across sectors.

"Table 3 about here"

On average, GPN orientation at industry level of Thai manufacturing increased from 0.78% in 1990 to 0.91% 2000. After that, it fell to 0.83 in 2010. This can be partly explained by the 2008 Global Financial Crisis that slowed down global trade. GPN orientation shown in Table 3 is particularly low simply because there are numerous sectors that do not engage in GPNs. Table A5 in the Appendix reports the GPN orientation in each sector during the period under study. According to Table A6, from 1990 to 2010, an export-weighted average of value added ratio of industries participated in network trade was smaller than that of total manufacturing industries. This is because industries integrated within GPNs rely more on imported intermediate; therefore, their value added ratio is relatively low.

Average export-induced employment increased from 104 thousand workers in 1990 to 116 thousand workers in 2000. It slightly declined to 110 thousand workers in 2005 before increasing to 118 thousand workers in 2010. This illustrates an increasing developmental gain in employment from export-oriented industrialisation.

Table 4 reports the results from the Pearson correlation test. In general, there is a positive correlation between value added ratio and export-induced employment. The correlation coefficient is small, however. The results from the Spearman's rank correlation test are consistent with these results.

"Table 4 about here"

To supplement the results from the correlation test, there are several industries with high per unit value added but low employment effect, for example, cement, concrete, and non-metallic products, aircraft, and shipbuilding. These industries rely mainly on domestic intermediate inputs in production process. At the same time, there are many industries with low per unit value added but high employment effect, for instance, electronics, office and household machinery, motor vehicles, and industrial machinery. These industries, which are well integrated within GPNs, account for the bulk of manufacturing employment.

4.4 Estimation method

The model is estimated using the fixed effects (FE) estimator. The Wu-Hausman test rejects the null hypothesis that unobserved explanatory variables are not distributed independently of the explanatory variables, favouring the FE estimator over the random effects estimator. Industry fixed effects are included to capture a large proportion of the cross-industry differences in export performance indicators and allows us to focus on the determinants of within-industry variations. Year dummies are included to capture unobservable time fixed effects. Heteroscedasticity-consistent robust standard error is used for testing statistical significance of the regression coefficients.

Reverse causality between export-induced employment and value added ratio is unlikely to bias the results because the dependent variable is direct and indirect (total) impact of employment induced from export. It is unlikely that total employment effect from export of a given sector could exist *prior to* changes in value added ratio. Admittedly, the estimate may suffer from the omitted variable bias because it is difficult to include industry characteristics, geographic formation, and the role of Multinational enterprises (MNEs) due to data issue. However, investment policy regime is rather neutral throughout the period of study. Tax and non-tax incentives granted by Thailand's Board of Investment are based on the location of firm, not the type of industry. Targeted industrial policy has been implemented only after 2017. Since the standard I-O table does not provide geographical information and other industry characteristics, industry fixed effects are expected to capture these factors. To check whether the estimate suffers significantly from endogeneity problem, the model is re-estimated by using value added ratio with one period lag and the first difference (FD) estimator. The results still hold.

5. Results

The results are presented in Table 5. The coefficient on value added ratio is positive but statistically insignificant even at the 20% level (Column 1). The coefficient on productivity is positive and statistically significant at the 10% level. An increase in productivity by 1% is associated with a 17% increase in export-induced employment.

Column 2 reports the results after including GPN orientation into the model. The coefficient on value added ratio is still positive but not statistically significant. The coefficient on productivity is positive and statistically significant at the 10% level. Interestingly, the estimated coefficient on GPN orientation is positive and statistically significant at the 1% level. A 1 percentage point increase in GPN orientation is associated with a 15% increase in export-induced employment. This finding provides strong evidence that participation in global production network significantly generates more employment.

"Table 5 about here"

Column 3 of Table 5 presents the results after adding two interaction terms: (a) GPN orientation and value added ratio, and (b) GPN orientation and productivity. The coefficients on both value added ratio and productivity are similar to previous column. In addition, the coefficient on the interaction term between GPN orientation and domestic value added is positive but not statistically significant even at the 20% level. This suggests that the relationship between export-induced employment and value added ratio is not statistically different among GPN industries. Moreover, the coefficient on the interaction term between GPN orientation and productivity is negative but statistically insignificant. This indicates that the relationship between export-induced employment and productivity does not significantly vary among GPN industries.

In summary, there is no empirical support for the notion that industries with high value added ratio can generate more employment than those with low value added ratio. However, there is strong evidence that participation in global production networks significantly increases export-induced employment.

Export-oriented industrialisation, poverty, and inequality

To supplement the result on export-induced employment, the analysis is expanded to cover poverty and inequality. These two developmental outcomes are central to the contemporary policy debate in developing countries in the era of economic globalisation. Here, poverty is proxied by the ratio of wage to total value added (GDP). Inequality is proxied by the ratio of wage to profit. According to the definitions from the input-output table, wage is total compensation received by employees. Employee covers long-term workers, temporary workers, executives and hired labourers in the agricultural sector excluding family workers. Profit is defined as the difference between total value added and wages and salaries, depreciation and indirect taxes.

These two proxies are, of course, not measures of poverty and inequality commonly used in the literature. However, they provide useful information about how wages, the major source of income of workers, are distributed across factors of production. Labour share in total income is often used in several studies to capture the pro-poor bias in the process of industrialisation (Case & Deaton, 2020, Daudey & García-Peñalosa, 2007; Glyn, 2011; Little, 1999). Labour is the main, if not the sole, 'wealth' owned by the poor. So, an increase in labour share in value added under export-oriented industrialisation in a developing country should contribute to poverty alleviation. A developing country's comparative advantage in export-oriented industrialisation lies mainly in labour-intensive production. Also, there is evidence that an increase in income inequality is closely associated with the share of income allocated to capital relative to the share of income accruing to labour (Piketty, 2014; World Bank, 2020b).

Table 6 reports the result on the ratio of wage to total value added (labour share of income). The coefficient on value added ratio is negative and statistically significant at the 1% level (Column 1). A 1-percentage point increase in value added ratio is associated with a 17-percentage point decrease in the share of wage in total value added. The results hold after adding other control variables and the interaction terms (Columns 2 and 3). This indicates that industries with high value added ratio do not necessarily have higher share of wage in total income.

"Table 6 about here"

Interestingly, the coefficient on GPN orientation is positive and statistically significant at the 10% level (Column 3). This supports the hypothesis that participation in network trade significantly increases the labour's income share in national income. However, the coefficient on the interaction term between GPN orientation and productivity is negative and statistically significant at the 5% level. This suggests that the impact of GPN orientation on wage share is smaller in high-productivity industries.

The results on the ratio of wage to profit are presented in Table 7. The coefficient on value added ratio is largely negative and statistically significant at the 1% level. This suggests that an increase in value added ratio can worsen inequality because the share of profit in total value added increases faster than the share of wage in total value added. This is presumably because industries with high value added ratio are in general capital-intensive (e.g., cement and concrete products) and do not employ significant amount of workers. In addition, the coefficient on GPN orientation is positive but statistically insignificant. This indicates that greater economic integration through GPNs does not exacerbate inequality. Lastly, none of the coefficients on the interaction term are different from zero.

"Table 7 about here"

6. Conclusion

This paper has revisited the current policy emphasis on value added ratio by examining the relationship between value added ratio and export-induced employment, poverty, and inequality. The analysis is based on a balanced panel dataset constructed by putting together the data covered by Thailand's input-output tables for 5 years (1990, 1995, 2000, 2005, and 2010).

The results cast doubt on the validity of the contemporary approach to policy guidance based on the domestic content of exports that is currently adopted across developing countries. It is found that there is no statistically significant relationship between value added ratio and export-induced employment. Moreover, there is strong evidence that value added ratio is associated with an increase in poverty (proxied by wage share in value added) and inequality (proxied by wage to profit ratio). In the meantime, the results suggest that participation in the global production networks helps generate employment through faster export growth driven by relative labour cost advantage.

The findings of this study by no means imply that value added ratio does not matter. Value added ratio can increase naturally as a result of industrial deepening, depending on the stage of economic development, technology transfer, and changing cost structure. However, there is a limit on value added created in a given country within production network because production sharing essentially involves spreading total value added of a given production across countries. An undue emphasis on industries with high value added through policy intervention (e.g., export ban, tariff and non-tariff barriers measures) may run counter the objective of raping developmental gains from engaging in global production networks.

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Tables

Table 1: Share of network products in manufacturing exports of Thailand, 1990 to 2010

	1990-91	1995-96	2000-01	2005-06	2010-11	Average annual growth rate (%)
Panel A: Export value of GPN products (million USD)						
Part and components	4,363	17,689	24,994	46,730	54,939	14.84
Final assembly	5,201	10,028	14,352	25,558	35,185	10.98
Total GPN	9,564	27,717	39,346	72,287	90,124	12.92
Manufactured products	14,459	38,714	55,361	102,315	143,180	13.18
Total exports	22,675	53,898	73,041	131,997	223,364	13.03
Panel B: Share of GPN in total GPN exports (%)						
Part and components	45.6	63.8	63.5	64.6	61.0	1.48
Final assembly	54.4	36.2	36.5	35.4	39.0	-1.42
Panel C: Share of GPN in total manufacturing exports (%)						
Parts and components	30.2	45.7	45.1	45.7	38.4	1.24
Final assembly	36.0	25.9	25.9	25.0	24.6	-1.79
Total GPN	66.2	71.6	71.1	70.7	62.9	-0.30
Panel D: Share of GPN in total exports (%)						
Parts and components	19.2	32.8	34.2	35.4	24.6	1.48
Final assembly	22.9	18.6	19.6	19.4	15.8	-1.72
Total GPN	42.2	51.4	53.9	54.8	40.3	-0.13

Notes: Manufacturing sectors are SITC 5-8 excluding SITC 68 (non-ferrous metals), two-year averages are used to minimise the effect of possible random shocks and measurement error.
Source: Compiled from UN Comtrade Database (SITC Rev. 3)

Table 2: Composition of network products in total GPN exports from Thailand, 1990 to 2010

	1990-91	1995-96	2000-01	2004-05	2010-11	Average annual growth rate (%)
Power-generating machinery and equipment (71)	1.9	2.6	3.1	2.9	4.2	17.87
Automatic data processing machines (75)	18.3	32.0	27.4	24.7	25.5	14.96
Telecommunication and sound recording equipment (76)	12.9	11.5	11.8	15.0	10.5	13.49
Electrical machinery excluding semiconductors (77 - 776)	7.7	10.3	9.9	10.4	12.4	16.08
Semiconductor (776)	9.8	12.5	14.3	13.4	3.2	9.84
Road vehicles (78)	1.4	1.2	6.7	12.8	20.8	29.62
Other transport equipment (79)	0.1	0.2	0.1	0.2	0.5	52.30
Apparel and clothing accessories (84)	21.8	11.1	10.7	6.8	5.9	5.70
Footwear (85)	8.0	3.7	2.5	1.5	1.0	1.91
Others	18.1	14.9	13.6	12.3	15.9	12.14
Total GPN	100	100	100	100	100	

Notes: two-year averages are used to minimise the effect of possible random shocks and measurement error.

Source: Compiled from UN Comtrade Database (SITC Rev. 3)

Table 3: Summary statistics

	1990	1995	2000	2005	2010	All
Value added ratio (%)	64.39 (18.80)	64.03 (18.92)	61.81 (18.78)	59.09 (18.72)	60.23 (18.17)	61.71 (18.68)
Productivity (log)	9.56 (2.41)	9.68 (2.23)	9.20 (2.20)	9.55 (1.36)	9.96 (1.28)	9.59 (1.92)
GPN orientation (%)	0.78 (3.06)	0.82 (2.98)	0.91 (3.50)	0.87 (2.95)	0.83 (2.66)	0.84 (3.03)
Export-induced employment (thousand worker)	104 (316)	97 (261)	116 (270)	110 (220)	118 (245)	109 (263)
Number of sectors	74	74	74	74	74	74

Notes: Simple mean and standard deviation (in parenthesis) are reported for each indicator.

Table 4: Correlation matrix

Export-induced employment (□□□□)	1			
Value added ratio (□□□)	0.24*** (0.00)	1		
Ln productivity (□□□□)	-0.05 (0.32)	-0.04 (0.43)	1	
GPN orientation (□□□)	0.13** (0.01)	-0.25*** (0.00)	0.05 (0.31)	1
	□□□□	□□□	□□□□	□□□

Table 5: Value added ratio and export-induced employment

	(1)	(2)	(3)
Value added ratio (□□□)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
Ln productivity (□□□□)	0.17* (0.10)	0.16* (0.09)	0.17* (0.10)
Global production network orientation (□□□)		0.15*** (0.05)	0.33*** (0.10)
□□□ × □□□			0.07 (0.16)
□□□ × □□□□			-0.02 (0.02)
1995	0.78*** (0.12)	0.78*** (0.12)	0.79*** (0.12)
2000	1.31*** (0.14)	1.29*** (0.14)	1.30*** (0.14)
2005	1.53*** (0.18)	1.52*** (0.18)	1.54*** (0.18)
2010	1.48*** (0.20)	1.48*** (0.19)	1.50*** (0.19)
Constant	6.58*** (1.27)	6.45*** (1.26)	6.34*** (1.28)
Observations	370	370	370
Adjusted R-squared	0.414	0.44	0.44
Industry fixed effects	Yes	Yes	Yes

Notes: Robust standard errors are reported in parentheses, time (year) dummy with the year 1990 as the base dummy, table reports within R-square, ***, **, * indicate significance level at 1, 5, and 10%, respectively.

Table 6: Value added ratio and labour share of income in Thai manufacturing (Dependent variable: the share of wages in total value added, %).

	(1)	(2)	(3)
Value added ratio (□□□)	-0.17*** (0.05)	-0.17*** (0.05)	-0.16*** (0.06)
Ln productivity (□□□□)	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)
Global production network orientation (□□□)		0.00 (0.00)	0.02* (0.01)
□□□ × □□□			0.00 (0.01)
□□□ × □□□□			-0.00** (0.00)
1995	-0.02*** (0.00)	-0.02*** (0.00)	-0.02*** (0.00)
2000	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
2005	0.00 (0.01)	0.00 (0.01)	0.00 (0.01)
2010	-0.02 (0.01)	-0.02 (0.01)	-0.01 (0.01)
Constant	42.30*** (3.78)	42.20*** (3.77)	40.70*** (3.86)
Observations	370	370	370
Adjusted R-squared	0.07	0.068	0.079
Industry fixed effects	Yes	Yes	Yes

Notes: Ratio of labour share (wages) in total value added is used as a proxy for poverty; robust standard errors are reported in parentheses; time (year) dummy with the year 1990 as the base dummy; table reports within R-square, ***, **, * indicate significance level at 1, 5, and 10%, respectively.

Table 7: Value added ratio and wage to profit ratio in Thai manufacturing (Dependent variable: the ratio of wage and profit, %)

	(1)	(2)	(3)
Value added ratio (□□□)	-0.82*** (0.21)	-0.81*** (0.20)	-0.73*** (0.20)
Ln productivity (□□□□)	-0.00 (0.01)	-0.01 (0.01)	-0.00 (0.01)
Global production network orientation (□□□)		0.02 (0.01)	0.11 (0.08)
□□□ × □□□			-0.05 (0.05)
□□□ × □□□□			-0.01 (0.01)
1995	-0.05*** (0.02)	-0.05*** (0.02)	-0.05*** (0.02)
2000	-0.05 (0.04)	-0.05 (0.04)	-0.05 (0.04)
2005	-0.04 (0.04)	-0.04 (0.04)	-0.04 (0.04)
2010	-0.07* (0.04)	-0.07* (0.04)	-0.06 (0.04)
Constant	125.30*** (14.30)	124.10*** (14.00)	115.80*** (13.30)
Observations	370	370	370
Adjusted R-squared	0.07	0.074	0.09
Industry fixed effects	Yes	Yes	Yes

Notes: Ratio of wages to profit is used as a proxy for inequality; robust standard errors are reported in parentheses; time (year) dummy with the year 1990 as the base dummy; table reports within R-square; ***, **, * indicate significance level at 1, 5, and 10%, respectively.

Appendix

Table A1: Commodity composition of Thailand's network exports in total manufacturing exports, 2009-2018 (%)

	1990-91	1995-96	2000-01	2005-06	2010-11	1990-2010 (%)
Power-generating machinery and equipment (71)	1.2	1.9	2.2	2.0	2.6	112.6
Automatic data processing machines (75)	12.1	22.9	19.5	17.5	16.1	32.4
Telecommunication and sound recording equipment (76)	8.5	8.2	8.4	10.6	6.6	-21.9
Electrical machinery excluding semiconductors (77 - 776)	5.1	7.4	7.0	7.3	7.8	52.6
Semiconductor (776)	6.5	8.9	10.2	9.4	2.0	-68.6
Road vehicles (78)	0.9	0.9	4.7	9.1	13.1	1314.0
Other transport equipment (79)	0.1	0.1	0.1	0.1	0.3	536.8
Apparel and clothing accessories (84)	14.4	7.9	7.6	4.8	3.7	-74.2
Footwear (85)	5.3	2.7	1.8	1.1	0.6	-88.1
Others	45.8	39.1	38.6	38.0	47.0	2.6
Total manufacturing export	100	100	100	100	100	

Notes: Manufacturing sectors are SITC 5-8 excluding SITC 68 (non-ferrous metals)

Source: Compiled from UN Comtrade Database (SITC Rev. 3)

Table A2: Definitions of manufacturing sectors

Sector	Definition	Sector	Definition
15	Slaughtering, canning and preservation of meat	52	Drugs and medicines
16	Dairy products	53	Soap, cleaning preparations, and cosmetics
17	Canning and preservation of fruit and vegetables	54	Other chemical products
18	Canning and preservation of fish and other seafood products	55	Petroleum refineries and other petroleum products
19	Oil from coconut, palm, animal, and vegetables	56	Types and tubes
20	Rice milling, grinding of maize, flour, and other grain milling	57	Plastic ware
21	Tapioca milling	58	Ceramic, earthen ware, and structural clay products
22	Bakery products	59	Glass and glass products
23	Noodles and similar products	60	Cement
24	Sugar	61	Concrete, cement products, and other non-metallic products
25	Confectionery	62	Iron, steel, and secondary steel products
26	Other food products	63	Non-ferrous metal
27	animal feed	64	Cutlery and hand tools
28	Distilling and spirits blending	65	Metal furniture and fixtures
29	Breweries	66	Structure metal products
30	Soft drinks and carbonated water	67	Engines and turbines
31	Tobacco processing and tobacco products	68	Agricultural machinery and equipment
32	Spinning and weaving	69	Wood and metal working machines
34	Made-up textile goods	70	Special industrial machinery
35	Knitting	71	Office and household machinery and electrical appliances
36	Wearing apparel	72	Electrical industrial machinery and appliances
37	Carpets and rugs	73	Radio, television and communication equipment and apparatus
38	Jute mill products	74	Insulated wire and cable
39	Tanneries and leather finishing	75	Electric accumulators and batteries
40	Leather products	76	Other electrical apparatus and supplies
41	Rubber products	77	Ship building and repairing
42	Saw mills	78	Railroad equipment
43	Wood and cork products	79	Motor vehicles
44	Wooden furniture and fixtures	80	Motorcycles and bicycles
45	Pulp, paper, and paperboard	82	Aircraft
46	Paper and paperboard products	83	Scientific equipment
47	Printing and publishing	84	Photographic and optical goods
48	Basic industrial chemicals	85	Watches and clocks
49	Fertiliser and pesticides	86	Jewellery
50	Petrochemical products	87	Recreational and athletic equipment
51	Paints	88	Other manufactured goods

Table A3: Export-induced employment, 1990 to 2010

Sector	Export-induced employment (Million Jobs)				
	1990	1995	2000	2005	2010
15	147.64	152.82	271.09	404.87	314.95
16	6.05	10.13	13.57	85.22	29.08
17	411.46	299.48	430.43	368.10	363.43
18	395.84	503.77	682.48	518.32	571.98
19	14.83	9.97	27.06	43.13	56.25
20	1,916.44	1,595.60	1,679.55	1,044.40	1,442.88
21	1,054.82	350.95	173.08	133.89	171.05
22	14.22	28.52	38.23	25.70	26.95
23	14.44	12.97	39.42	34.76	41.28
24	868.16	520.31	390.26	178.00	302.41
25	11.26	34.81	17.60	11.93	18.52
26	64.70	105.05	143.70	155.01	160.59
27	90.71	63.97	127.20	79.69	80.72
28	1.32	0.35	4.88	2.65	6.89
29	0.32	0.28	0.60	0.99	2.19
30	0.86	6.09	8.29	6.64	20.04
31	4.34	1.20	1.97	2.06	2.21
32	61.67	99.42	134.76	169.06	122.71
34	11.49	23.62	19.09	37.90	28.23
35	45.48	46.33	92.40	67.25	79.22
36	273.97	318.97	320.36	299.15	113.57
37	12.96	42.21	36.51	26.94	15.34
38	40.31	30.10	50.54	47.36	15.50
39	11.84	19.38	7.63	26.43	10.88
40	25.87	29.51	41.11	15.68	18.16
41	1,437.07	1,434.72	1,350.29	1,423.90	1,346.55
42	6.12	11.30	40.52	123.62	189.27
43	89.92	67.11	139.53	97.76	34.21
44	31.20	47.51	140.24	121.37	11.71
45	4.37	12.35	28.09	29.64	31.56
46	1.73	11.48	20.28	34.19	21.29
47	1.23	14.75	3.08	12.41	4.38
48	3.08	6.28	21.91	29.61	127.47
49	0.37	1.10	2.70	6.40	8.12
50	4.41	21.18	87.18	87.28	81.08
51	0.46	14.89	2.43	3.37	4.11
52	1.87	4.50	7.74	5.89	12.32
53	3.37	6.24	25.79	54.90	61.68
54	9.77	25.75	32.71	32.35	28.53
55	0.30	0.66	7.56	6.73	19.15
56	11.40	19.82	46.29	96.85	180.44

Sector	Export-induced employment (Million Jobs)				
	1990	1995	2000	2005	2010
57	17.02	74.67	35.86	112.16	79.40
58	34.26	39.86	69.57	63.83	39.57
59	4.57	12.52	25.73	19.28	22.63
60	0.10	3.51	12.47	12.84	6.99
61	1.21	3.25	7.31	11.06	13.24
62	8.41	19.32	60.18	45.30	42.77
63	5.97	25.01	17.93	35.29	22.22
64	2.15	3.12	3.83	5.54	7.04
65	23.28	44.98	49.66	95.25	153.47
66	33.74	36.76	94.07	139.99	73.14
67	0.75	2.08	10.42	28.56	45.43
68	0.36	4.38	5.74	10.11	10.66
69	1.29	2.54	5.67	5.41	4.19
70	3.65	10.01	26.63	70.98	97.80
71	88.93	290.20	649.38	422.22	541.84
72	6.81	24.73	51.71	44.50	68.59
73	57.52	79.51	178.15	375.22	369.86
74	6.32	22.70	14.12	20.36	18.61
75	3.84	10.06	38.65	39.07	31.25
76	37.64	46.51	55.69	65.31	77.60
77	0.90	8.26	4.06	13.76	11.64
78	0.00	0.01	0.05	0.35	2.54
79	2.73	12.60	83.94	217.36	342.83
80	3.61	13.25	20.10	31.99	29.38
82	0.00	4.20	0.38	11.48	14.58
83	1.85	6.92	12.57	18.30	26.50
84	2.63	12.72	22.68	37.19	39.12
85	10.49	14.61	14.11	10.82	9.84
86	95.79	91.46	81.73	104.37	219.00
87	24.20	43.47	59.58	40.47	32.33
88	101.25	168.37	127.48	81.92	74.16

Table A4: Value added ratio and coefficient of variation, 1990-2010

Sector	1990	1995	2000	2005	2010	1990-2010 (%)	Mean	Standard Deviation	Coefficient of Variation
15	90.15	86.63	86.53	83.32	85.39	-5.28	86.40	2.22	2.57
16	73.12	67.07	71.05	77.10	77.92	6.56	73.25	3.99	5.45
17	85.75	84.47	81.41	77.47	83.46	-2.67	82.51	2.89	3.51
18	58.98	74.76	73.19	60.43	62.30	5.63	65.93	6.67	10.12
19	86.80	79.11	58.73	59.82	64.65	-25.52	69.82	11.17	16.00
20	89.08	88.69	86.47	83.07	85.88	-3.59	86.64	2.17	2.50
21	91.45	90.85	88.17	84.30	86.25	-5.69	88.20	2.71	3.07
22	82.25	84.44	72.31	64.76	71.48	-13.09	75.05	7.30	9.72
23	88.69	88.68	86.33	81.95	82.65	-6.81	85.66	2.88	3.37
24	89.87	89.04	89.01	86.99	87.34	-2.82	88.45	1.10	1.24
25	80.73	80.95	82.04	79.63	74.83	-7.31	79.64	2.52	3.17
26	79.20	77.06	74.91	70.46	56.40	-28.79	71.61	8.13	11.36
27	74.24	61.87	55.89	47.34	43.82	-40.98	56.63	10.85	19.16
28	91.41	89.61	87.30	87.86	91.55	0.15	89.55	1.75	1.96
29	79.93	78.66	82.79	82.26	81.02	1.36	80.93	1.51	1.86
30	84.75	84.60	66.73	69.51	72.65	-14.28	75.65	7.60	10.05
31	85.60	88.56	88.81	94.06	95.92	12.06	90.59	3.81	4.21
32	63.80	66.00	71.83	67.15	63.81	0.02	66.52	2.95	4.44
33	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
34	66.89	69.30	65.83	67.61	62.04	-7.25	66.33	2.43	3.66
35	70.15	73.48	66.79	61.01	65.86	-6.12	67.46	4.20	6.22
36	67.98	72.83	74.62	73.05	70.67	3.96	71.83	2.30	3.20
37	82.27	82.93	80.69	75.73	74.58	-9.35	79.24	3.43	4.33
38	86.19	83.55	51.01	64.01	77.06	-10.59	72.36	13.15	18.17
39	49.02	41.51	23.42	43.27	38.93	-20.58	39.23	8.57	21.85
40	67.05	66.52	72.00	69.14	57.90	-13.65	66.52	4.72	7.10
41	79.84	78.84	80.31	76.83	70.66	-11.50	77.30	3.53	4.56

Sector	1990	1995	2000	2005	2010	1990-2010 (%)	Mean	Standard Deviation	Coefficient of Variation
42	53.14	43.31	60.91	80.91	78.44	47.61	63.34	14.48	22.85
43	76.15	76.26	79.75	84.42	82.73	8.64	79.86	3.34	4.18
44	73.63	69.59	69.96	70.25	72.75	-1.20	71.24	1.63	2.29
45	56.93	55.28	68.97	63.75	60.91	6.99	61.17	4.90	8.02
46	43.71	47.08	54.33	46.74	51.23	17.20	48.62	3.73	7.66
47	56.33	60.62	56.28	61.42	63.31	12.39	59.59	2.82	4.74
48	65.76	62.36	58.35	54.37	59.50	-9.52	60.07	3.83	6.38
49	47.12	44.17	55.84	43.56	49.15	4.31	47.97	4.43	9.23
50	69.01	68.11	58.31	59.35	57.33	-16.93	62.42	5.06	8.11
51	60.17	59.81	73.12	68.43	62.15	3.29	64.74	5.21	8.05
52	59.63	57.97	63.81	65.54	67.49	13.18	62.89	3.57	5.68
53	67.04	63.94	60.81	54.22	54.76	-18.32	60.15	5.03	8.36
54	58.25	54.02	59.68	55.65	57.40	-1.46	57.00	1.98	3.47
55	42.42	48.38	33.07	22.37	28.11	-33.73	34.87	9.43	27.05
56	74.49	69.57	66.37	60.98	63.63	-14.58	67.01	4.71	7.02
57	64.70	64.58	59.92	57.18	57.99	-10.37	60.87	3.20	5.26
58	84.10	75.81	75.51	72.34	73.71	-12.35	76.29	4.10	5.38
59	75.85	69.12	50.72	59.16	64.81	-14.56	63.93	8.57	13.40
60	86.40	82.84	82.96	75.52	75.93	-12.12	80.73	4.28	5.31
61	78.59	79.49	77.24	72.84	72.65	-7.56	76.16	2.88	3.78
62	49.69	38.92	59.34	49.08	45.10	-9.24	48.43	6.67	13.78
63	56.74	47.49	60.20	43.27	53.96	-4.90	52.33	6.16	11.77
64	52.58	49.29	56.88	48.26	53.69	2.11	52.14	3.11	5.96
65	54.54	54.85	54.63	42.51	41.05	-24.73	49.52	6.33	12.79
66	53.09	52.89	56.28	46.54	51.47	-3.05	52.05	3.17	6.10
67	60.93	43.68	44.52	51.37	44.72	-26.60	49.04	6.55	13.36
68	47.55	55.93	66.57	56.20	51.26	7.80	55.50	6.39	11.52
69	65.83	68.88	52.82	43.61	48.42	-26.45	55.91	9.83	17.59
70	47.78	48.20	54.28	47.93	45.44	-4.90	48.73	2.95	6.05
71	38.99	44.28	48.40	42.82	54.78	40.50	45.85	5.38	11.74

Sector	1990	1995	2000	2005	2010	1990-2010 (%)	Mean	Standard Deviation	Coefficient of Variation
72	52.25	44.03	43.99	34.03	35.91	-31.27	42.04	6.54	15.55
73	36.61	31.92	17.87	16.70	27.18	-25.76	26.06	7.77	29.81
74	57.44	54.41	66.78	49.08	47.56	-17.20	55.05	6.86	12.46
75	50.98	52.08	57.17	48.90	50.88	-0.20	52.00	2.78	5.35
76	42.93	49.24	30.27	50.79	42.56	-0.86	43.16	7.24	16.76
77	70.98	62.53	66.15	65.28	64.95	-8.50	65.98	2.77	4.20
78	44.90	59.85	63.92	60.46	53.01	18.06	56.43	6.76	11.98
79	44.33	45.27	33.16	40.51	42.63	-3.83	41.18	4.32	10.50
80	53.14	56.41	52.35	52.39	49.35	-7.13	52.73	2.25	4.27
81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
82	32.70	18.93	30.82	42.48	71.60	118.96	39.31	17.80	45.28
83	59.93	62.82	47.75	32.05	37.46	-37.49	48.00	12.06	25.13
84	77.19	62.80	68.65	66.38	59.38	-23.07	66.88	6.04	9.04
85	69.13	71.77	64.34	58.78	64.02	-7.39	65.61	4.50	6.85
86	53.11	57.37	53.52	38.44	47.51	-10.54	49.99	6.58	13.15
87	78.34	76.85	72.06	66.11	68.34	-12.76	72.34	4.72	6.52
88	74.23	71.30	67.40	61.41	65.51	-11.75	67.97	4.47	6.57

Table A5: GPN orientation (% of total manufacturing exports), 1990-2010

Sector	1990	1995	2000	2005	2010
34	0.25	0.41	0.41	0.51	0.36
35	1.62	1.12	0.95	0.28	0.19
36	19.32	12.15	7.28	4.84	3.04
38	0.23	0.17	0.12	0.11	0.09
40	0.07	0.06	0.05	0.04	0.05
44	0.27	0.18	0.08	0.07	0.04
46	0.00	0.02	0.00	0.01	0.01
47	0.00	0.00	0.00	0.01	0.00
56	0.41	0.32	0.39	0.50	0.58
57	0.29	0.39	0.24	0.19	0.22
58	0.05	0.08	0.09	0.09	0.21
59	0.08	0.07	0.09	0.15	0.24
61	0.02	0.01	0.01	0.02	0.02
64	0.05	0.07	0.09	0.10	0.16
65	1.57	0.71	0.60	0.53	0.59
67	0.16	0.25	0.40	0.68	1.09
68	0.02	0.00	0.00	0.00	0.01
69	0.08	0.07	0.07	0.11	0.18
70	0.09	0.15	0.15	0.26	0.25
71	11.38	15.35	18.42	15.43	14.90
72	0.86	2.06	2.61	1.48	1.43
73	14.58	17.00	22.81	17.77	11.44
74	0.60	0.61	0.66	0.67	0.73
75	0.16	0.19	0.23	0.27	0.46
76	2.00	3.61	3.73	4.77	6.52
78	0.01	0.05	0.03	0.09	0.08
79	1.35	1.27	4.24	8.84	12.21
80	0.37	0.72	1.16	1.93	2.50
82	0.04	1.51	0.22	1.91	1.15
83	0.32	0.55	0.57	0.76	1.05
84	0.77	0.86	0.99	1.29	1.49
85	0.96	0.98	0.54	0.44	0.45
87	0.01	0.00	0.00	0.00	0.00

Table A6: Weighted average of domestic value added ratio (weighted by export), 1990-2010

Year	GPN industry	Total manufacturing including processed foods
1990	0.54	0.64
1995	0.50	0.60
2000	0.42	0.52
2005	0.41	0.49
2010	0.47	0.53
Number of sectors	31	74

Notes: GPN industry is an industry in which the share of parts and components and final assembly to total manufacturing exports is greater than zero.