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Employment effects of joining global production networks

Does domestic value-added matter?

Wannaphong Durongkaveroj*

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Abstract: Is the emphasis placed in trade and industry policy-making in developing countries on the share of domestic value-added ('value-added ratio') in exports consistent with the objective of achieving economic development through an export-oriented development strategy? This paper examines the rationale behind this policy emphasis, first by revisiting the conventional case for using the value-added ratio as a policy guide, and then by undertaking an input-output (I-O) analysis of manufacturing industry in Thailand with an emphasis on employment generation and equity. The analysis is based on a balanced panel data set covering 74 manufacturing sectors from 1990 to 2015. The findings do not support the widely shared view among policy makers that industries with high value-added ratios have more potential to create export-induced employment. The policy implication of the results is that in this era of economic globalization, national industrial policy needs to be guided by the market potential of products rather than value-added ratios.

Key words: global production networks, value-added in exports, export performance, employment, Thailand

JEL classification: D57, F13, F16, O19

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* Ramkhamhaeng University, Bangkok, Thailand, wannaphong@ru.ac.th

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Katajanokanlaituri 6 B, 00160 Helsinki, Finland

1 Introduction

Since the 1980s, several developing countries have undergone a decisive policy shift from import substitution industrialization (ISI) to export-oriented industrialization (EOI). After several waves of effort towards liberalization, 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. Thus, 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') in gross export earnings.

This decline in the value-added ratio has been driven by economic globalization. Since the 1990s, international trade has been powered by the cross-border dispersion of production processes within vertically integrated global industries, a phenomenon I will label 'global production sharing' (GPS) in this paper.[1] This is particularly the case with growing trade within global production networks (GPNs) in East Asia. The resultant GPNs open up opportunities for a country to specialize 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 2014a; Feenstra 2009; Helpman 2011). Therefore, the value-added ratio tends to fall in this era of economic globalization.

Policy makers in many countries are seeking to increase the domestic value-added ratio in exports by formulating a number of policy instruments (Dollar et al. 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, 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 processes: for example, Indonesia's Medium-Term National Development Plan, Malaysia's National Policy on Industry 4.0, and India's grand vision of 'Make in India.' The justification of these policies is that an increase in the value-added ratio will boost economic growth and create more employment.

The emphasis on the 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, the 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 the Apple iPod, which shows that Chinese value-added is less than ten per cent of the total value of that product, supports this view (Dedrick et al. 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 (I-O) tables. Well-known databases include, for example, Trade in Value Added and the 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; Pahl and Timmer 2019). The case for using value-added trade rather than customs

[1] This phenomenon is variously known as 'global production sharing', 'international production fragmentation', 'vertical specialization', and 'slicing up the value chain'.

records-based trade to analyse bilateral trade imbalances in this era of GPNs is impeccable (Lamy 2013).

However, policy makers who place an emphasis on the value-added ratio have ignored the employment potential of engagement in GPS, which essentially involves the slicing of total value-added in a given final product among many countries that are engaged in the global manufacturing value chain. Engagement in specific tasks/slices in the production process is characterized by low per-unit value-added, but these tasks are naturally more labour-intensive. In addition, low value-added tasks (e.g., parts and components, final assembly) within the manufacturing value chain are usually more labour-intensive compared with high value-added tasks (e.g., research and development, marketing). Therefore, an emphasis on high value-added activities at the expense of low value-added manufacturing tends to increase the income gap (Jones 2000; Jones and Kierzkowski 2004).

The purpose of this paper is to examine the rationale behind using the value-added ratio as a policy guide to promote economic growth in the era of economic globalization, using Thailand as a case study. The hypothesis is that in the context of the increasingly important role of GPS, industries characterized by high value-added ratios do not have the potential to generate employment effects from EOI.

Thailand provides an excellent case study on this subject, given the pivotal role of engagement in GPNs in EOI and structural shifts in the export structure in the economy, and the availability of data covering a period of sufficient length for empirical analysis. The analysis is based on the value-added ratio and gains from EOI, calculated by applying the I-O technique to Thailand's I-O tables covering 74 manufacturing sectors for 1990, 1995, 2000, 2005, 2010, and 2015. This paper finds no empirical support for the view that the value-added ratio is associated with export-induced employment. The findings, however, shed light on the importance of a GPN orientation as a crucial determinant of export-induced employment.

The paper is structured as follows. Section 2 discusses the emphasis on the value-added ratio as a policy guide. Section 3 briefly summarizes Thailand's engagement in GPS. Section 4 outlines the methodology. Section 5 reports the results. Section 6 summarizes the key findings and discusses future research.

2 Value-added ratio

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. The unbalanced growth strategy proposed by Hirschman (1958) provided theoretical support for this emphasis. This involved promoting selected industries that had strong forward and backward linkages ('key sectors') (Acharya and Hazari 1971; Hazari 1970; Rasmussen 1956; Yotopoulos and Nugent 1973). The commonly held view at the time was that a key sector was more capable of delivering high economic growth and creating greater employment.

However, the experience of newly industrialized economies in East Asia in the 1960s and 1970s in achieving rapid economic growth, together with the balance-of-payment crises of the 1980s, inspired policy makers in many developing countries to shift from ISI to EOI. Much empirical evidence also suggests that in contrast to ISI, EOI is more efficient at 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 and Myint 1996; Little et al. 1970).

Recent years have witnessed a revival of the emphasis on domestic value-added. This policy emphasis is based on the premise that a country can reap gains by joining global value chains on the basis of existing comparative advantages (for example, through the export of labour-intensive products) and then moving towards more sophisticated production processes. This concept is known as the smiling curve (Meng et al. 2020; Mudambi 2008). Current import substitution proponents also promote high domestic value-added by upgrading towards high-value segments of the value chain.

The emphasis on domestic value-added lies within the concept of 'economic upgrading', which is defined as the process by which economic actors—firms and workers—move from low-value to relatively high-value activities in GPNs (Gereffi 2005: 171). However, Gereffi and Luo (2014) find that developmental gains from moving up the global value chain are not equally distributed. Such gains are concentrated among large, professional, and high-tech firms with diversified markets and high-skilled workers.

Several microeconomic analyses of upgrading rely implicitly or explicitly on the concept of the smiling curve (Rehnberg and Ponte 2018; Shin et al. 2012). However, Escaith (2013) finds that the original value-added smiling curve, which focuses only on shares (value-added per unit of output), is misleading, because tasks characterized by small per-unit value-added margins are also characterized by high production volumes (and employment). In contrast, high value-added ratio activities in the smiling curve are either non-tradable (e.g., retail trade) or plagued by high risks/low volumes (e.g., research and development activities). He proposes to include both the unit value and the volume dimensions in an amplified smiling curve.

In addition, a decline in the value-added ratio driven by the structural shift in the export basket towards manufactured products and the rise of GPS is observed in several countries, such as the Republic of Korea and Japan. Policy makers in many developing countries are concerned about this trend and aspire to increase the 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 the policy instruments commonly used to increase the value-added ratio. This policy emphasis on value-added harks back to the era of ISI, under which domestic industry was promoted through trade protection and other measures (e.g., local content requirements, export bans).

Attempts to increase the value-added ratio through direct policy interventions in this era of GPS are questionable, for a number of reasons. First, under EOI, 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, toys, 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. Thus, the value-added ratio is low in this traditional export-oriented manufacturing production. Policy interventions to increase the value-added ratio will stifle this development strategy.

Second, the production of intermediate goods is in general more capital-intensive compared with the assembly of final goods (Riedel 1975). Since developing countries, especially in Asia, are relatively labour-abundant, shifting domestic production towards the production of intermediate goods may run counter to a country's comparative advantage. In addition, the import of intermediate inputs implicitly substitutes labour for relatively capital-intensive intermediate inputs. This increases labour intensity and magnifies employment creation in the economy.

In the past three decades, the structural feature of economic globalization has changed as international trade has been driven by GPS (Bems et al. 2011; Krugman 1995; World Bank 2020b). Jones and Kierzkowski (1990, 2004) and Jones (2000) developed the traditional trade theory based on comparative advantage to address GPS. This phenomenon has been brought about by a surge of trade in tasks instead of trade in goods (Grossman and Rossi-Hansberg 2008; Johnson and Noguera 2012). An implication of the rise of GPS is that it expands the choice of a country to pursue EOI. 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 specializing in a few tasks in the production process. This phenomenon can be explained by the Heckscher-Ohlin model. The factor proportions of each production block are different in each location. This enables firms to locate labour-intensive production blocks in locations where labour costs are cheap (Athukorala 2014b).

An emphasis on the value-added ratio can hinder opportunities for a country to reap gains from joining GPNs, for several reasons. In general, the import content in vertical specialization is higher than in horizontal specialization (Brumm et al. 2019). In many cases, there is no possibility of the local substitution of intermediate inputs. This results in a low value-added ratio. Even if the value-added ratio is low, superior employment effects from GPS may be high, due to two factors. First, GPS opens up opportunities for a country to specialize in a given slice/task within a vertically integrated global industry 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 with the production of goods from beginning to end within national boundaries (Barrientos et al. 2011; Head and Ries 2002; Timmer et al. 2014). Low-linked industries can therefore have greater employment potential. Second, employment generation may be substantial due to the volume effect. Most GPS products have larger markets compared with traditional products based on horizontal specialization. Therefore, a low value-added ratio should not be viewed as a 'disappointing' outcome of deeper economic integration through joining GPNs.

Nevertheless, this does not mean that domestic value-added does not matter. Beverelli et al. (2019) look at the role of domestic value chains as stepping stones to global value chains. One of their findings is that a one standard deviation increase in domestic value chain integration raises the subsequent global value chain integration by about 0.4 per cent. The results are robust for countries at varying stages of development, over several time periods and econometric assumptions.

To summarize, policy guidance based on value-added ratios—that is, producing more at home and relying less on imported intermediates for export—is not pertinent to a country's comparative advantage in this era of economic globalization.

3 EOI in Thailand

During the post-war period until about the mid-1970s, Thailand pursued an 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 liberalized its trade policy regime and increasingly participated in 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 export composition away from primary products towards manufactured exports (Athukorala and Suphachalasai 2004). The share of primary products in total exports fell dramatically, from about 75 per cent in 1970 to less than 30 per cent in the early 1990s. During this period, the share of manufacturing rose from less than five per cent to over 70 per cent 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 JPY and an increase in real wages, which eroded international competitiveness (Warr 2000). Since the 1997 Asian financial crisis, manufacturing exports have been dominated by the broader category of machinery and transport equipment (Table A1 in Appendix B).

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

Recently, Thailand's engagement in production network trade has expanded to the aerospace and aviation industry. Boeing sources metal, 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 the Triumph Group, Rolls-Royce, and Senior Aerospace (Board of Investment 2018). These manufacturers have attracted several suppliers, such as CCS Advance Tech and Jinpao Precision Industry. These suppliers sell less-customized products not only to Boeing but also to Airbus, Bombardier, and other aircraft manufacturers.

Table 1: Share of network products in Thailand's manufacturing exports, 1990–2010

	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

Note: manufacturing sectors are Standard International Trade Classifications (SITC) 5–8, excluding SITC 68 (non-ferrous metals); two-year averages are used to minimize the effect of possible random shocks and measurement errors.

Source: author's compilation based on data from UN Comtrade Database (SITC Rev. 3).

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

	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
Semiconductors (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
Other	18.1	14.9	13.6	12.3	15.9	12.14
Total GPN	100	100	100	100	100	

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

Source: author's compilation based on data from UN Comtrade Database (SITC Rev. 3).

Table 1 shows that between 1990–91 and 2010–11, the 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 per cent of total manufacturing exports in 1990–91, and increased to more than 70 per cent in 2005–06. This share dropped to 63 per cent in 2010–11. Parts and components accounted for 61 per cent of total network exports in 2010–11, up from 46 per cent 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 per cent in 1990–91 to only seven per cent in 2010–11. During this period, there was a heavy concentration of network exports in electronics and electrical goods and automobiles.

4 Methodology

4.1 The model

The relationship between the value-added ratio and export-induced employment is estimated using a balanced panel data set covering 74 subsectors in the manufacturing sector in Thailand, with data for six intermittent years (1990, 1995, 2000, 2005, 2010, and 2015). Value-added ratios are estimated using I-O tables for these six years, using the methodology described in Appendix A.

The regression model takes the following form:

$$EXEM_{it} = \alpha + \beta_1 DVA_{it} + \beta_2 GPN_{it} + \beta_3 PROD_{it} + \beta_4 GPN_i * DVA_{it} + \beta_5 GPN_i * PROD_{it} + \mu_i + v_t + \varepsilon_{it} \quad [1]$$

where $EXEM$ is export-induced employment, and the subscripts i and t refer to industry and year. The explanatory variables are listed below, with the postulated sign of the regression coefficient for the explanatory variables in parentheses.

DVA $(+/-)$	value-added ratio
GPN $(+)$	GPN orientation
$PROD$ $(+/-)$	productivity
α	a constant term
μ	industry fixed effects
v	year fixed effects
ε	an error term

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

4.2 Data

The model is estimated based on a balanced panel data set covering 74 manufacturing sectors for six periods (1990, 1995, 2000, 2005, 2010, and 2015).

Export-induced employment (DVA) and value-added ratios (DVA) are calculated based on the I-O model described in Appendix A. Engagement in GPN (GPN) is measured in terms of the share of exports of parts and components and final assembly within a production network in the total manufacturing exports of each industry. Trade based on GPN is trade in parts and components and assembled end products within production networks. The data is compiled at the five-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 United Nations Broad Economic Classification onto SITC Rev. 3.[2] Exports of assembled end products are estimated as the difference between exports of parts and components and total exports of those product categories. According to Athukorala (2019), the 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 a natural logarithm. Thailand's I-O tables are taken from the National Economic and Social Development Council (NESDC 2020) and were originally published in THB. In the regression analysis, variables calculated from the I-O table are deflated using the GDP deflator from the World Bank. Employment data comes from the annual Labour Force Survey from the National Statistics Office of Thailand. Employment data (originally coded using Thailand's Standard Industrial Classification) is matched with the I-O table using the concordance table provided by the NESDC. Tables A2 and A3 in Appendix B provide the definitions of I-O industries and summary statistics on export-induced employment respectively.

Productivity $(PROD)$ is measured by the real value-added per worker. It is calculated for each sector. It captures both total factor productivity and capital deepening. Unfortunately, data is not available to estimate total factor productivity at the required level of industry disaggregation. Productivity is measured in a natural logarithm.

Table 3 presents the summary statistics. On average, the value-added ratio decreased over time from 64.39 per cent in 1990 to 60.24 per cent in 2010, and slightly increased to 60.66 per cent in 2015. This suggests a decreasing role of domestically produced intermediates (domestic content) in exports. Table A4 in Appendix B reports the value-added ratio in each sector. The coefficient of variation illustrates the variation in value-added ratios across sectors.

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

Table 3: Summary statistics

	1990	1995	2000	2005	2010	2015	All
Value-added ratio (%)	64.39	64.05	61.81	59.04	60.24	60.66	61.53
	(18.80)	(18.92)	(18.78)	(18.72)	(18.19)	(17.54)	(18.48)
Productivity (log)	9.56	9.68	9.20	9.55	9.96	9.76	9.62
	(2.41)	(2.23)	(2.20)	(1.36)	(1.28)	(1.12)	(1.81)
GPN orientation (%)	0.78	0.82	0.91	0.87	0.83	0.81	0.84
	(3.06)	(2.98)	(3.50)	(2.95)	(2.66)	(2.65)	(2.96)
Export-induced employment (thousand workers)	104	97	116	110	118	144	114
	(316)	(261)	(270)	(220)	(245)	(233)	(257)
Number of sectors	74	74	74	74	74	74	74

Note: simple mean and standard deviations (in parentheses) are reported for each indicator.

Source: author's calculations.

On average, GPN orientation at the industry level in Thai manufacturing increased from 0.78 per cent in 1990 to 0.91 per cent 2000. After that, it fell to 0.81 per cent in 2015. This can be partly explained by the 2008 global financial crisis, which slowed down global trade. The GPN orientation shown in Table 3 is particularly low simply because there are numerous sectors that do not engage in GPNs. Table A5 in Appendix B reports the GPN orientation in each sector during the period under study. According to Table A6, from 1990 to 2015, the export-weighted average of value-added ratios in industries participating in network trade was smaller than that of total manufacturing industries. This is because industries integrated within GPNs rely more on imported intermediates; therefore, their value-added ratios are relatively low.

Average export-induced employment increased from 104,000 workers in 1990 to 116,000 workers in 2000. It slightly declined to 110,000 workers in 2005 before increasing to 144,000 workers in 2015. This demonstrates an increasing developmental gain in employment from EOI.

The model used to estimate the relationship between the value-added ratio and export-induced employment is based on a static approach. The results are supplemented by comparing the evolution of export-induced employment and exports in the group of high value-added ratio industries and the group of low value-added ratio industries. According to Table A7 in Appendix B, industries with relatively low value-added ratios in 1990 have higher rates of exports and export-induced growth than those with relatively high value-added ratios. This indicates that industries characterized by low value-added ratios have the potential to create domestic jobs.

The results from the Pearson correlation test suggest that there is a positive correlation between value-added ratios and export-induced employment (Table A8 in Appendix B). However, the correlation coefficient is small, and the correlation is not statistically significant at the ten per cent level for the years 2005, 2010, and 2015. This implies that during the past two decades, as Thailand has engaged more in GPNs, industries characterized by high value-added ratios may no longer generate relatively high amounts of employment. Supplementing the results from the correlation test, there are several industries with high per-unit value-added but low employment effects—for example, cement, concrete, non-metallic products, aircraft, and shipbuilding. These industries rely mainly on domestic intermediate inputs in production processes. At the same time, there are many industries with low per-unit value-added but high employment effects—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.

4.3 Estimation method

The model is estimated using the fixed effects estimator. The Hausman test rejects the null hypothesis that unobserved explanatory variables are not distributed independently of the explanatory variables, favouring the fixed effects 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 it allows us to focus on the determinants of within-industry variations. Year dummies are included to capture unobservable time fixed effects. The heteroscedasticity-consistent robust standard error is used to test the statistical significance of the regression coefficients.

Reverse causality between export-induced employment and value-added ratios is unlikely to bias the results, because the dependent variable is the direct and indirect (total) impact of employment induced by exports. It is unlikely that the total employment effect from exports in a given sector existed *prior to* changes in the value-added ratio. Admittedly, the estimate may suffer from the omitted variable bias because of some industry characteristics, geographical formations, and the role of multinational enterprises, due to data issues. However, the 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 the firm, not the type of industry. The targeted industrial policy was implemented only after 2017. The standard I-O table does not provide information on geographical locations and other industry characteristics that are relevant as control variables for delineating the relationship between employment intensity and the value-added ratio. However, industry fixed effects should capture at least some of these sectoral omitted variables.

The model is also estimated using the system generalized method of moments (GMM) to address potential endogeneity issues. Productivity and GPN orientation may not be strictly exogenous. This estimator is suitable for a linear functional relationship with few time periods and several individual units. The key assumption of this strategy is that the instruments are internal, based on lagged values and lagged differences of the instrumented variables (Arellano and Bover 1995; Blundell and Bond 1998; Bun and Sarafidis 2015). The results still hold (shown in Table A9 in Appendix B).

5 Results

The results are presented in Table 4.

According to column (1), the coefficient on the value-added ratio is positive but not statistically significant. The coefficient on productivity is positive and not statistically significant. Interestingly, the coefficient on GPN orientation is positive and statistically significant at the five per cent level. A one percentage point increase in GPN orientation is associated with a 14 per cent increase in export-induced employment. This finding provides strong evidence that participation in GPNs significantly generates more employment.

Column (2) presents the results after the addition of two interaction terms: (i) GPN orientation and value-added ratio, and (ii) GPN orientation and productivity. The coefficients on both value-added ratio and productivity are similar to the previous column. The coefficient on GPN orientation is positive and statistically significant at the one per cent level. The size of the coefficient is larger than those reported in column (1). A one percentage point increase in GPN orientation is associated with a 40 per cent increase in export-induced employment.

Table 4: Value-added ratio and export-induced employment

	(1)	(2)
Value-added ratio (DVA)	0.011 (0.009)	0.011 (0.009)
Ln productivity ($PROD$)	0.137 (0.097)	0.150 (0.097)
GPN orientation (GPN)	0.142** (0.059)	0.402*** (0.099)
$GPN \times DVA$		0.002 (0.001)
$GPN \times PROD$		-0.034** (0.015)
1995	0.783*** (0.124)	0.799*** (0.125)
2000	1.283*** (0.144)	1.301*** (0.144)
2005	1.526*** (0.184)	1.546*** (0.183)
2010	1.494*** (0.89)	1.517*** (0.190)
2015	1.868*** (0.216)	1.882*** (0.208)
Constant	6.672*** (1.287)	6.539*** (1.295)
Observations	444	444
Adjusted R-squared	0.439	0.444
Industry fixed effects	Yes	Yes

Note: robust standard errors are reported in parentheses; time (year) dummy with the year 1990 as the base dummy; table reports within R-squared; ***, **, * indicate significance levels at one per cent, five per cent, and ten per cent respectively.

Source: author's calculations.

In addition, the coefficient on the interaction term between GPN orientation and domestic value-added is positive but not statistically significant. This suggests that the relationship between export-induced employment and the value-added ratio is not statistically different among GPN industries. Moreover, the coefficient on the interaction term between GPN orientation and productivity is negative and statistically significant at the five per cent level. However, the magnitude of the coefficient is very small (-0.034). This indicates that an increase in productivity may slightly reduce export-led employment among GPN industries. The results from the system GMM estimator are reported in Table A9 in Appendix B.

In summary, there is no empirical support for the notion that industries with high value-added ratios can generate more export-induced employment than those with low value-added ratios. The results are consistent with Escaith's (2013) finding that high value-added ratios do not necessarily result in greater employment generation. However, there is strong evidence that participation in GPNs significantly increases export-induced employment.

6 Conclusion

This paper has revisited the current policy emphasis on the value-added ratio by examining the relationship between value-added ratios and export-induced employment. The analysis is based on a balanced panel data set constructed by putting together the data covered by Thailand's I-O tables for six periods.

The results cast doubt on the validity of the contemporary approach to policy guidance based on the domestic content of exports, which is currently adopted across developing countries. It is found that there is no statistically significant relationship between value-added ratios and export-induced employment. At the same time, the results also suggest that participation in GPNs helps to generate export-induced employment through faster export growth driven by relative labour cost advantages.

The findings of this study by no means imply that the value-added ratio does not matter. The 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 the value-added created in a given country within a production network, because production sharing essentially involves spreading the total value-added of a given product across countries. An undue emphasis on industries with high value-added through policy interventions (e.g., export bans, tariff and non-tariff barrier measures) may run counter to the objective of reaping developmental gains from engaging in GPNs.

This paper mainly focuses on static gains from joining GPNs. The results imply that by specializing its exports in relation to its existing comparative advantage from the Heckscher-Ohlin model perspective, a country can create more jobs than by trying to diversify into more capitalistic, complex, and high-value added industries. Future research may extend the analysis to cover the dynamic perspective (e.g., through the concept of product space, or capabilities theory), which is a very important issue in the discussion of industrialization. The increasing export sophistication and the deepening of the domestic value chain as a condition for job creation are relevant subjects for further research. In addition, future research could formally distinguish between direct (the exporting industry) and indirect (the domestic value chain) job creation. This would allow us to measure the downstream induced effects, and to differentiate more precisely between high and low value-added industries.

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Appendix A: I-O model

The standard I-O framework is used to examine the relationship between the value-added ratio and developmental gains from EOI (Leontief 1936). I-O tables fall under two categories: the 'non-competitive type', which shows domestic and import transactions in two separate matrices of inter-industry flows of goods and services; and the 'competitive type', which lumps together the two types of input as a single inter-industry matrix (Miller and Blair 2009). In this paper, the non-competitive I-O framework is used, because the focus is on domestic I-O linkages in determining the selected performance indicators. For a non-competitive I-O system, the Leontief balance equation can be written as

$$X = (I - A^d)^{-1}F \qquad [A1]$$

where X is a matrix of gross output, A^d is a matrix of the domestic I-O coefficient, and F is a matrix of final demand.

Final demand can be decomposed to

$$X = (I - A^d)^{-1}(Y^d + E) \qquad [A2]$$

where Y^d is a vector of domestic final demand, and E is exports of domestically produced goods. $(I - A^d)^{-1}$ 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 j.

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

$$BWL_j = \sum_{i=1}^{n} l_{ij} \qquad [A3]$$

Import intensity

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

$$R = [r_i], r_i = \frac{R_i}{X_i} \qquad [A4]$$

where R_i is imports used by sector i, and r_i is thus the imported input coefficient. It can be written in matrix form:

$$R = \begin{bmatrix} r_{11} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & r_{nn} \end{bmatrix}$$

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

$$M = R(I - A^d)^{-1} = \begin{bmatrix} r_{11} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & r_{nn} \end{bmatrix} \begin{bmatrix} l_{11} & \cdots & l_{1n} \\ \vdots & \ddots & \vdots \\ l_{n1} & \cdots & l_{nn} \end{bmatrix} = \begin{bmatrix} m_{11} & \cdots & m_{1n} \\ \vdots & \ddots & \vdots \\ m_{n1} & \cdots & m_{nn} \end{bmatrix}$$

where M is the total import requirement matrix of domestic production. An element of matrix M, m_{ij}, is the total amount of import i needed to produce one unit of commodity j. As sector j uses imported intermediates from several industries, the total import required to produce a unit of commodity j is therefore

$$m_{Tj} = \sum_{i=1}^{n} m_{ij} \qquad [A5]$$

Value-added ratio

Let e_j be the value of total exports from sector j. 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 j, e_j, is embodied in imports used by sector j, m_{Tj}. It yields

$$m_{Tj}^{e} = m_{Tj} e_j \qquad [A6]$$

where m_{Tj}^{e} is the total value of imports embodied in the export of commodity j.

Let e_j^n be the net export earnings of sector j. This is estimated by

$$e_j^n = e_j - m_{Tj} e_j = (1 - m_{Tj}) e_j \qquad [A7]$$

Lastly, dividing [A7] by gross exports yields the per-unit domestic value-added of exports (the value-added ratio) as the following:

$$DVA = e_j^n / e_j \qquad [A8]$$

This is the domestic content of exports as a percentage of gross exports.[3]

Export-induced employment

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

$$G = \begin{bmatrix} g_{11} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & g_{nn} \end{bmatrix}$$

where G_i is the number of employed persons in sector i, and g_i is an employment coefficient (the ratio of employment to total output).

Total employment as a part of production can be quantified as

[3] For detailed discussion and alternative calculation of the value-added ratio, see Hummels et al. (2001), Koopman et al. (2012), and Timmer et al. (2019).

$$K = G(I - A^d)^{-1} = \begin{bmatrix} g_{11} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & g_{nn} \end{bmatrix} \begin{bmatrix} l_{11} & \cdots & l_{1n} \\ \vdots & \ddots & \vdots \\ l_{n1} & \cdots & l_{nn} \end{bmatrix} = \begin{bmatrix} k_{11} & \cdots & k_{1n} \\ \vdots & \ddots & \vdots \\ k_{n1} & \cdots & k_{nn} \end{bmatrix}$$

where K is the total employment requirement matrix of domestic production.

An element of matrix K, k_{ij}, is the total number of workers in sector i that sector j needs to produce one unit of commodity j in the economy. The total required employment from all sectors to produce a unit of commodity j is thus

$$k_{Tj} = \sum_{i=1}^{n} k_{ij} \quad \text{[A9]}$$

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

$$k_{Tj}^{e} = k_{Tj} e_j \quad \text{[A10]}$$

where k_{Tj}^{e} is the total value of employment embodied in the export of commodity j. Thus, the total export-induced employment in the economy, K_T, is

$$K_T = \sum_{j=1}^{n} k_{Tj}^{e} \quad \text{[A11]}$$

Appendix B: Tables

Table A1: Commodity composition of Thailand's network exports in total manufacturing exports, 2009–18 (per cent)

	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
Semiconductors (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
Other	45.8	39.1	38.6	38.0	47.0	2.6
Total manufacturing exports	100	100	100	100	100	

Note: manufacturing sectors are SITC 5–8, excluding SITC 68 (non-ferrous metals).

Source: author's compilation based on data 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	Plasticware
21	Tapioca milling	58	Ceramic, earthenware, 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 spirit 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 metalworking 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	Shipbuilding and repairing
42	Sawmills	78	Railway 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	Fertilizer and pesticides	86	Jewellery
50	Petrochemical products	87	Recreational and athletic equipment
51	Paints	88	Other manufactured goods

Source: author’s compilation based on data from NESDC (2020).

Table A3: Export-induced employment, 1990–2015

Sector	Export-induced employment (thousand jobs)					
	1990	1995	2000	2005	2010	2015
15	147.64	152.82	271.09	404.87	314.95	202.77
16	6.05	10.13	13.57	85.22	29.08	26.98
17	411.46	299.48	430.43	368.1	363.43	467.72
18	395.84	503.77	682.48	518.32	571.98	747.90
19	14.83	9.97	27.06	43.13	56.25	63.13
20	1,916.44	1,595.60	1,679.55	1,044.40	1,442.88	1074.93
21	1,054.82	350.95	173.08	133.89	171.05	563.12
22	14.22	28.52	38.23	25.7	26.95	39.89
23	14.44	12.97	39.42	34.76	41.28	62.46
24	868.16	520.31	390.26	178	302.41	465.79
25	11.26	34.81	17.6	11.93	18.52	22.39
26	64.7	105.05	143.7	155.01	160.59	302.74
27	90.71	63.97	127.2	79.69	80.72	151.88
28	1.32	0.35	4.88	2.65	6.89	12.25
29	0.32	0.28	0.6	0.99	2.19	4.74
30	0.86	6.09	8.29	6.64	20.04	58.79
31	4.34	1.2	1.97	2.06	2.21	2.03
32	61.67	99.42	134.76	169.06	122.71	89.77
34	11.49	23.62	19.09	37.9	28.23	0.00
35	45.48	46.33	92.4	67.25	79.22	54.34
36	273.97	318.97	320.36	299.15	113.57	61.11
37	12.96	42.21	36.51	26.94	15.34	90.88
38	40.31	30.1	50.54	47.36	15.5	19.59
39	11.84	19.38	7.63	26.43	10.88	43.05
40	25.87	29.51	41.11	15.68	18.16	11.89
41	1,437.07	1,434.72	1,350.29	1,423.90	1,346.55	33.92
42	6.12	11.3	40.52	123.62	189.27	1190.46
43	89.92	67.11	139.53	97.76	34.21	273.89
44	31.2	47.51	140.24	121.37	11.71	25.21
45	4.37	12.35	28.09	29.64	31.56	7.02
46	1.73	11.48	20.28	34.19	21.29	60.51
47	1.23	14.75	3.08	12.41	4.38	15.88
48	3.08	6.28	21.91	29.61	127.47	4.36
49	0.37	1.1	2.7	6.4	8.12	105.77
50	4.41	21.18	87.18	87.28	81.08	10.86
51	0.46	14.89	2.43	3.37	4.11	121.10
52	1.87	4.5	7.74	5.89	12.32	8.89

53	3.37	6.24	25.79	54.9	61.68	19.47
54	9.77	25.75	32.71	32.35	28.53	89.45
55	0.3	0.66	7.56	6.73	19.15	89.97
56	11.4	19.82	46.29	96.85	180.44	40.88
57	17.02	74.67	35.86	112.16	79.4	204.06
58	34.26	39.86	69.57	63.83	39.57	148.45
59	4.57	12.52	25.73	19.28	22.63	46.33
60	0.1	3.51	12.47	12.84	6.99	20.42
61	1.21	3.25	7.31	11.06	13.24	15.80
62	8.41	19.32	60.18	45.3	42.77	23.25
63	5.97	25.01	17.93	35.29	22.22	64.93
64	2.15	3.12	3.83	5.54	7.04	96.06
65	23.28	44.98	49.66	95.25	153.47	16.92
66	33.74	36.76	94.07	139.99	73.14	316.84
67	0.75	2.08	10.42	28.56	45.43	51.33
68	0.36	4.38	5.74	10.11	10.66	80.87
69	1.29	2.54	5.67	5.41	4.19	22.65
70	3.65	10.01	26.63	70.98	97.8	18.18
71	88.93	290.2	649.38	422.22	541.84	126.89
72	6.81	24.73	51.71	44.5	68.59	431.50
73	57.52	79.51	178.15	375.22	369.86	281.67
74	6.32	22.7	14.12	20.36	18.61	629.62
75	3.84	10.06	38.65	39.07	31.25	19.20
76	37.64	46.51	55.69	65.31	77.6	35.74
77	0.9	8.26	4.06	13.76	11.64	123.45
78	0	0.01	0.05	0.35	2.54	29.44
79	2.73	12.6	83.94	217.36	342.83	2.24
80	3.61	13.25	20.1	31.99	29.38	569.45
82	0	4.2	0.38	11.48	14.58	55.11
83	1.85	6.92	12.57	18.3	26.5	0.00
84	2.63	12.72	22.68	37.19	39.12	10.72
85	10.49	14.61	14.11	10.82	9.84	61.97
86	95.79	91.46	81.73	104.37	219	49.00
87	24.2	43.47	59.58	40.47	32.33	11.30
88	101.25	168.37	127.48	81.92	74.16	239.29

Source: author’s compilation based on data from NESDC (2020).

Table A4: Value-added ratios and coefficients of variation (CoV), 1990–2015

Sector	1990	1995	2000	2005	2010	2015	1990-2015 (%)	Mean	Std dev.	CoV
15	90.15	86.63	86.53	83.32	85.39	87.07	-3.41	86.52	2.04	2.36
16	73.12	67.07	71.05	77.10	77.92	76.72	4.92	73.83	3.87	5.24
17	85.75	84.47	81.41	77.47	83.46	81.17	-5.34	82.29	2.69	3.27
18	58.98	74.76	73.19	60.43	62.30	62.68	6.27	65.39	6.21	9.49
19	86.80	79.11	58.73	59.82	64.65	68.11	-21.54	69.54	10.22	14.70
20	89.08	88.69	86.47	83.07	85.88	83.80	-5.93	86.16	2.24	2.61
21	91.45	90.85	88.17	84.30	86.25	81.26	-11.14	87.05	3.58	4.11
22	82.25	84.44	72.31	64.76	71.48	62.07	-24.54	72.88	8.23	11.29
23	88.69	88.68	86.33	81.95	82.65	73.62	-16.99	83.65	5.20	6.22
24	89.87	89.04	89.01	86.99	87.34	87.97	-2.12	88.37	1.02	1.15
25	80.73	80.95	82.04	79.63	74.83	73.96	-8.38	78.69	3.13	3.97
26	79.20	77.06	74.91	70.46	56.40	51.21	-35.34	68.21	10.63	15.58
27	74.24	61.87	55.89	47.34	43.82	50.75	-31.63	55.65	10.14	18.23
28	91.41	89.61	87.30	87.86	91.55	90.51	-0.98	89.71	1.64	1.83
29	79.93	78.66	82.79	82.26	81.02	77.59	-2.92	80.38	1.86	2.31
30	84.75	84.60	66.73	69.51	72.65	70.93	-16.31	74.86	7.16	9.57
31	85.60	88.56	88.81	94.06	95.92	96.15	12.32	91.52	4.05	4.42
32	63.80	66.00	71.83	67.15	63.81	64.15	0.54	66.12	2.84	4.29
34	66.89	69.30	65.83	67.61	62.04	62.10	-7.15	65.63	2.72	4.14
35	70.15	73.48	66.79	61.01	65.86	61.70	-12.05	66.50	4.39	6.60
36	67.98	72.83	74.62	73.05	70.67	70.71	4.02	71.64	2.14	2.99
37	82.27	82.93	80.69	75.73	74.58	76.04	-7.57	78.71	3.35	4.26
38	86.19	83.55	51.01	64.01	77.06	77.64	-9.92	73.24	12.16	16.60
39	49.02	41.51	23.42	43.27	38.93	31.52	-35.70	37.94	8.34	21.97
40	67.05	66.52	72.00	69.14	57.90	54.64	-18.50	64.54	6.18	9.57
41	79.84	78.84	80.31	76.83	70.66	74.92	-6.17	76.90	3.34	4.34
42	53.14	43.31	60.91	80.91	78.44	84.30	58.65	66.84	15.35	22.97
43	76.15	76.26	79.75	84.42	82.73	84.22	10.60	80.59	3.46	4.29
44	73.63	69.59	69.96	70.25	72.75	69.63	-5.43	70.97	1.61	2.26
45	56.93	55.28	68.97	63.75	60.91	59.22	4.02	60.84	4.54	7.45
46	43.71	47.08	54.33	46.74	51.23	51.75	18.38	49.14	3.60	7.32
47	56.33	60.62	56.28	61.42	63.31	60.99	8.27	59.82	2.63	4.39
48	65.76	62.36	58.35	54.37	59.50	63.99	-2.69	60.72	3.79	6.24
49	47.12	44.17	55.84	43.56	49.15	52.47	11.35	48.72	4.37	8.98
50	69.01	68.11	58.31	59.35	57.33	56.72	-17.82	61.47	5.09	8.27
51	60.17	59.81	73.12	68.43	62.15	65.38	8.66	64.84	4.76	7.34
52	59.63	57.97	63.81	65.54	67.49	70.62	18.43	64.18	4.35	6.78
53	67.04	63.94	60.81	54.22	54.76	57.65	-14.01	59.74	4.69	7.84
54	58.25	54.02	59.68	55.65	57.40	62.78	7.78	57.96	2.81	4.85
55	42.42	48.38	33.07	22.37	28.11	34.67	-18.27	34.84	8.61	24.71
56	74.49	69.57	66.37	60.98	63.63	57.04	-23.42	65.35	5.68	8.69
57	64.70	64.58	59.92	57.18	57.99	62.52	-3.37	61.15	2.99	4.88
58	84.10	75.81	75.51	72.34	73.71	75.73	-9.95	76.20	3.75	4.92

59	75.85	69.12	50.72	59.16	64.81	66.77	-11.96	64.41	7.89	12.25
60	86.40	82.84	82.96	75.52	75.93	78.18	-9.51	80.30	4.02	5.01
61	78.59	79.49	77.24	72.84	72.65	76.48	-2.69	76.21	2.63	3.45
62	49.69	38.92	59.34	49.08	45.10	53.59	7.85	49.29	6.39	12.96
63	56.74	47.49	60.20	43.27	53.96	54.66	-3.66	52.72	5.69	10.79
64	52.58	49.29	56.88	48.26	53.69	57.79	9.91	53.08	3.53	6.65
65	54.54	54.85	54.63	42.51	41.05	43.17	-20.86	48.46	6.25	12.89
66	53.09	52.89	56.28	46.54	51.47	53.28	0.35	52.26	2.93	5.61
67	60.93	43.68	44.52	51.37	44.72	47.91	-21.37	48.85	6.00	12.27
68	47.55	55.93	66.57	56.20	51.26	57.52	20.97	55.84	5.88	10.54
69	65.83	68.88	52.82	43.61	48.42	51.78	-21.34	55.22	9.11	16.49
70	47.78	48.20	54.28	47.93	45.44	44.64	-6.56	48.05	3.09	6.43
71	38.99	44.28	48.40	42.82	54.78	54.95	40.94	47.37	5.97	12.61
72	52.25	44.03	43.99	34.03	35.91	39.79	-23.85	41.67	6.03	14.47
73	36.61	31.92	17.87	16.70	27.18	29.09	-20.53	26.56	7.18	27.03
74	57.44	54.41	66.78	49.08	47.56	49.66	-13.54	54.16	6.58	12.15
75	50.98	52.08	57.17	48.90	50.88	50.41	-1.11	51.74	2.61	5.04
76	42.93	49.24	30.27	50.79	42.56	45.34	5.61	43.52	6.65	15.29
77	70.98	62.53	66.15	65.28	64.95	64.79	-8.72	65.78	2.57	3.91
78	44.90	59.85	63.92	60.46	53.01	52.02	15.87	55.69	6.39	11.47
79	44.33	45.27	33.16	40.51	42.63	43.73	-1.35	41.61	4.06	9.76
80	53.14	56.41	52.35	52.39	49.35	52.15	-1.86	52.63	2.07	3.93
82	32.70	18.93	30.82	42.48	71.60	55.10	68.50	41.94	17.28	41.20
83	59.93	62.82	47.75	32.05	37.46	38.44	-35.86	46.41	11.57	24.94
84	77.19	62.80	68.65	66.38	59.38	58.34	-24.41	65.46	6.37	9.73
85	69.13	71.77	64.34	58.78	64.02	61.13	-11.58	64.86	4.43	6.83
86	53.11	57.37	53.52	38.44	47.51	48.68	-8.34	49.77	6.02	12.10
87	78.34	76.85	72.06	66.11	68.34	71.20	-9.12	72.15	4.33	6.00
88	74.23	71.30	67.40	61.41	65.51	64.86	-12.62	67.45	4.24	6.28

Source: author’s compilation based on data from NESDC (2020).

Table A5: GPN orientation (percentage of total manufacturing exports), 1990–2015

Sector	1990	1995	2000	2005	2010	2015
34	0.25	0.41	0.41	0.51	0.36	0.38
35	1.62	1.12	0.95	0.28	0.19	0.29
36	19.32	12.15	7.28	4.84	3.04	2.92
38	0.23	0.17	0.12	0.11	0.09	0.05
40	0.07	0.06	0.05	0.04	0.05	0.06
44	0.27	0.18	0.08	0.07	0.04	0.04
46	0	0.02	0	0.01	0.01	0.02
47	0	0	0	0.01	0	0.00
56	0.41	0.32	0.39	0.5	0.58	0.60
57	0.29	0.39	0.24	0.19	0.22	0.27
58	0.05	0.08	0.09	0.09	0.21	0.19
59	0.08	0.07	0.09	0.15	0.24	0.23
61	0.02	0.01	0.01	0.02	0.02	0.03
64	0.05	0.07	0.09	0.1	0.16	0.21
65	1.57	0.71	0.6	0.53	0.59	0.83
67	0.16	0.25	0.4	0.68	1.09	1.31
68	0.02	0	0	0	0.01	0.01
69	0.08	0.07	0.07	0.11	0.18	0.25
70	0.09	0.15	0.15	0.26	0.25	0.50
71	11.38	15.35	18.42	15.43	14.9	15.99
72	0.86	2.06	2.61	1.48	1.43	1.61
73	14.58	17	22.81	17.77	11.44	8.43
74	0.6	0.61	0.66	0.67	0.73	0.71
75	0.16	0.19	0.23	0.27	0.46	0.41
76	2	3.61	3.73	4.77	6.52	6.21
78	0.01	0.05	0.03	0.09	0.08	0.02
79	1.35	1.27	4.24	8.84	12.21	13.10
80	0.37	0.72	1.16	1.93	2.5	2.33
82	0.04	1.51	0.22	1.91	1.15	0.15
83	0.32	0.55	0.57	0.76	1.05	0.62
84	0.77	0.86	0.99	1.29	1.49	1.23
85	0.96	0.98	0.54	0.44	0.45	0.43
87	0.01	0	0	0	0	0.00

Source: author’s compilation based on data from NESDC (2020).

Table A6: Weighted averages of domestic value-added ratios (weighted by export), 1990–2015

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
2015	0.30	0.53
Number of sectors	31	74

Source: author’s compilation based on data from NESDC (2020).

Table A7: Evolution of export-induced employment, value-added ratios, and exports, 1990–2015

	Sector	1990			2000			2015			Growth 1990-2015 (%)	
		Export-led employment	Value-added ratio	Exports (billion THB)	Export-led employment	Value-added ratio	Exports (billion THB)	Export-led employment	Value-added ratio	Exports (billion THB)	Export-led employment	Exports
Low value-added ratio	82	3	33	0	380	31	79	10,716	55	607	396,357.88	137,189.27
	73	57,520	37	4,100	178,153	18	15,000	629,622	29	24,485	994.61	497.20
	71	88,932	39	3,800	649,385	48	14,000	431,501	55	20,281	385.20	433.72
	55	303	42	160	7,558	33	2,000	40,879	35	8,203	13,400.20	5,027.15
	76	37,641	43	520	55,687	30	1,800	123,455	45	5,404	227.98	939.14
	46	1,735	44	30	20,279	54	280	15,882	52	481	815.43	1,503.19
	79	2,725	44	190	83,942	33	3,100	569,453	44	27,456	20,796.74	14,350.69
	78	0	45	0	51	64	2	2,239	52	110	3,207,372.55	1,675,063.35
	49	373	47	19	2,698	56	76	10,858	52	311	2,810.54	1,538.94
	68	359	48	14	5,738	67	44	22,649	58	654	6,215.13	4,573.66
	Total	189,591		8,833	1,003,871		36,381	1,857,255		87,994	879.61	896.14
High value-added ratio	17	411,461	86	1,000	430,432	81	970	467,715	81	3,038	13.67	203.78
	38	40,306	86	170	50,536	51	74	43,050	78	146	6.81	-14.27
	60	96	86	4	12,465	83	380	15,799	78	562	1,6419.90	15,499.14
	19	14,827	87	31	27,059	59	94	63,133	68	377	325.79	1,115.30
	23	14,444	89	28	39,416	86	77	62,457	74	439	332.43	1,467.69
	20	1,900,000	89	2,100	1,700,000	86	2,100	1,074,931	84	5,127	-43.42	144.16
	24	868,164	90	1,400	390,258	89	870	465,794	88	3,117	-46.35	122.62
	15	147,643	90	630	271,093	87	1,000	202,775	87	1,990	37.34	215.86
	28	1,322	91	17	4,877	87	19	12,250	91	261	826.69	1,434.84
	21	1,100,000	91	1,500	173,078	88	250	563,119	81	3,137	-48.81	109.12
	Total	4,498,262		6,880	3,099,213		5,834	2,971,023		18,192	-33.95	164.44

Source: author’s compilation based on data from NESDC (2020).

Table A8: Correlation matrix

Export-induced employment ($EXEM$)	1			
Value-added ratio (DVA)	0.22*** (0.00)	1		
Ln productivity ($PROD$)	-0.05 (0.27)	-0.03 (0.59)	1	
GPN orientation (GPN)	0.16*** (0.00)	-0.24*** (0.00)	0.05 (0.31)	1
	$EXEM$	DVA	$PROD$	GPN

Source: author's compilation based on data from NESDC (2020).

Table A9: Value-added ratios and export-induced employment (using system GMM estimator, lags(2))

	(1)	(2)
Lagged 1 Ln export-induced employment ($L.EXEM$)	0.437*** (0.086)	0.436*** (0.088)
Lagged 2 Ln export-induced employment ($L2.EXEM$)	0.199*** (0.029)	0.202*** (0.029)
Value-added ratio (DVA)	0.013 (0.007)	0.009 (0.007)
Ln productivity ($PROD$)	0.006 (0.004)	0.008 (0.038)
GPN orientation (GPN)	0.086** (0.036)	0.083 (0.171)
$GPN \times DVA$		0.002 (0.168)
$GPN \times PROD$		-0.007 (0.016)
2000	-0.112 (0.109)	-0.096 (0.110)
2005	-0.094 (0.076)	-0.081 (0.077)
2010	-0.266*** (0.074)	-0.263*** (0.074)
Constant	3.303*** (0.875)	3.362*** (0.880)
Observations	296	296
Adjusted R-squared		
Industry fixed effects	Yes	Yes

Note: robust standard errors are reported in parentheses; time (year) dummy with the year 1990 as the base dummy; table reports within R-squared; ***, **, * indicate significance levels at one per cent, five per cent, and ten per cent respectively.

Source: author's calculations.