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Product Diversification and Export Performance: A Comparative Study of Developing Asian Countries

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Abstract

There has been renewed emphasis in the recent trade policy debate on the potential positive impact of diversification of the product composition on export expansion. However, the standard trade theory predicts that export success depends on pursuing comparative advantages rather than policy-induced export diversification. This paper studies the relationship between product diversification and export performance of developing Asian economies using panel data from 1976 to 2017. The methodology involves estimating export equations for total non-oil exports and product subcategories. Commodity diversification is alternatively measured using the Herfindahl-Hirschman and Theil indices. The autoregressive distributed lag (ARDL) technique is used to delineate short-run and long-run effects. The results suggest that export diversification has a negative and statistically significant impact on export performance. This relationship holds for total non-oil exports and the major exports subcategories. The magnitude of the impact varies for product categories, casting doubt on the results of previous studies that focused on aggregate exports. Supply-side factors appear to be more important than external demand in explaining inter-country differences in export performance.

Keywords: Export diversification, International trade, Export performance
JEL Classifications: F13, F14, O10

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1. Introduction

The World economic slump and export contraction in the aftermath of the global economic crisis of 2008 - 2009 has led to a renewed policy concern calling for export diversification. It is widely believed that dependence on too few products can adversely affect export growth. This concern is prominent in policy circles for both developed and developing countries (Newfarmer, Shaw, & Walkenhorst, 2009; López-Cálix, Walkenhorst, & Diop, 2010; Vos & Koparanova, 2011).

The case for the diversification of the product mix of exports of developing countries is not new to the trade and development policy debate (Maizels, 2003). The related literature dates back to the early 1950s when economic development in developing countries emerged as a key theme in the economic profession (Prebisch, 1950; Singer, 1959). These studies were concerned with the decline in the term of trade of developing countries resulting from the heavy concentration of exports in primary products.

Some later studies came up with the idea of 'Dutch disease', alternatively called the natural resource curse, which postulated the negative impact of natural resource export on economic growth and non-natural resource exports (Corden, 1984; Gelb, 1988; Sachs & Warner, 1999). The Dutch disease mechanism is that when there is a boom in natural resource exports, this situation can raise wage levels and result in currency appreciation. The latter effects deteriorate the price competition in non-natural resource sectors such as manufacturing products. Thus, high dependence on natural resource export is postulated to be potentially harmful to export performance.

In the context of renewed policy emphasis on export diversification, some economists have recently argued that countries should be able to diversify exports through industrial policy, that is, government policy targeted explicitly at industries, or even individual firms, with export potential, to overcome the barriers to entry into export markets (Hausmann & Rodrik, 2005; Rodrik, 2007). This literature based on the perceived risk faced by 'pioneer firms' firms in "discovery of exports" and make a strong case of the government engage in targeted industrial policy to eliminate barriers to entry. When the pioneer firm succeeds in discovering a new export product, other firms can obtain information from the pioneer firm and enter export markets.

The case for export diversification policy, however, is not consistent with the standard trade theory: the Ricardian and the Heckscher-Ohlin models. These standard trade theories postulate that export patterns should evolve naturally on specialization based on countries' comparative advantage. The international market is highly competitive. Hence, specialization in a few products based on comparative advantage would be more important for export success than diversification into many products through direct policy intervention because specialization would help reap gains from economies of scale and competitiveness in world markets.

There are, indeed, some vivid examples that export diversification may not always guarantee faster export growth. For instance, India had a highly diversified export basket that evolved through a protectionist trade regime during the first four decades of the post-independent period. However, its share in world trade declined throughout this period (Krueger, 2010). In contrast, some countries with less export diversification can maintain considerable export growth. Hong Kong is such a particular case. Hong Kong experienced rapid export growth with high commodity concentrations in textiles, clothing, and footwear in the 1970s to the 1990s. The share of textiles, clothing, and footwear exports accounted for over 60% of the total exports of Hong Kong during this

period (Weiss, 2005). Recent in-depth studies of emerging exports patterns in developing countries have demonstrated that product-specific factors matter in export success over and above policy-induced changes in the commodity mix (Hausmann & Rodrik, 2005; Daruich, Easterly, & Reshef, 2019).

Besides, the rise in global production networks cast doubt on the validity of the proposition that export diversification contributes to export expansion. This is because the lead firms operating within global production networks set up production bases in individual countries based on their relative cost advantage for specialization-specific segments/tasks in the value chain. A given developing country is, therefore, not able to determine its pattern of specialization within global production networks. It can only create an enabling business environment to facilitate the process of specialization within global production networks (Jones & Kierzkowski, 2001; Athukorala, 2014).

The advocacy of export diversification as a means of export expansion based on the prior view that export diversification invariably promotes export growth. Only a few studies have systematically tested this hypothesized relationship (Ali, Alwang, & Siegel, 1991; Roy, 1991; Piñeres & Ferrantino, 1997; Funke & Ruhwedel, 2001; Kandogan, 2006; Rosal, 2019). There are mixed results in the impact of export diversification on export performance for developed and developing economies.

Therefore, the purpose of this paper is to examine the impact of export diversification on export growth, drawing on the experiences of export performance record in developing Asian countries over the period 1976-2017. These countries provide an ideal laboratory for examining this issue because they have significant policy shifts and structural changes in export patterns during this period.

This paper has some methodological improvements compared to the previous studies. First, we cover a more prolonged period that can capture significant policy shifts and structural changes in export patterns of the countries covered. The previous studies covered much shorter periods (10 to 15 years), which is insufficient to capture the dynamic of export diversification and its impact on export growth. Second, our empirical analysis is undertaken for total non-oil exports and decomposing total non-oil exports into commodity groups (primary products and manufactured products and major subcategories within the latter). This disaggregation is needed because diversification within different product groups can result in other impacts on export performance. Third, we examine the implications of countries' engagement in global production networks for the relationship between commodity diversification and export growth. Finally, we employ an econometric methodology that distinguishes between the short-run and long-run (steady-state) relationships between export diversification and export growth.

The main finding of the paper is that product diversification is negatively associated with export growth. This result holds for total non-oil merchandise exports, primary exports, and manufactured exports. Thus, the findings are consistent with the postulate of the standard trade theory that export success depends on specialization based on comparative advantage in world trade rather than on product diversification achieved through direct policy intervention.

The rest of the paper is structured as follows. Section 2 examines the trends and patterns of commodity diversification and export performance. Section 3 describes the estimation method and variables. Section 4 undertakes an econometric analysis of the impact of commodity diversification on export performance. The final section summarises the findings and makes policy inferences.

2. Trends and patterns of export diversification

2.1 Measurement of export diversification

There are two standard measures of export diversification: the Herfindahl-Hirschman index (HHI) (Hirschman, 1964), and the Theil index (THI) (Theil, 1972).

The Herfindahl-Hirschman index (HHI) is

$$HHI = \frac{\sqrt{\sum_{i=1}^{N}(s_i)^2} - \sqrt{1/N}}{1 - \sqrt{1/N}} \quad (1)$$

where s_i is the share of export in each product i and N is total product lines[1]. An increase in the HHI represents concentration, while a decrease in the HHI indicates diversification. In the extreme case, each product has the same export share; then, the HHI is zero. By contrast, a country exports only one product; then the HHI is one.

The Theil index (*THI*) is defined as

$$THI = \frac{1}{N}\sum_{i=1}^{N}\frac{x_i}{\mu} ln\left(\frac{x_i}{\mu}\right) \text{ and } \quad \mu = \frac{1}{N}\sum_{i=1}^{n} x_i \quad (2)$$

where x_i is the export value of product i and an N is the number of product lines. A higher value of the *THI* indicates higher export concentration, while a lower value reflects higher export diversification. The index ranges between 0 (extreme export diversification) and the natural logarithm of N (extreme export concentration). Thus, the Theil index can be normalized between 0 and 1 by dividing the natural logarithm of N.

The *HHI* is more sensitive to large export shares changes, which can result from an economic crisis and demand and supply shocks because it is the sum of squared export shares. By contrast, the *THI* is less susceptible to such extreme changes since it measures each export's share relative to the average exports. The *HHI* is generally more volatile than the *THI*. In the case of negatively skewed export data series, the numerical value of the *THI* tends to be higher than that of the *HHI* (Cowell, 2000). Given these differences, both indices are used in this paper for a robustness check.

Both indices are 'indirect' measures of diversification ('direct' measures of concentration). Decreases in both indices (reflecting export diversification) can result from two factors: an increase in numbers of new product lines and/or reduction of export shares of existing products without new product lines.

2.2 Data compilation

The pattern of export diversification in developing Asian countries is examined over the period 1976-2017. Data are compiled from the United Nation (UN) Comtrade database. Data based on the Revision 3 of Standard International Trade Classification (SITC Rev. 3) is available for 1986 - 2018. Data are backdated to 1976 by linking data based on the SITC Rev 2 for 1976-1985 to data based on SITC Rev. 3 using the SITC Rev 3 – Rev 2 concordance available from the United Nation Statistical Office's website. Data for non-oil exports (Total exports – products belonging to SITC Section

[1] Number of product lines refers to active exported products (excluding zero-valued exports) in each country at each year because the prevalence of many zero-valued exports at the SITC 5-digit level are found in the case of developing countries. So, this paper does not count zero-valued exports as number of product lines to avoid any bias in measuring the level of export diversification, especially developing countries with different stages of economic development.

3) are disaggregated into four subcategories (Table 1). Data on oil and gas products (SITC 3) are excluded from our analysis because exports of these products depend on a country's specific resource endowment. Not all countries are thus able to diversify their exports into oil and gas products. Also, price and volume fluctuations of oil and gas products are significantly determined by non-market factors.[2]

Table 1: Definition of commodity group

No.	Commodity group	SITC Codes
1	Total non-oil merchandise	Item 1 + 2
2	Primary products	SITC section 0, 1, 2, 4 and 68 excluding oil and gas (SITC section 3)
3	Manufactured products[1]	SITC section 5, 6 (less SITC 68: nonferrous metals), 7, 8
4	GPN products	See Athukorala (2019)
5	Non-GPN products	Item 3 - 4

Note: [1] Manufactured products are comprised of GPN products and Non-GPN products.
Source: Author's compilation.

2.3 Trends and patterns

The export structures of developing Asian countries have changed significantly over the past five decades (Table 2). The shares of primary products in total exports have declined, while manufactured goods account for an increasing share of export composition. In the early 1980s, manufactured goods accounted for 46.8% of total exports from developing Asian countries. This share had increased to 74.3% by 2016/17.

At the individual country level, this pattern is more prominent in East Asia and Southeast Asia and South Asia, where, on average, manufactured goods account for over two-thirds of the total exports. In Southeast Asia, the only exception to this overall pattern is Indonesia, where primary products still account for over 40% of total exports. Interestingly, some developing countries with low per capita income have very high export shares in manufactured products. For example, Bangladesh's manufactured products accounted for around 80% of total exports in 1990/91 and increased to about 96% of total exports in 2016/17. In Cambodia, the manufacturing share has remained around 90% over the past two decades.

In Central and West Asia, primary products still account for the bulk of total exports. Armenia has the highest primary export share in developing Asian countries, with these products accounting for around 70% of total exports in 2016/17. In this subregion, only two transition countries (Kazakhstan and Kyrgyzstan) have an upward trend in their manufactured export shares in total exports (Table 2).

Data compiled to discuss the role of global production sharing exports within global production networks (GPNs) in the export composition are summarized in Table 3. A comparison of data in Table 2 and 3 clearly shows that GPN exports are the key factor in the upward trend of manufactured export shares. In the region as a whole, the percentage of GPNs products in total manufacturing exports increased from 46.7% in 1980/81 to 65.0% in 2016/17. This evidence can be seen for all countries except India, Pakistan, and Kazakhstan. The shares of GPN exports in total manufactured exports, on average, in North Asia, Southeast Asia and South Asia were more than 60%, while the shares of GPN exports in Central and West Asia were only 34.3% in 2016/17 (Table 3).

[2] We perform the robustness check by estimating total merchandise exports including oil and gas products. According to the estimation results, the coefficient of diversification indices between total merchandise exports and total non-oil merchandise exports are not significantly different sign. However, the size of coefficient in the case of total merchandise export is greater than the coefficient of total non-oil merchandise.

Table 2: Shares of manufactured products in total non-oil exports (%)[1]

	1980/81	1990/91	1995/96	2000/01	2005/06	2010/11	2016/17
North Asia	**91.8**	**89.6**	**92.3**	**94.4**	**95.6**	**94.5**	**94.8**
China	n.a.	80.7	87.6	91.5	94.3	94.7	94.9
Hong Kong	92.9	93.4	93.9	95.9	96.8	94.2	94.7
South Korea	90.7	94.7	95.3	95.9	95.8	94.6	94.7
Southeast Asia	**32.0**	**72.3**	**82.2**	**86.2**	**84.3**	**79.6**	**82.4**
Brunei	n.a.	81.3	98.9	99.2	94.1	96.2	95.5
Cambodia	n.a.	n.a.	n.a.	96.3	97.6	94.9	93.0
Indonesia	11.7	64.7	68.5	76.1	62.9	51.0	57.0
Malaysia	26.0	69.1	82.4	89.7	87.2	73.9	74.9
Philippines	27.7	64.4	77.1	92.4	90.1	80.0	86.2
Singapore	70.0	88.6	92.7	95.7	94.1	93.0	91.8
Thailand	24.4	65.8	73.8	79.4	81.0	76.0	79.0
Vietnam	n.a.	n.a.	n.a.	60.6	67.6	71.4	82.0
South Asia	**45.8**	**73.5**	**81.3**	**84.4**	**82.0**	**79.6**	**81.9**
Bangladesh	68.1	80.0	87.2	91.9	91.9	93.6	96.4
India	45.2	74.0	75.0	81.5	78.7	78.6	81.2
Pakistan[2]	58.7	80.2	84.3	86.6	85.5	77.0	77.9
Sri Lanka	11.3	59.8	78.8	77.5	72.0	69.2	72.3
Central and West Asia	n.a.	n.a.	**46.1**	**41.0**	**49.3**	**47.2**	**42.9**
Armenia[3]	n.a.	n.a.	56.4	62.6	68.4	33.6	29.4
Azerbaijan	n.a.	n.a.	58.4	44.7	42.3	44.1	32.7
Georgia	n.a.	n.a.	50.0	36.1	44.0	62.0	48.2
Kazakhstan	n.a.	n.a.	19.8	16.6	35.5	42.3	44.8
Kyrgyzstan	n.a.	n.a.	46.1	45.1	56.5	54.0	59.6
Developing Asia	46.8	76.7	73.7	75.8	76.8	73.7	74.3

Note: 1. n.a. denotes non-available data.
2. Due to the lack of observation in 1980/81 for Pakistan, we use observation in 1982 instead of 1980/81.
3. Due to the lack of observation in 1995/96 for Armenia, we use observation in 1997 instead of 1995/96.
Source: Author's computation using the UN Comtrade database.

As some countries in South Asia, and Central and West Asia involving slightly in global production networks, their GPN export shares account for less than 40% of total manufactured exports. India is one example that is not able to engage in global production networks. Compared with Bangladesh and Sri Lanka, India's share of GPN exports in total manufactured exports was very low, around 35% in 2016/17. On the other hand, the shares of GPN exports in Bangladesh and Sri Lanka accounted for about 90% and 80% of total manufactured exports, respectively.

Data on export diversification patterns are summarized as measured by the Herfindahl-Hirschman index (*HHI*), and the Theil index (*THI*) are plotted in Figure 1 and Figure 2, respectively. Table 4 reports only the Herfindahl-Hirschman index (*HHI*) for each developing Asian country. To facilitate our analysis, both indices are reported as percentages.

In general, both indices show the same export diversification pattern in total exports, primary products, and the major export categories over the last three decades (Figure 1 and Figure 2). The two indices are highly correlated[3]. However, there are two vital differences between the *HHI* and the *THI*; the *HHI* is slightly more volatile than the *THI*, and on average, the magnitude of the *THI* is relatively large than the *HHI* for all commodity groups.

The export diversification levels in total non-oil exports and subcategories are shown in Figure 1. In developing Asia, this region experienced a significant export diversification in total non-oil exports. Its export diversification increased by approximately 10% during the period 1980-2017. A comparison between primary products and manufactured products shows that level of *HHI* in primary products, on

[3] As the correlation calculation (not shown in this paper), we find that correlations between the *HHI* and the *THI* in each commodity group are around 0.90 - 0.97.

average, is higher (the degree of diversification is lower) than that of manufactured products. This finding is consistent because the manufactured sector has more chances of product diversification than primary products due to its higher range of product lines and smaller resource constraints in domestic productions.

Table 3: Shares of GPN Products in total manufactured exports (%)[1]

	1980/81	1990/91	1995/96	2000/01	2005/06	2010/11	2016/17
North Asia	**65.8**	**67.3**	**65.0**	**70.3**	**73.6**	**68.7**	**67.0**
China	n.a.	63.0	61.4	68.1	70.2	65.9	62.0
Hong Kong	74.6	72.1	68.5	73.1	78.2	74.0	75.1
South Korea	57.0	66.9	65.1	69.6	72.3	66.3	64.0
Southeast Asia	**59.7**	**67.6**	**67.5**	**77.1**	**72.6**	**63.0**	**66.1**
Brunei	n.a.	n.a.	46.2	81.0	79.2	54.7	41.8
Cambodia	n.a.	n.a.	n.a.	79.2	78.3	67.8	92.3
Indonesia	40.4	36.2	45.3	52.1	51.5	49.8	49.0
Malaysia	75.1	80.5	79.2	82.2	77.2	65.2	63.1
Philippines	55.7	73.6	83.0	93.3	91.4	82.3	86.2
Singapore	71.0	77.3	81.9	81.8	65.4	61.3	58.1
Thailand	56.1	70.6	69.4	69.9	66.8	57.8	60.9
Vietnam	n.a.	n.a.	n.a.	77.1	71.2	64.8	77.3
South Asia	**21.0**	**49.0**	**54.1**	**58.6**	**56.3**	**56.3**	**61.2**
Bangladesh	2.9	60.7	75.7	85.7	83.7	88.4	93.2
India	28.5	35.2	32.4	31.7	30.5	32.1	35.0
Pakistan[2]	35.0	28.8	31.5	35.2	35.3	31.2	38.1
Sri Lanka	17.6	71.4	76.7	81.8	75.6	73.5	78.5
Central and West Asia	n.a.	n.a.	**25.6**	**33.9**	**31.0**	**32.5**	**34.3**
Armenia[3]	n.a.	n.a.	28.0	24.5	9.7	15.7	34.3
Azerbaijan	n.a.	n.a.	29.1	50.5	47.1	25.0	18.9
Georgia	n.a.	n.a.	15.9	37.8	41.7	44.6	37.3
Kazakhstan	n.a.	n.a.	25.0	10.1	15.1	7.0	11.9
Kyrgyzstan	n.a.	n.a.	30.0	46.5	41.5	70.1	69.0
Developing Asia	46.7	61.4	52.5	61.6	59.1	54.9	65.0

Note: 1. n.a. denotes non-available data.
2. Due to the lack of observation in 1980/81 for Pakistan, we use observation in 1982 instead of 1980/81.
3. Due to the lack of observation in 1995/96 for Armenia, we use observation in 1997 instead of 1995/96.
Source: Author's computation using the UN Comtrade database.

Figure 1: Export diversification in developing Asia: the Herfindahl-Hirschman index[1]

Figure 1 (a): Total exports, primary and manufactured products

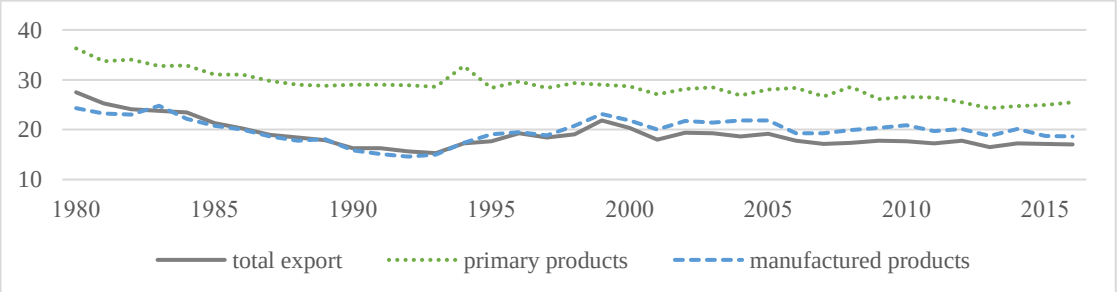
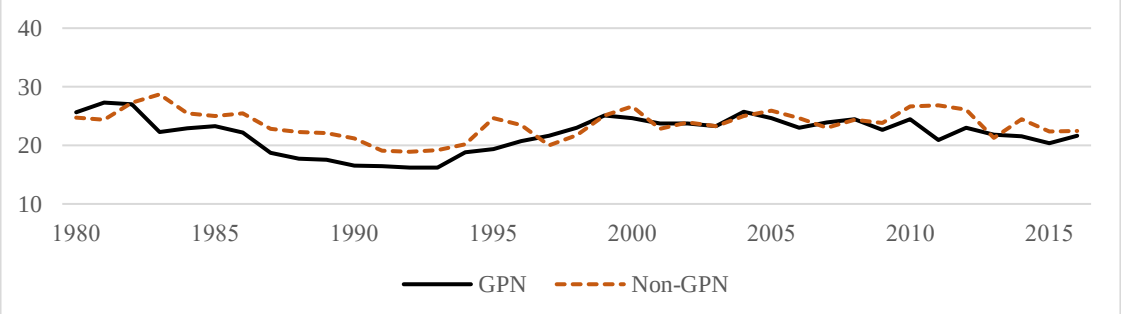


Figure 1 (b): GPN and non-GPN products



Note: [1] The values are simple average of the Herfindahl-Hirschman index (HHI).
Source: Author's computation using the UN Comtrade database.

Figure 2: Export diversification in developing Asia: the Theil index[1]

Figure 2 (a): Total exports, primary and manufactured products

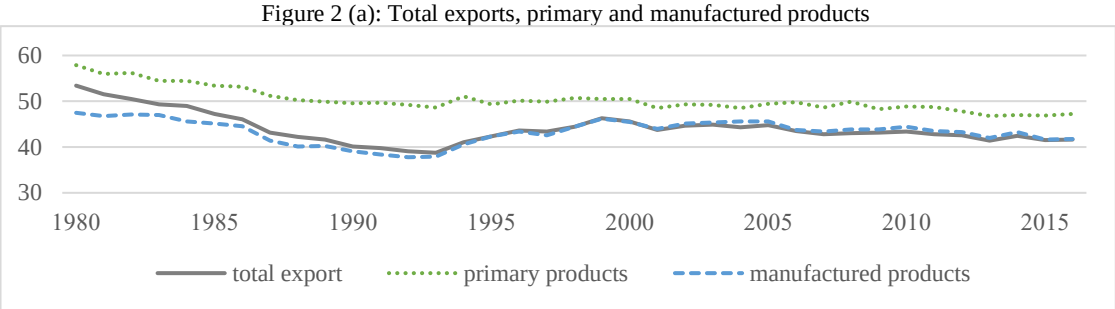
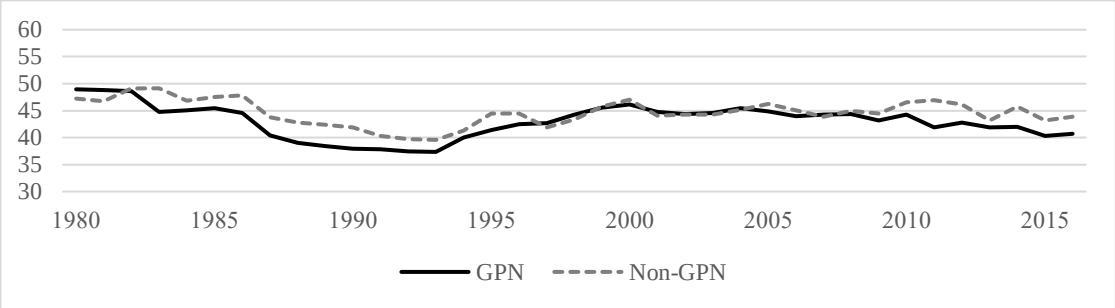


Figure 2 (b): GPN and non-GPN products



Note: [1] The values are simple average of the Theil index (THI).
Source: Author's computation using the UN Comtrade database.

Patterns of export diversification reflect some responses to external shocks. For example, after the Asian financial crisis of 1997-98, the degree of export diversification dropped significantly; the *HHI* for total non-oil exports increased from 18.9% in 1997 to 23.1% in 1999 (Figure 1).

The data in Table 4 reveal the level of export diversification is different among the four regions. On average, export diversification is highest in North Asia, followed by Southeast Asia, South Asia, and Central and West Asia. Moreover, the enormous changes in export diversification level for all four regions existed in 1980 to 2000. But since 2000, export diversification has not been changing for all subregions. For example, in total non-oil exports, the *HHI*'s South Asia was high at around 34.08% in 1980/81 and fell to 16.49% in 1995/96. However, after 2000, South Asia could not substantially diversify its export basket.

GPN exports are generally more concentrated at the country level than non-GPN exports for only the Asian countries with high engagement in global product sharing. China is also such a case (Table 4 (e)). Compared with other commodity groups, export diversification levels in China's GPN products are low (the higher value in the *HHI*). This characterizes the nature of GPN products which most countries have no freedom choice for diversifying their products.

In Southeast Asia, all countries tended to diversify their total non-oil exports between 2000 and 2017, except Vietnam and Indonesia. Total non-oil exports in Vietnam became less export diversification, as shown in Table 4 (a). The *HHI*'s Vietnam was 12.72% in 2000/01 and increased to 17.87% in 2016/17. However, the primary source of its lesser export diversification results from GPN exports, not non-GPN exports. The *HHI* of GPN exports rose from 17.55% in 2000/01 to 27.05% in 2016/17. Interestingly, Vietnam experienced rapid export expansion during the period 2000-17, even though its export composition has become relatively less diversified since 2010.

Table 4: Export diversification in developing Asia: the Herfindahl-Hirschman index

Table 4.a: Total non-oil exports[1]

	1980/81	1990/91	1995/96	2000/01	2005/06	2010/11	2016/17
North Asia	**7.66**	**7.44**	**8.10**	**9.23**	**11.70**	**10.70**	**10.56**
China	n.a.	7.76	4.37	5.30	7.90	8.07	7.59
Hong Kong	7.66	5.74	6.34	7.69	11.70	10.17	12.02
South Korea	7.66	8.82	13.60	14.69	15.50	13.85	12.08
Southeast Asia	**18.95**	**12.63**	**19.32**	**20.16**	**17.35**	**16.21**	**16.13**
Brunei	n.a.	n.a.	48.66	34.10	33.74	30.18	28.97
Cambodia	n.a.	n.a.	n.a.	30.03	32.89	32.57	21.94
Indonesia	25.25	17.06	11.57	7.40	9.27	13.00	11.75
Malaysia	20.81	12.25	13.53	16.83	13.63	11.64	8.11
Philippines	16.01	11.92	17.24	31.02	19.86	14.08	23.41
Singapore	9.93	12.13	15.90	17.94	10.57	8.58	7.50
Thailand	22.75	9.77	9.00	11.26	8.89	9.29	9.45
Vietnam	n.a.	n.a.	n.a.	12.72	9.97	10.32	17.87
South Asia	**34.08**	**19.52**	**17.00**	**17.04**	**16.72**	**18.19**	**16.49**
Bangladesh	42.76	21.81	20.11	21.90	24.86	28.99	27.59
India	23.11	15.31	14.69	15.43	12.76	14.22	11.58
Pakistan[2]	24.68	21.42	21.31	16.82	15.22	14.46	12.97
Sri Lanka	45.80	19.57	11.90	14.04	14.03	15.08	13.85
Central and West Asia	n.a.	n.a.	**22.52**	**23.53**	**24.07**	**23.02**	**22.12**
Armenia[3]	n.a.	n.a.	25.73	32.94	36.20	30.79	29.65
Azerbaijan	n.a.	n.a.	22.87	18.46	25.21	21.69	20.83
Georgia	n.a.	n.a.	16.61	18.75	19.69	27.61	22.65
Kazakhstan	n.a.	n.a.	31.61	26.92	24.32	22.78	22.18
Kyrgyzstan	n.a.	n.a.	15.81	20.58	14.95	12.25	15.31

Table 4.b: Primary products[1]

	1980/81	1990/91	1995/96	2000/01	2005/06	2010/11	2016/17
North Asia	**14.75**	**14.64**	**12.11**	**10.91**	**11.88**	**13.40**	**11.60**
China	n.a.	9.37	7.71	7.61	8.24	8.03	8.14
Hong Kong	14.30	21.29	14.77	11.54	13.46	18.48	13.57
South Korea	15.19	13.25	13.86	13.59	13.94	13.70	13.09
Southeast Asia	**26.65**	**20.32**	**24.17**	**22.23**	**27.15**	**27.28**	**24.39**
Brunei	n.a.	n.a.	31.49	25.38	42.78	40.91	32.84
Cambodia	n.a.	n.a.	n.a.	30.95	50.31	45.98	49.81
Indonesia	25.95	20.03	22.93	20.33	22.59	25.65	25.19
Malaysia	30.49	25.99	30.59	26.30	26.70	31.81	21.07
Philippines	23.53	20.88	22.54	19.65	22.70	20.72	17.44
Singapore	25.68	13.66	15.94	13.55	11.37	11.67	15.66
Thailand	27.58	21.04	21.52	18.12	16.74	18.04	14.46
Vietnam	n.a.	n.a.	n.a.	23.56	23.97	23.43	18.68
South Asia	**46.38**	**40.88**	**38.44**	**43.29**	**37.87**	**32.79**	**28.53**
Bangladesh	56.64	54.60	65.89	70.21	50.11	38.44	35.21
India	36.21	19.61	19.57	16.37	20.82	18.31	17.17
Pakistan[2]	**45.50**	45.58	41.95	43.49	47.82	39.78	30.89
Sri Lanka	47.18	43.73	26.35	43.09	32.75	34.64	30.85
Central and West Asia	n.a.	n.a.	**33.03**	**30.09**	**30.43**	**28.82**	**31.40**
Armenia[3]	n.a.	n.a.	31.24	32.45	37.93	40.96	39.97
Azerbaijan	n.a.	n.a.	49.48	26.70	28.37	28.78	27.00
Georgia	n.a.	n.a.	23.16	24.88	27.55	27.25	34.44
Kazakhstan	n.a.	n.a.	37.47	32.79	33.55	27.07	26.89
Kyrgyzstan	n.a.	n.a.	23.79	33.65	24.76	20.03	28.69

Table 4.c: Manufactured products[1]

	1980/81	1990/91	1995/96	2000/01	2005/06	2010/11	2016/17
North Asia	**8.04**	**8.12**	**8.48**	**9.54**	**12.04**	**11.14**	**10.98**
China	n.a.	9.45	4.80	5.64	8.22	8.35	7.83
Hong Kong	7.96	5.79	6.53	7.82	11.88	10.60	12.52
South Korea	8.11	9.13	14.10	15.15	16.01	14.48	12.59
Southeast Asia	**17.07**	**15.02**	**20.70**	**21.41**	**17.92**	**16.37**	**17.24**
Brunei	n.a.	n.a.	49.07	34.32	35.39	31.18	30.19
Cambodia	n.a.	n.a.	n.a.	31.05	33.53	34.09	23.21
Indonesia	24.68	24.29	13.35	7.49	6.61	6.69	8.29
Malaysia	18.75	13.59	15.12	18.48	15.12	11.09	8.36
Philippines	10.07	13.53	19.98	33.47	21.85	16.85	27.06
Singapore	8.88	13.53	16.99	18.61	11.07	9.06	7.94
Thailand	22.95	10.18	9.66	13.45	10.30	10.82	11.39
Vietnam	n.a.	n.a.	n.a.	14.42	9.51	11.14	21.49
South Asia	**37.39**	**20.76**	**19.29**	**18.32**	**18.20**	**19.70**	**17.95**
Bangladesh	57.79	23.82	21.03	22.95	26.64	30.77	28.46
India	19.36	19.67	18.59	18.63	15.27	17.44	13.74
Pakistan[2]	25.09	24.37	24.10	18.25	15.94	14.91	14.31
Sri Lanka	47.31	15.20	13.44	13.44	14.98	15.68	15.28
Central and West Asia	n.a.	n.a.	**27.09**	**28.52**	**32.69**	**33.82**	**27.24**
Armenia[3]	n.a.	n.a.	39.02	48.51	50.17	41.43	26.61
Azerbaijan	n.a.	n.a.	18.05	24.29	39.31	32.32	27.67
Georgia	n.a.	n.a.	23.69	25.12	27.02	41.64	28.84
Kazakhstan	n.a.	n.a.	35.29	25.94	28.74	38.91	36.63
Kyrgyzstan	n.a.	n.a.	19.39	18.75	18.22	14.82	16.48

Table 4.d: GPN products[1]

	1980/81	1990/91	1995/96	2000/01	2005/06	2010/11	2016/17
North Asia	**10.43**	**11.58**	**11.99**	**12.64**	**15.51**	**15.17**	**15.12**
China	n.a.	15.24	6.63	7.25	10.93	12.03	11.92
Hong Kong	9.87	7.12	8.48	9.58	14.14	12.32	14.54
South Korea	10.99	12.39	20.86	21.10	21.45	21.17	18.91
Southeast Asia	**23.86**	**14.75**	**19.49**	**24.52**	**21.02**	**16.95**	**19.21**
Brunei	n.a.	n.a.	32.42	39.82	41.51	20.77	22.48
Cambodia	n.a.	n.a.	n.a.	31.81	34.73	26.79	24.01
Indonesia	33.22	11.39	11.46	10.15	8.98	9.23	10.12
Malaysia	27.39	16.15	17.91	21.58	18.68	16.04	12.12
Philippines	11.12	16.47	22.70	35.00	22.82	18.72	30.08
Singapore	11.87	17.00	19.89	21.84	15.69	12.91	10.43
Thailand	35.70	12.73	12.55	18.40	14.28	17.01	17.37
Vietnam	n.a.	n.a.	n.a.	17.55	11.50	14.09	27.05
South Asia	**34.77**	**20.34**	**19.20**	**18.96**	**19.33**	**20.79**	**19.46**
Bangladesh	39.56	27.62	25.51	25.59	30.46	33.84	29.56
India	28.60	16.13	14.76	11.87	9.68	11.21	10.80
Pakistan[2]	20.29	20.21	21.23	23.40	19.77	19.87	19.81
Sri Lanka	50.64	17.40	15.30	14.97	17.43	18.24	17.67
Central and West Asia	n.a.	n.a.	**24.29**	**31.85**	**37.31**	**37.64**	**28.99**
Armenia[3]	n.a.	n.a.	17.66	19.68	33.17	25.96	19.93
Azerbaijan	n.a.	n.a.	20.13	40.49	65.50	50.68	37.20
Georgia	n.a.	n.a.	20.15	41.40	33.38	69.32	49.18
Kazakhstan	n.a.	n.a.	38.88	26.50	30.38	22.49	16.41
Kyrgyzstan	n.a.	n.a.	24.62	31.20	24.15	19.75	22.22

Table 4.e: Non-GPN products[1]

	1980/81	1990/91	1995/96	2000/01	2005/06	2010/11	2016/17
North Asia	**8.72**	**7.43**	**6.35**	**6.29**	**6.85**	**9.22**	**10.70**
China	n.a.	7.06	5.00	4.97	4.08	3.92	4.65
Hong Kong	8.15	6.62	5.88	7.14	9.46	16.54	20.14
South Korea	9.29	8.62	8.17	6.77	7.02	7.21	7.30
Southeast Asia	**20.74**	**17.69**	**25.37**	**24.99**	**26.54**	**29.07**	**20.76**
Brunei	n.a.	n.a.	86.94	55.61	59.05	63.93	49.86
Cambodia	n.a.	n.a.	n.a.	82.91	88.90	90.62	29.64
Indonesia	29.59	37.97	22.90	10.92	9.55	9.57	13.10
Malaysia	17.31	14.61	14.29	9.24	8.76	7.44	7.06
Philippines	19.43	14.44	11.72	10.65	14.65	25.47	35.58
Singapore	7.27	6.83	6.30	9.95	9.47	9.96	11.62
Thailand	30.09	14.60	10.06	7.95	8.57	9.62	9.51
Vietnam	n.a.	n.a.	n.a.	12.71	13.36	15.97	9.68
South Asia	**40.85**	**33.44**	**28.32**	**24.06**	**24.92**	**25.30**	**22.61**
Bangladesh	57.34	41.94	29.35	25.12	30.76	28.29	27.55
India	25.28	29.41	26.89	27.04	21.82	25.47	20.64
Pakistan[2]	35.80	34.29	34.12	25.39	22.41	19.90	19.88
Sri Lanka	44.99	28.12	22.94	18.69	24.71	27.55	22.37
Central and West Asia	n.a.	n.a.	**35.31**	**35.95**	**36.49**	**36.44**	**33.21**
Armenia[3]	n.a.	n.a.	54.18	64.08	55.45	48.85	39.53
Azerbaijan	n.a.	n.a.	24.28	26.94	27.37	29.00	32.57
Georgia	n.a.	n.a.	27.91	25.86	40.21	49.52	36.00
Kazakhstan	n.a.	n.a.	44.33	40.32	33.12	41.66	41.48
Kyrgyzstan	n.a.	n.a.	25.84	22.55	26.34	13.19	16.45

Note: [1] n.a. denotes non-available data.

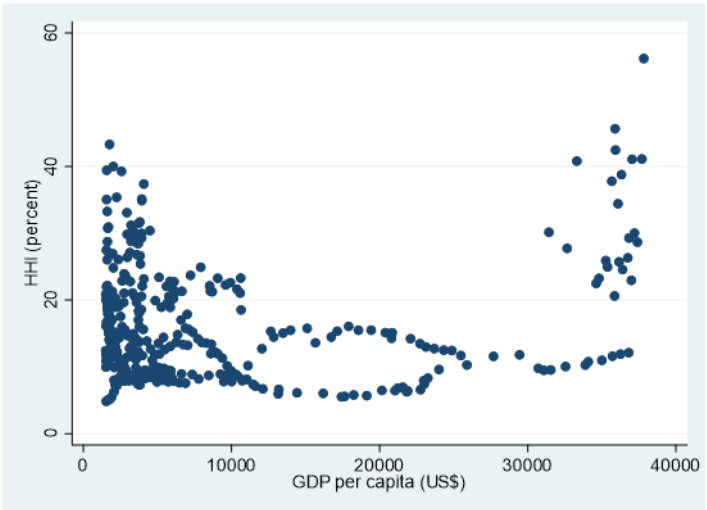
[2] Due to lack of observation in 1980/81 for Pakistan, we use observation in 1982 instead of 1980/81.

[3] Due to lack of observation in 1995/96 for Armenia, we use observation in 1997 instead of 1995/96.

Source: Author's computation using the UN Comtrade database.

The relationship between the level of economic development (a measure of per capita GDP) and export diversification measured using the *HHI* is depicted in Figure 3. The relationship is consistent with the hump-shaped relationship between the level of development and the degree of commodity diversification (the inverted U-shaped relationship based on the *HHI* (and the *THI*) uncovered by Cadot, Carrère, & Strauss-Kahn (2011).

Figure 3: Export diversification in total non-oil exports (measured by the *HHI*) and GDP per capita in developing Asian countries in the period 1976-2017



Source: The Herfindahl-Hirschman index (HHI) is estimated using data from the UN Comtrade database, and data on GDP per capita are from World Development Indicators, World Bank.

At the individual country level, we noticed that only two high-income countries (Hong Kong and South Korea) are currently at the right-hand side of the inverted U-shaped in Figure 3. Thus, when GDP per capita increases, their export diversifications tend to decrease. On the other hand, other developing Asian countries are in the stage of export diversification as GDP per capita rises.

3. Econometric analysis

3.1 Model specification

This section aims to estimate a 'reduced form' export equation with export diversification as an explanatory variable. The control variables are guided by previous studies on export performances determinants (Goldstein & Khan, 1985; Bayar, 2018). The export equation is specified as follow,

$$EXP_{it} = \beta_0 + \beta_1 DIVER_{it} + \beta_2 WD_{it} + \beta_3 GDPC_{it} + \beta_4 REER_{it} + \beta_5 FDI_{it} + \beta_6 TRADE_{it} + \beta_7 CRISIS_{it} + \varepsilon_{it} \quad (3)$$

where EXP is real exports (total non-oil exports and product subcategories), i = 1,2,…,N is the developing Asian countries, t = 1,2,…,T is the time unit in years. ε is the error term in the model. The explanatory variables are listed below with the expected sign of the regression coefficient in brackets:

DIVER	(- / +)	Export diversification alternatively measured by the *HHI* and the *THI* indices
WD	(+)	Real world demand measured as export-weighted GDP of trading partner countries (US$)
GDPC	(+)	Real per capita income of exporting country (US$)
REER	(-)	Real effective exchange rate
FDI	(+)	Real foreign direct investment (US$)
TRADE	(+)	Trade policy regime alternatively measured by openness index and trade liberalization index
CRISIS	(-)	Dummy variable for the global financial crisis taking value of 1 if year 2018-2019

WD is the real weighted income of export-destination countries. GDPC is real per capita income representing the economic development stage, with higher GDPC indicating the higher advanced stage of economic development. REER captures the combined price effect of relative prices and exchange rate (export competitiveness). An increase in REER implies a real appreciation of the domestic currency, which causes export more expensive in export markets. FDI is real foreign direct investment (net inflow), which influences the improvement in export supply capacity.

Trade policy regime (TRADE) is used by two indices: OPEN and LIB. OPEN is trade openness measured as percentage shares of foreign trade (exports + imports) in GDP. LIB is a trade liberalization index constructed by Sachs and Warner (1995) and updated by Wacziarg and Welch (2008) and Paudel (2014). LIB represents trade openness in terms of policy liberalization. Sachs and Warner (1995) state that a country is classified as having open trade policy if a country exhibits the following five characteristics: none of the average tariff rates of 40% or more on imports of intermediate and capital goods, none of the non-tariff barrier covering 40% or more of imports of intermediate and capital goods, none of black-market exchange rate premium of 20% or more, none of a socialist economic system, and none of a state monopoly on major export. We estimate the export model by using both indices for a robustness check. The last variable (CRISIS) represents the effect of the global financial crisis on exports in developing countries.

In this paper, we estimate the export equation as shown in equation (3) for total non-oil exports and product subcategories for capturing the impact of export diversification on export performance among product subcategories because of two reasons. First, the stylized facts in section 2 show that the pattern of export diversification level is determined by mixed patterns of export diversification in product

subcategories for some developing countries. For example, a decrease in export diversification for Vietnam's manufactured exports from 2000 to 2017 was from less export diversification in GPN exports and higher export diversification in non-GPN exports. Thus, we should investigate the effect of export diversification on export growth for product subcategories, not only total non-oil exports. Second, the estimated export equations for product subcategories can directly compare the impact of export diversification on export growth among product subcategories such as GPN exports and non-GPN exports.

3.2 Data

The model is estimated for total non-oil exports and four subcategories (primary products, manufactured products, GPN products and non-GPN products) using panel data for 20 developing Asian countries with a population of more than one million and covers the period from 1976 to 2017. The panel data are unbalanced because of limitations on data availability. Roughly, the sample coverage can be separated into three groups (Table 5). The first group (10 countries) covers the starting years in the late 1970s. The second group (2 countries) and the third group (8 countries) have the starting years in the 1980s and the 1990s, respectively. The sample covers countries at different economic development stages and includes natural-resource rich countries such as Indonesia, Vietnam, and Kazakhstan. This would give considerable variability, both over time in a given country and across countries, for econometric analysis on commodity diversification's impact on export growth.

Table 5: List of developing Asian countries

Time range	Number of countries	List of country
The late 1970s - 2017	10	Bangladesh, Hong Kong, India, Indonesia, South Korea, Malaysia, Philippines, Sri Lanka, Singapore, Thailand
The 1980s - 2017	2	China, Pakistan
The late 1990s - 2017	8	Armenia, Azerbaijan, Brunei, Cambodia, Georgia, Kazakhstan, Kyrgyzstan, Vietnam

Source: Author's compilation from the list of developing countries based on the UN country classification.

As already discussed in Section 2, data series for the dependent variable (total non-oil exports and product subcategories) and export diversification index (*HHI* and *THI*) are computed using data from the UN Comtrade database at SITC five-digit level. We use export price (unit value) indices from the UNCTAD database to construct real export series. However, export price indices are available at the SITC 3-digit level. Thus, real export series in this paper are deflated at SITC 3-digit level for all product subcategories.

Real world demand (WD) is measured by the weighted average of the real GDP of the 20 major export destination countries of each developing Asian country. WD varies by each country's export market structure. We compute WD by using real GDP at constant prices 2010 US$ from the World Bank database. GDPC is real GDP per capita at constant prices 2010 US$ extracting from the World Bank database. FDI is from the UNTAD database and is deflated by using GDP deflator for each country. REER and the openness index are from the French Research Center in International Economics (CEPII) and the World Bank database, respectively. Finally, LIB (policy liberalization index) is from Sachs and Warner (1995), Wacziarg and Welch (2008), and then Paudel (2014).

3.3 Estimation method

The traditional panel data estimation is not suitable for this study because of the long-time span (t) in the panel dataset (Baltagi, 2001). Specifically, it could encounter a spurious regression problem if the data series are non-stationary. It also fails to capture possible differences between the short-run and long-run export diversification impact on export growth. To avoid the above problems, we use the Autoregressive Distributed Lag (ARDL) estimator (Pesaran, 2015).

The ARDL estimator can be used for the data series which are either stationary at the level I(0) or stationary at the first difference I(1). The study uses the Fisher combination test of Im, Pesaran, and Shin (2003), which applies to an unbalanced panel dataset. This test method is also superior because it allows a heterogeneous panel dataset with serially uncorrelated errors, unlike the traditional stationarity test, which assumes a homogeneous panel dataset with serially uncorrelated errors. The stationarity test results suggest that all data series are non-stationary at the level, but their first differences are stationary (see Appendix B).

The export equation can be specified in ARDL with one period lag as following form,

$$\begin{aligned} EXP_{it} = {} & \alpha_1 DIVER_{it} + \alpha_2 WD_{it} + \alpha_3 GDPC_{it} + \alpha_4 REER_{it} + \alpha_5 FDI_{it} + \alpha_6 TRADE_{it} + \alpha_7 CRISIS_{it} \\ & + \alpha_1' DIVER_{it-1} + \alpha_2' WD_{it-1} + \alpha_3' GDPC_{it-1} + \alpha_4' REER_{it-1} + \alpha_5' FDI_{it-1} + \alpha_6' TRADE_{it-1} \\ & + \alpha_7' CRISIS_{it-1} + \gamma_i EXP_{it-1} + \delta_i + \varepsilon_{it} \end{aligned} \tag{4}$$

where δ_i is country specific effects, and ε_{it} is the error term. Given that X denotes all exogenous variables in the model, except EXP. The error-correction formulation of equation (4) is as follows:

$$\Delta EXP_{it} = \mu_i (EXP_{it-1} - \beta_i' X_{it-1}) + \lambda_i' \Delta X_{it-1} + \delta_i + \varepsilon_{it} \tag{5}$$

where $\Delta EXP_{it} = EXP_{it} - EXP_{it-1}$, $\mu_i = -(1-\gamma_i)$, and $\beta_i' = \dfrac{\alpha_i + \alpha_i'}{1-\gamma_i}$.

In equation (5), the short-run and long-run coefficients are represented as λ_i' and β_i', respectively. The study transforms all data series into the natural logarithm form, except only LIB and CRISIS because both variables are dummy variables. Thus, the coefficients can be explained as elasticity term. Besides, μ is the parameter of adjustment toward the long-run equilibrium. To ensure a long run co-integration relationship among the variables, μ must be negative and statistically significant.

One concern relating to the model specification as equation (5) is the possible endogeneity problem in export value between two periods. However, the "ARDL models have the advantage that they are robust to integration and co-integration properties of the regressors, and for sufficiently high lag-orders could be immune to the endogeneity problem, at least as far as the long-run properties of the model are concerned" (Pesaran, 2015: p.726). This paper uses the Akaike information criterion (AIC) as the criteria for choosing sufficiently high lags-order for ARDL estimation. Based on the AIC, the optimal lag-orders for the dependent variable (p) and independent variables (q) are two lags and one lag, respectively, for all cases except primary products and GPN products. The latter cases are preferred to the one lag in the dependent variable and independent variables.

The estimation allows heterogeneous characteristics in the panel dataset. We estimate the export equation using the three alternative ARDL estimations: the Pooled Mean Group estimator (PMGE), the Mean Group estimator (MGE), and the Dynamic Fixed Effects estimator (DFEE). These estimations have different assumptions on short-term and long-term coefficients. The PMG allows the short-term coefficients to differ

across groups, but the long-term coefficients are identical. However, the MG allows both the short-term and long-term coefficients to differ across groups. The DFEE imposes the constraints of identical coefficients in the short-term and long-term coefficients for across groups.

To choose the preferred estimation among three alternative estimations, we conduct the Hausman test. Regarding the Hausman test results in Appendix B, the dynamic fixed effect estimation (DFEE) is the most preferred estimator.

4. Results

The results based on the DFEE estimator with *HHI* as the measure of commodity diversification are reported in Table 6. The parameter of adjustment toward the long-run equilibrium μ is negative and statistically significant. Thus, there is a long-run cointegration relationship between the variables. The result of the alternative estimate of the model with the Theil index (*THI*) is used in place of *HHI* for comparison (see Appendix C). Since the two diversification indices are highly correlated, the estimations with both indices have similar sign coefficients for all explanatory variables[4].

Table 6: The estimation results based on the Herfindahl-Hirschman index (*HHI*)

Dependent var.	**Total non-oil**		**Primary**		**Manufacture**		**GPN**		**Non-GPN**	
(Real export)	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Long-run Coefficients										
HHI_{t-1}	0.241***	0.395***	0.473***	0.498***	0.391***	0.548***	0.414*	0.494**	0.282***	0.284***
	(0.002)	(0.000)	(0.079)	(0.084)	(0.003)	(0.058)	(0.241)	(0.244)	(0.016)	(0.025)
World $demand_{t-1}$	0.009	0.059	-0.255***	-0.235***	0.169*	0.199*	0.520***	0.494***	0.168***	0.103
	(0.086)	(0.137)	(0.017)	(0.007)	(0.099)	(0.114)	(0.027)	(0.046)	(0.038)	(0.128)
$GDPC_{t-1}$	1.245***	1.306***	1.280***	1.261***	1.125***	1.208***	0.900***	0.994***	1.632***	1.763***
	(0.137)	(0.203)	(0.203)	(0.202)	(0.125)	(0.191)	(0.158)	(0.105)	(0.199)	(0.287)
FDI_{t-1}	0.087*	0.107	0.078**	0.084***	0.087*	0.134	0.207***	0.255***	0.027	0.037
	(0.051)	(0.095)	(0.038)	(0.031)	(0.049)	(0.092)	(0.057)	(0.020)	(0.113)	(0.121)
$REER_{t-1}$	-0.481***	-0.864***	-0.417***	-0.564***	-0.360**	-0.894***	-0.884***	-1.076***	-1.198***	-1.331***
	(0.136)	(0.192)	(0.063)	(0.064)	(0.155)	(0.065)	(0.153)	(0.093)	(0.157)	(0.026)
$OPENNESS_{t-1}$	0.615***		0.139***		0.883***		0.687***		0.487**	
	(0.109)		(0.042)		(0.084)		(0.117)		(0.217)	
LIBER		0.264		0.031*		0.236		0.063		0.209
		(0.422)		(0.017)		(0.458)		(0.161)		(0.219)
CRISIS	-0.337***	-0.532***	-0.139***	-0.253***	-0.315***	-0.550***	-0.515***	-0.484***	-0.191***	-0.166
	(0.059)	(0.197)	(0.017)	(0.004)	(0.074)	(0.096)	(0.131)	(0.036)	(0.050)	(0.110)
Adjustment coefficient	-0.155***	-0.157***	-0.311***	-0.314***	-0.150***	-0.152***	-0.235***	-0.228***	-0.263***	-0.258***
	(0.042)	(0.026)	(0.011)	(0.010)	(0.018)	(0.006)	(0.015)	(0.018)	(0.069)	(0.065)
Short-run Coefficients										
ΔHHI	0.204	0.186	-0.084	-0.098	0.109	0.092	0.028	0.023	0.236	0.245
	(0.246)	(0.244)	(0.059)	(0.061)	(0.174)	(0.180)	(0.173)	(0.162)	(0.265)	(0.272)
ΔWorld demand	0.033	0.006	0.091***	0.083***	0.040	0.008	0.089***	0.082***	-0.070	-0.076
	(0.101)	(0.107)	(0.026)	(0.029)	(0.119)	(0.130)	(0.001)	(0.010)	(0.045)	(0.065)
ΔGDPC	0.935***	0.990***	0.376***	0.386***	1.387***	1.463***	1.805***	1.882***	1.023***	1.046***
	(0.035)	(0.011)	(0.064)	(0.037)	(0.001)	(0.022)	(0.011)	(0.001)	(0.217)	(0.227)
ΔFDI	-0.006	-0.000	0.011**	0.017***	-0.004	0.001	0.051***	0.046***	0.018***	0.016
	(0.009)	(0.001)	(0.005)	(0.004)	(0.013)	(0.004)	(0.017)	(0.008)	(0.006)	(0.011)
ΔREER	-0.184	-0.292***	0.007	-0.008	-0.250**	-0.358***	-0.006	0.001	-0.198	-0.164**
	(0.136)	(0.057)	(0.008)	(0.009)	(0.118)	(0.017)	(0.008)	(0.002)	(0.137)	(0.069)
ΔOPENNESS	0.400**		0.419***		0.449*		-0.178		-0.132	
	(0.176)		(0.027)		(0.233)		(0.295)		(0.228)	
ΔLIBER		-0.024		-0.170***		-0.034		-0.047***		0.095
		(0.061)		(0.009)		(0.049)		(0.018)		(0.070)
ΔCRISIS	-0.037	-0.017	-0.030***	-0.010	-0.032	-0.008	0.034	0.036**	-0.022	-0.019
	(0.038)	(0.040)	(0.003)	(0.006)	(0.032)	(0.037)	(0.030)	(0.015)	(0.035)	(0.046)
ΔEXP at t-1	0.045	0.063			0.048***	0.064***			0.058	0.061
	(0.063)	(0.050)			(0.012)	(0.007)			(0.083)	(0.078)
Constant	-0.156	0.342	0.925*	1.294***	-0.655***	0.098***	-1.441***	-0.653***	-0.985***	-0.339**
	(0.313)	(0.217)	(0.476)	(0.377)	(0.163)	(0.015)	(0.241)	(0.231)	(0.226)	(0.152)
Observations	621	621	621	621	621	621	621	621	621	621

Note: ***, **, * respectively denotes 1%, 5%, and 10% level of significance. The standard errors are reported in parentheses.
Source: Author's estimation.

[4] The coefficients of export diversification index are positive and statistically significant for all models using the *HHI* and the *THI*, except only the GPN model using the *THI*. However, the coefficients of the *HHI* model are lower than that of the *THI*. Also, there is no highly volatile measurement in export diversification when we use the *HHI*. Thus, the *HHI* model has reliable estimations and can be used as a baseline index.

In Table 6, the adjustment coefficients are statistically significant in all equations with the expected negative sign. This indicates that the model can capture the long-term effect of the explanatory variables on export growth. The adjustment coefficient varies in the range of -0.15 to -0.35, suggesting that the speed of adjustment varies significantly among the product categories. For example, there are vast differences in speed of adjustment towards equilibrium between primary products and manufactured products. The adjustment coefficient of primary products (-0.31) is around twice as much as the manufactured products' coefficient (-0.15). Primary products have a much slower speed of adjustment towards the long-run equilibrium compared to manufactured products. Within manufacturing, non-GPN products have a higher adjustment coefficient than GPN products. This suggests that GPN products would respond better to any economic shock rather than non-GPN products. In the following discussion, we specifically focus on the long-run regression coefficients based on the adjustment coefficients.

The coefficient of the *HHI*, the key variable of interest, is positive and statistically significant at the 1% level or better in all equations for the long-term effect. In contrast, the short-term coefficient of the *HHI* is not statistically different from zero in all cases. As expected, the relationship between commodity diversification and export performance is effectually a long-term phenomenon.

Therefore, after controlling other variables, more export diversification is associated with negative export growth for only the long-term effect. This result may be surprising for some international trade economists. However, the result is consistent with the evidence of India. India experienced a big improvement in export diversification from 1980 to 2000, however, its export share in world market was constant at 0.6% of world exports for the two decades. Moreover, the coefficients of export diversification are different among product subcategories. For example, GPN products have a higher coefficient of the *HHI* compared to non-GPN products. In Table 6, the *HHI* coefficients are 0.414 and 0.282 for GPN products (column 7) and non-GPN products (column 9), respectively. Thus, a decrease in commodity diversification by 1% would increase export growth by 0.414% for GPN products and 0.282% for non-GPN products.

To comment on the control variables' results, the dummy variable for the global financial crisis (CRISIS) has a negative long-term effect on export growth as expected. The trade openness coefficient measured by the trade to GDP ratio is statically significant with the expected positive sign in all equations. However, the Sachs-Werner index's coefficient, which is used as an alternative measure of trade openness, is not statistically significant in all regressions even though it carries the positive sign as expected. This is presumably because a binary variable does not have sufficient variation over time.

The impact of world demand on export growth is positive for all product subcategories except primary products. In other words, an increase in world demand results in export growth in the long run. However, Table 6 shows that the coefficients of world demand are distinct among product subcategories. Comparing GPN products and non-GPN products, the coefficients of world demand are 0.520 (column 7) and 0.168 (column 9), respectively. As a result, GPN products would respond more to an increase in world demand than non-GPN products. This result confirms the importance of GPN products in export success in developing Asian countries.

The REER coefficient is negative and statistically significant in the long run for total non-oil exports and all product subcategories. As expected, real exchange rate appreciation leads to lower export performance. Interestingly, the degree of long-run responsiveness of GPN products (-0.884) is much smaller compared to that of non-GPN products (-1.198). This difference is consistent with the postulate that exports based on

global production sharing are relatively less responsive to relative price changes (as the overall production structure is dispersed among many countries) compared to export based on the traditional form of horizontal specialization (Athukorala & Khan, 2016).

On the supply side, GDP per capita is a vital factor determining export performance in developing Asian countries. The coefficient of GDPC is significant at the 1% level, and it is the largest coefficient compared to that of other explainable variables. The long-term coefficients range between 0.7 and 1.7, while the short-term coefficients range between 1.0 and 2.9. Notably, the coefficients of GDPC are statistically significant for all cases. Thus, the stage of economic development is essential for improving export performance.

Also, the FDI coefficient is positive and statistically significant at the 1% level in the short-run and the long-run for only GPN products. Unsurprisingly, most FDI inflow in Asia is relevant to global production sharing. An increase in FDI inflow is associated with higher export growth for GPN products. Thus, FDI inflow is one important channel to boost export performance for the short-run and the long-run.

Lastly, the results suggest that GDP per capita, which captures the country's state of development, is much more important than world demand in explaining export performance. This result is consistent with the standard small-country assumption relating to export performance (Athukorala & Riedel, 1996). Thus, the role of supply capability is vital for export expansion. Interestingly, alternative estimates suggest that the results are remarkably resilient to the exclusion of the world demand variable from the model (see Appendix C, Table C.1).

5. Conclusion

This paper has examined the relationship between export product diversification and export performance in developing Asian countries. The analysis covered total non-oil exports distinguishing between primary products and manufactured products, with the latter further disaggregated into exports within global production networks (GPN products) and non-GPN products.

The key finding is that export diversification has a negative impact on export performance for total exports and all product subcategories in developing Asian countries. This result is consistent with some previous studies. For example, Piñeres and Ferrantino (1997) provided evidence of a negative association between export growth and export diversification in Chile. Also, export diversification in new products did not contribute much to export growth in developing countries (Newfarmer et al., 2009). Thus, the result in this paper supports the prediction of the standard trade theory, which postulates that a country gains from international trade by specialization based on its own comparative advantage.

This paper does not suggest that developing countries should not diversify their exports. However, developing countries should realize that export diversification does not guarantee higher export growth. One reason is that high export performance can occur when a country can diversify its exports toward new potential products in the world market. The second reason is that a country should diversify its exports based on its comparative advantage in each stage of economic development.

In conclusion, our estimation results suggest that government should facilitate and improve the attractiveness of foreign direct investment for improving export supply capacity and promoting potential exported products with corresponding a country’s comparative advantage. In particular, GPN products should be targeted for developing countries because GPN exports can highly grow with world demand compared to other product subcategories.

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Appendix A

Table A.1: Export diversification pattern by the Theil index[1]

Total non-oil export	1980/81	1990/91	1995/96	2000/01	2005/06	2010/11	2016/17
North Asia	**29.15**	**26.97**	**26.34**	**28.30**	**32.11**	**30.48**	**29.96**
China	n.a.	26.48	20.43	21.85	24.97	23.65	22.67
Hong Kong	28.06	24.24	25.28	27.80	33.28	32.06	34.66
South Korea	30.23	30.19	33.32	35.25	38.08	35.73	32.54
Southeast Asia	**46.98**	**35.78**	**42.22**	**44.88**	**42.19**	**40.14**	**38.69**
Brunei	n.a.	n.a.	70.87	61.83	60.34	53.55	52.00
Cambodia	n.a.	n.a.	n.a.	62.22	65.13	63.00	53.88
Indonesia	57.46	38.60	34.00	28.90	30.70	34.95	32.90
Malaysia	51.60	37.65	38.10	40.11	37.30	32.75	28.60
Philippines	44.36	37.65	42.51	53.97	48.75	43.14	45.84
Singapore	28.74	31.09	36.57	40.46	30.23	29.38	28.98
Thailand	52.72	33.93	31.24	31.53	30.18	30.28	29.69
Vietnam	n.a.	n.a.	n.a.	40.03	34.86	34.06	37.61
South Asia	**64.08**	**48.68**	**45.52**	**45.01**	**43.48**	**44.56**	**42.89**
Bangladesh	75.90	58.24	55.16	55.87	55.91	58.62	58.06
India	53.82	36.36	34.14	32.38	30.23	32.10	28.97
Pakistan[2]	51.32	51.64	51.03	47.85	44.11	42.18	41.52
Sri Lanka	75.30	48.48	41.75	43.94	43.67	45.35	43.02
Central and West Asia	n.a.	n.a.	**50.77**	**51.96**	**53.69**	**53.50**	**51.22**
Armenia[3]	n.a.	n.a.	52.05	57.58	64.08	61.45	57.84
Azerbaijan	n.a.	n.a.	48.36	49.02	55.00	53.93	52.65
Georgia	n.a.	n.a.	47.18	50.28	52.10	57.14	52.15
Kazakhstan	n.a.	n.a.	60.06	55.84	53.82	54.30	50.46
Kyrgyzstan	n.a.	n.a.	46.20	47.06	43.44	40.69	43.01

Note: [1] n.a. denotes non-available data.
[2] Due to lack of observation in 1980/81 for Pakistan, we use observation in 1982 instead of 1980/81.
[3] Due to lack of observation in 1995/96 for Armenia, we use observation in 1997 instead of 1995/96.
Source: Author's computation using the UN Comtrade database.

Appendix B

Table B.1: Results of the unit root test

Variable	Level I(0)		First Difference I(1)	
	W-t-bar	p-value	W-t-bar	p-value
Real Export				
Total non-oil merchandise	3.2043	0.9993	-7.0074	0.0000
Total non-oil primary	-1.0556	0.1456	-6.8276	0.0000
Total manufacture	3.1862	0.9993	-6.1229	0.0000
GPN (Global Production Network)	1.6147	0.9468	-5.0500	0.0000
Non-GPN (Non-Global Production Network)	1.7280	0.9580	-6.9212	0.0000
HHI				
Total non-oil merchandise	-0.7963	0.2129	-6.5698	0.0000
Total non-oil primary	-2.0240	0.0215	-8.2894	0.0000
Total manufacture	-0.5008	0.3082	-7.6920	0.0000
GPN (Global Production Network)	-0.7706	0.2205	-7.6358	0.0000
Non-GPN (Non-Global Production Network)	0.0129	0.5051	-7.7406	0.0000
Theil Index				
Total non-oil merchandise	0.1509	0.5600	-6.5127	0.0000
Total non-oil primary	-1.5810	0.0569	-8.2565	0.0000
Total manufacture	0.6403	0.7390	-6.6045	0.0000
GPN (Global Production Network)	-1.3903	0.0822	-7.2479	0.0000
Non-GPN (Non-Global Production Network)	0.1110	0.5442	-7.8281	0.0000
World demand	-6.8245	0.0000	-10.2172	0.0000
GDP per capita	3.5049	0.9998	-4.5110	0.0000
FDI	-1.9681	0.0245	-8.3495	0.0000
REER (Real Effective Exchange Rate)	0.4385	0.6695	-4.7517	0.0000
Openness Index	1.8672	0.9691	-4.1507	0.0000
LIBER Index	1.9058	0.9717	-3.8781	0.0001
CRISIS	-5.4239	0.0000	-13.2856	0.0000

Note: All variables are transformed into natural logarithm form, except LIBER Index and CRISIS.
Source: Author's estimation

Table B.2: Results of the Hausman test

P-value (Chi2)	(1)		(2)		(3)		(4)		(5)	
	HHI	Theil	HHI	Theil	HHI	Theil	HHI	Theil	HHI	Theil
PMG versus DFE	1.000	1.000	1.000	1.000	0.981	0.992	0.765	0.865	0.999	0.999
MG versus DFE	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	HHI	Theil	HHI	Theil	HHI	Theil	HHI	Theil	HHI	Theil
PMG versus DFE	1.000	1.000	1.000	1.000	0.981	0.992	0.765	0.865	0.999	0.999
MG versus DFE	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Note: Column (1) – (5) represent product categorizes as following total non-oil export, primary, manufacturing, GPN, and non-GPN, respectively.
Source: Author's estimation.

Appendix C

Table C.1: The alternative estimation results excluding world demand

Dependent var	**Total non-oil**	**Primary**	**Manufacture**	**GPN**	**Non-GPN**
(Real export)	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Long-run Coefficients					
HHI_{t-1}	0.241***	0.549***	0.392***	0.430*	0.292***
	(0.015)	(0.081)	(0.005)	(0.240)	(0.006)
$GDPC_{t-1}$	1.246***	1.203***	1.164***	1.044***	1.686***
	(0.117)	(0.195)	(0.110)	(0.201)	(0.187)
FDI_{t-1}	0.085*	0.061*	0.092**	0.233***	0.038
	(0.047)	(0.035)	(0.046)	(0.065)	(0.114)
$REER_{t-1}$	-0.502***	-0.377***	-0.416	-1.057***	-1.231***
	(0.064)	(0.075)	(0.264)	(0.156)	(0.221)
$OPENNESS_{t-1}$	0.611***	0.127***	0.885***	0.680***	0.499**
	(0.107)	(0.043)	(0.080)	(0.127)	(0.224)
CRISIS	-0.340***	-0.135***	-0.331***	-0.573***	-0.197***
	(0.045)	(0.015)	(0.094)	(0.145)	(0.047)
Adjustment coefficient	-0.155***	-0.309***	-0.146***	-0.222***	-0.258***
	(0.041)	(0.011)	(0.015)	(0.016)	(0.067)
Short-run Coefficients					
ΔHHI	0.204	-0.102*	0.112	0.032	0.238
	(0.250)	(0.060)	(0.173)	(0.172)	(0.263)
ΔGDPC	0.935***	0.421***	1.373***	1.754***	1.001***
	(0.043)	(0.067)	(0.008)	(0.009)	(0.212)
ΔFDI	-0.005	0.011**	-0.003	0.053***	0.018***
	(0.010)	(0.005)	(0.014)	(0.017)	(0.005)
ΔREER	-0.186	0.008	-0.247**	-0.011	-0.182
	(0.139)	(0.008)	(0.119)	(0.008)	(0.132)
ΔOPENNESS	0.398**	0.410***	0.454*	-0.168	-0.117
	(0.180)	(0.023)	(0.239)	(0.304)	(0.235)
ΔCRISIS	-0.037	-0.031***	-0.033	0.032	-0.022
	(0.039)	(0.003)	(0.034)	(0.029)	(0.035)
ΔEXP at t-1	0.047		0.049***		0.055
	(0.067)		(0.018)		(0.082)
Constant	-0.115	-0.026	-0.282	0.258	-0.424
	(0.072)	(0.400)	(0.174)	(0.317)	(0.577)
Observations	621	621	621	621	621

Note: To test sensitivity results, world demand is excluded in the model. The model shows only trade policy regime through trade openness (OPENNESS) because this trade policy variable is statistically significant in all equations. In contrast, policy liberalization index (LIB) is not statistically significant in most cases.
***, **, * respectively denotes 1%, 5%, and 10% level of significance. The standard errors are reported in parentheses.
Source: Author's estimation.

Table C.2 The estimation results based on the Theil index[1]

Dependent var.	**Total non-oil**		**Primary**		**Manufacture**		**GPNs**		**Non-GPNs**	
(Real export)	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Long-run Coefficients										
Theil index $_{t-1}$	0.508**	0.829***	0.758***	0.907***	1.114***	1.457***	0.503	0.664	0.585***	0.580***
	(0.206)	(0.161)	(0.165)	(0.163)	(0.261)	(0.335)	(0.395)	(0.406)	(0.108)	(0.099)
World demand $_{t-1}$	0.044	0.063	-0.265***	-0.246***	0.178***	0.171***	0.505***	0.484***	0.197***	0.129
	(0.049)	(0.079)	(0.015)	(0.004)	(0.040)	(0.037)	(0.049)	(0.063)	(0.035)	(0.126)
GDPC $_{t-1}$	1.251***	1.347***	1.299***	1.298***	1.154***	1.276***	0.920***	1.011***	1.622***	1.757***
	(0.087)	(0.136)	(0.204)	(0.205)	(0.027)	(0.075)	(0.057)	(0.005)	(0.219)	(0.307)
FDI $_{t-1}$	0.091*	0.111	0.075*	0.078**	0.095*	0.140*	0.207***	0.268***	0.031	0.041
	(0.053)	(0.082)	(0.040)	(0.033)	(0.049)	(0.071)	(0.041)	(0.015)	(0.118)	(0.121)
REER$_{t-1}$	-0.499***	-0.937***	-0.476***	-0.643***	-0.453	-1.022***	-0.869***	-1.106***	-1.179***	-1.308***
	(0.108)	(0.214)	(0.043)	(0.043)	(0.289)	(0.145)	(0.186)	(0.121)	(0.114)	(0.027)
OPENNESS $_{t-1}$	0.646***		0.148***		0.904***		0.767***		0.499*	
	(0.028)		(0.044)		(0.052)		(0.027)		(0.270)	
LIBER		0.288		0.074***		0.284		0.007		0.218
		(0.342)		(0.015)		(0.362)		(0.112)		(0.204)
CRISIS	-0.338***	-0.542**	-0.146***	-0.262***	-0.307***	-0.545***	-0.520***	-0.500***	-0.175**	-0.141
	(0.073)	(0.232)	(0.015)	(0.008)	(0.051)	(0.125)	(0.086)	(0.002)	(0.068)	(0.129)
Adjustment coefficient	-0.157***	-0.156***	-0.309***	-0.313***	-0.151***	-0.152***	-0.233***	-0.224***	-0.267***	-0.261***
	(0.055)	(0.041)	(0.014)	(0.013)	(0.026)	(0.016)	(0.008)	(0.009)	(0.081)	(0.076)
Short-run Coefficients										
ΔTheil index	0.148	0.119	-0.159	-0.209	-0.030	-0.047	-0.422	-0.427	0.273	0.296
	(0.821)	(0.818)	(0.227)	(0.239)	(0.717)	(0.722)	(0.449)	(0.418)	(0.711)	(0.711)
ΔWorld demand	0.032	0.00754	0.083***	0.077***	0.034	0.003	0.095***	0.085***	-0.078*	-0.080
	(0.100)	(0.109)	(0.027)	(0.029)	(0.108)	(0.120)	(0.000)	(0.011)	(0.041)	(0.063)
ΔGDPC	0.926***	0.978***	0.366***	0.372***	1.400***	1.463***	1.840***	1.937***	1.106***	1.127***
	(0.016)	(0.0442)	(0.066)	(0.042)	(0.059)	(0.062)	(0.022)	(0.006)	(0.104)	(0.127)
ΔFDI	-0.008	-0.00190***	0.012**	0.019***	-0.006	-0.001	0.051***	0.045***	0.015	0.012
	(0.006)	(0.000198)	(0.006)	(0.004)	(0.011)	(0.004)	(0.013)	(0.006)	(0.009)	(0.014)
ΔREER	-0.184	-0.288***	0.010	-0.004	-0.247**	-0.352***	0.000	0.008***	-0.208	-0.162
	(0.153)	(0.0744)	(0.007)	(0.008)	(0.116)	(0.023)	(0.006)	(0.002)	(0.188)	(0.111)
ΔOPENNESS	0.391**		0.411***		0.435**		-0.155		-0.170	
	(0.175)		(0.024)		(0.219)		(0.253)		(0.256)	
ΔLIBER	-0.034	-0.040		-0.186***		-0.047		-0.054***		0.069
	(0.032)	(0.038)		(0.011)		(0.040)		(0.008)		(0.051)
ΔCRISIS	0.041	-0.014	-0.029***	-0.008	-0.033	-0.008	0.030	0.034**	-0.032	-0.030
	(0.086)	(0.034)	(0.003)	(0.007)	(0.028)	(0.033)	(0.030)	(0.017)	(0.047)	(0.060)
ΔEXP at t-1	0.148	0.059			0.048***	0.065***			0.060	0.062
	(0.821)	(0.075)			(0.017)	(0.014)			(0.086)	(0.081)
Constant	-0.259	0.326**	0.971**	1.359***	-0.628***	0.205	-1.564***	-0.671***	-1.131***	-0.463**
	(0.246)	(0.128)	(0.485)	(0.375)	(0.039)	(0.132)	(0.055)	(0.082)	(0.180)	(0.233)
Observations	621	621	621	621	621	621	621	621	621	621

Note: ***, **, * respectively denotes 1%, 5%, and 10% level of significance. The standard errors are reported in parentheses.
Source: Author's estimation.