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Competitive Advantage of Cambodian Industries

Analysis of Trade Specialization Patterns

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This article aims to understand Cambodia's long-term trade specialization patterns at the country and industry levels. To achieve this, trade specialization indices are constructed for a sample of 253 industries. The findings show that Cambodia has an incipient national innovation system to support the organizational and technological capabilities of domestic firms. It has four growing high-tech, sixteen emerging high-tech, and eleven marginal high-tech industries. The country is also home to eleven growing low-tech, twelve emerging low-tech, and seventy-one marginal industries. Cambodian industries reveal stickiness and incremental change, which means that the initial trade specialization values move slowly towards the average within sectors. We also notice a decrease in the dispersion of trade specialization, which is indicative of slow mobility across sectors towards the broad pattern of specialization. This finding suggests that Cambodia lacks Schumpeterian entrepreneurs, who have the organizational and technological capabilities to learn and adapt new knowledge and technologies into the local context before diffusing them into the broader economy to build national competitiveness.

Keywords: national innovation system, net trade specialization, structural transformation, competitive advantage, Cambodia

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1. Introduction

Trade specialization patterns are important analytical tools that can be used by a government to set priority industries and initiate key industrial policies to target them. Cambodia has the vision to transform and modernize its labour-intensive industries to become more skill-based by 2025 (RGC 2015). Policymakers claim that this long-term goal can be achieved by improving the productivity of local industries and linking them to regional and global value chains to strengthen their competitiveness.

Cambodia accelerated the structural transformation of its economy from 2016 onwards. Agriculture's contribution to the national GDP declined to 26.3 per cent in 2016 from 31.6 per cent in 2013, whereas the GDP contribution of industries went up to 31.3 per cent in 2016 from only 24.1 per cent in 2013. The service sector stayed nearly the same at 42.4 per cent throughout this period. In the industrial sector, the emerging manufacturing sector grew substantially, making up to 16 per cent of GDP by 2016 (World Bank 2017). However, to achieve its 2025 goals, Cambodia needs to further structural transformation and promote trade specialization in new industries.

A few studies have been conducted to understand the patterns of trade specialization in Cambodia. JICA (2007) analysed this in five sectors using their revealed comparative advantage. However, the study focused on only priority sectors, which did not represent the bigger picture of the Cambodian innovation system. Vixathep (2013) made use of the index of revealed comparative advantage to understand the country's structure of international trade and the patterns of trade specialization from 1985 to 2010. But there is very limited literature devoted to the analysis of the pattern of trade specialization at the national and industry levels. Our study aims to fill this gap.

The rest of the paper is structured as follows. The next section focuses on the theoretical framework and empirical evidence. Data and research methodology form the central themes of the third section. Results are explained in the subsequent section, and the fifth section concludes.

2. Theoretical Framework and Empirical Evidence

The National Innovation System (NIS) is a widely recognized tool that helps to explain how developing economies can catch up with their developed counterparts. The concept of NIS was used explicitly for the first time by Freeman (1982 and 2004). His study has contributed to the modern notion of NIS that highlights the effect of national technological infrastructure on trade specialization, national competitiveness, and catching up. Freeman (1987) used novel organization and innovation theories to explain Japanese NIS in particular. Japanese innovation systems have focused on the interaction among various elements—including internal organization of firms, inter-firm relationships, public sectors, national education system, and R&D system—to build national competitiveness in new techno-economic paradigms.

2.1 Development and Stability of Trade Specialization

Stability is a key metric that needs to be studied at the firm and industry levels. Anderson (2010) recognized the importance of the concept of learning by doing and applied it to explain the evolution of the industrial structure. In a given industry, many firms produce differentiated goods with similar characteristics. These firms apply the existing production routines to generate total productivity growth. In this sense, firms begin a new search only when their profitability falls below a certain threshold. This fall in profitability generally results from their problems with production processes and products. Such specific problems encourage them to start a new search for "favourable responses". In this innovation process, firms rationally embark on a "localized" search with a high success rate. Utilizing this, the firms mostly perform permanent and surface-level search and learning, leading to only small productivity gains and no significant jump in production performance.

Unger (1988) provides empirical evidence explaining the lack of new routines among companies that prevent developing countries from gaining higher productivity growth. He states that least developed countries (LDC) previously implemented import substitution industrialization strategies in the final consumer industries, creating oligopolistic markets that relied on imported technology, thereby creating few incentives for local entrepreneurial risk-taking. However, when they put in place new industrial policies, such as export promotion or technological leapfrogging strategies, they were rarely successful during the early years. This may be because the countries lack the necessary Schumpeterian entrepreneurs to develop the local supply industries to support the final consumer industries.

But, with entirely new productive routines, firms can raise their competitiveness, profitability, production capability, and market share. In their evolutionary path, firms need to both learn from the available global knowledge and rely on localized learnings, innovation and knowledge diffusion. We define "localized" as an activity that is country- or industry-specific. So, localized search represents particular characteristics of the national pattern of specialization.

Trade specialization strategy can be defined as an industrial structure transformation process. When two industries are included in the analysis, one industry may reveal a higher productivity increase than the other, even though both experience the same growth rate. This sectoral difference in productivity increase is usually derived from the different distribution of world income between them. Anderson (2010) theorized a development block concept to show the connection of the historically recorded innovations between inter-related sectors and the expectations of the entrepreneurs about the income potential of the innovative products.

Fagerberg (2003) introduced the Mark-Schumpeter model of technological competition, which is similar to the development block concept, to explain the regularities of the innovation-diffusion process. In the model, innovation-diffusion is seen as a creative process. A firm that launches an innovative product may induce other firms in the same sector to imitate the core of innovation in producing their differentiated products. As a result, the industry grows significantly for a while. The imitators, however, can become successful only if they improve the original innovation and become innovators themselves. Over time, the sector slows down once the effect of innovation on growth decreases. In most sectors, regularity is observed when original innovations induce the imitators to create innovations in similar or related sectors due to the interdependencies between the original and induced innovations.

The convergence pattern of trade specialization becomes noticeable when developing countries decide to invest in mature industries because these industries are standardized by multinational companies (MNCs), which relocate them to emerging economies to reduce production costs. Vernon (1966) developed a product-life-cycle theory to explain how new technologies are diffused from developed to developing countries. The process is composed of four stages: introduction, growth, maturity, and declining phases. The profit incentives of the original innovation incentivize many firms to produce several products related to the original innovation at the early stage. When the induced innovations significantly increase during the growth and maturity periods, they become standardized. This standardization may be accompanied by process innovation, economies of scale, and cost competition, thus promoting technology transfer from innovator countries to developing states through foreign direct investments.

However, sometimes the industrial structure is not developed at the product level but at the sectoral level, which follows specific technology trajectories. Thus, a technology-life-cycle rather than the product-life-cycle concept should be applied to analyse the particular technology trajectories in order to understand the window of opportunities for catching up. There are four stages in the technology life cycle: introduction, early growth, late growth, and maturity (Perez and Soete 1988). When firms enter a new technological system at the introduction stage, they require a low level of investment capital and limited experience, management and marketing skills. However, they need adequate accumulated stock of technological knowledge and locational advantage. On the other hand, entering the maturity stage requires higher investment costs and significant experience and skills, but lower levels of technological knowledge and locational advantage. During the early and late growth stages, firms incur higher investment costs and need substantial experience and skills. At the same time, they need sufficient technological knowledge to invest significantly in the distribution infrastructure. Therefore, a country trying to pursue technological catch-up needs to know its position in the technological cycle and implement policies that support the development of various skills, resources and capabilities needed for the priority industries.

Dosi, Pavitt, and Soete (1990) studied the determinants of the pattern of technological accumulation. They found that these determinants are economic stimuli, industrial cluster, and structure and dynamics of the home markets. Here, economic stimuli focus on the abundance or scarcity of economic inputs and pressure to substitute labour for machines. Industrial clusters can also help support technological accumulation by allowing firms to develop information flows, learning processes, and technological complementarities. The structure and dynamics of home markets represent the markets for consumption goods and intermediate inputs, which are also central to supporting technological accumulation. This model suggests that governments must periodically intervene to upgrade innovativeness, tackle inputs efficiencies, and improve organizational and technological capabilities of domestic firms to promote the overall structural transformation of the economy.

2.2 Empirical Evidence

Several studies explain the stability of trade specialization patterns. Dalum, Laursen, and Villumsen (1996) studied the stability pattern of export specialization in twenty OECD countries by analysing intra-country exports across industries and intra-industry exports across countries. They treated export specialization as technological specialization following the view that both specialization indices are significantly correlated. From the analysis of intra-country inter-sectoral differences, the authors find elements of stickiness and incremental change in the trade specialization patterns within those countries. This means that the initially less specialized industries gradually become more specialized to reach the average level. At the same time, the initially highly specialized industries become less specialized, down to the average value. The σ despecialization pattern means that the industries' proportional positions move to the broader specialization pattern within OECD countries.

Based on the analysis of intra-sectoral inter-national differences, the results indicate the patterns for both β-convergence and σ-convergence. The former means that countries with initially less specialized industries tend to converge to the average. Simultaneously, countries with initially highly specialized industries move back to the average within industries. The latter means that there is mobility between industries towards the broad specialization pattern across OECD countries. When the mobility between industries within countries is compared with the intra-industries across countries, the former's mobility effect is smaller than that of the latter by 7 per cent. This finding suggests that industries tend to converge faster across OECD economies than within them.

Another study divided the specialization indices into trade and technological specialization by trying to explain the relationship between them at the national and industry levels. Uchida and Cook (2005) focus on the trade and technology model of East Asian developing countries. Analysis at the country level indicates that the differences across the countries are more pronounced in the pattern of technological specialization than in trade specialization. Cumulative and path-dependent technological specialization is seen more in Hong Kong, South Korea and Singapore than in other East Asian economies, which explains the former group's economic prosperity. However, the rest of the countries in the region continue to transform their industrial structures to create more high-value-added sectors to catch up with the leading economies. On the other hand, trade specialization is characterized as a cumulative pattern in all economies—stable and concentrated. The authors conclude that technological specialization supports trade specialization in the advanced East Asian countries, but the reverse is true for the less developed states. Therefore, trade success is vital to improve technological specialization by employing the learning-by-doing approach.

Archibugi and Pianta (1994) studied the pattern of technological specialization at the aggregate and disaggregate level for twenty OECD countries. The aggregate variables include R&D thrust, patent intensity, and bibliometric indicators. While the authors found convergence of the technological specialization in these aggregate variables, they also noted some concentration in the disaggregated data. This suggests that nations tend to converge more by increasing the differences in sectoral specialization.

A few studies have been conducted to understand the pattern of trade specialization in Cambodia. JICA (2007) analysed the trade specialization of five key sectors using their revealed comparative advantage indices. Among them, the garment sector is the dominant exporter, while footwear, and agriculture and food processing sectors are considered potential exporters. Even though electronics and machinery are just marginal sectors, they have the potential to boost exports if the Cambodian government initiates the necessary industrial policies to nurture them. However, the five sectors included in JICA (2007) do not represent the big picture of the national innovation system. Vixathep (2013) applied the index of revealed comparative advantage and adopted the research methodology used by Dalum, Laursen, and Villumsen (1996) to understand the structure of international trade and the patterns of trade specialization from 1985 to 2010 in Cambodia. He found that the country channelizes its resources mainly towards a small number of primary and low-tech product segments. At the same time, export specialization has been seen mostly in resource-based manufactured goods since in the 1990s.

3. Data and Research Methodology

We calculate the indices of trade specialization using trade data from the International Trade Centre's website (www.intracen.org). This paper employs product classification by technological categories developed by Lall (2000) to construct the concordance table to transform the trade data from a Harmonized System to Standard International Trade Classification (SITC version 3). This allows us to construct net trade specialization indices for 253 industries in Cambodia. We also compute the net trade specialization indices for Thailand and Vietnam for comparison.

We make use of the research methodology developed by Dalum, Laursen, and Villumsen (1996). For testing the stability pattern of trade specialization, Balassa's (1965) measure may be unsuitable since the index value ranges from zero to infinity, and the (weighted) average equals one. Instead of using revealed comparative advantage (RCA), we use the net trade specialization (NTS) index proposed by Iapadre (2011) as the latter includes import and export data to calculate the indices. NTS can also solve the normality problem that occurs in the Balassa measure. Specifically:

$$\mathrm{NTS}_{i,j} = \frac{\frac{X_{i,j}}{X_{i,q}} - \frac{M_{i,j}}{M_{i,q}}}{\frac{X_{i,j}}{X_{i,q}} + \frac{M_{i,j}}{M_{i,q}}}$$

where X and M are the volume of export and import, respectively; *i* and *j* represent country and sector; and *q* represents the sum of all sectors. The value of NTS*i, j* lies between –1 and +1.

We use the bivariate Galtonian regression to analyse the distribution of trade specialization (Dalum, Laursen, and Villumsen 1996) as follows:

$$\mathrm{NTS}_{ij}^{t} = \alpha + \beta \mathrm{NTS}_{ij}^{tn} + e_{ij}^{t}$$

where i stands for countries, and j for product groups. High-technology industries have ninety product subgroups with a three-digit level of SITC version 3. Low-technology industries are composed of 163 product subgroups with a three-digit level of SITC version 3. These include low-technology products, resource-based manufactures and primary products.

The indices have been divided into four periods: period I (2001–5), period II (2006–10), period III (2011–15), and period IV (2016–19). Additionally, t represents period IV, while tn represents previous periods III, II, and I.

If $\beta = 1$, the specialization pattern is constant. When $\beta > 1$, the existing pattern of specialization is strengthened. This condition means that competitive industries become more specialized while the less competitive ones become even less specialized. When $0 < \beta < 1$, the pattern of specialization is indicative of the elements of stickiness and incremental change. It means that the initially high or low values of NTS move slowly towards the average within the sectors. This means that the highly competitive industries are not so different from their less competitive counterparts. On the contrary, when $\beta < 0$, the NTS that is initially above average falls below the average in the final period, while the initially below average NTS rises above the average in the final period. When the regression effect $(1 - \beta)$ is low (high β), the specialization pattern is concentrated in a few industries. But when the regression effect $(1 - \beta)$ is high (low β), a more diversified pattern emerges.

We use the variance β/ρ to measure the degree of specialization, i.e., the extent of dispersion in the trade specialization distribution. ρ is the correlation coefficient. From Hart's (1976) formula $\rho = 1 - \frac{\sigma_\varepsilon^2}{\sigma_t^2}$, we have: $\frac{\sigma_i^{2t}}{\sigma_i^{2nt}} = \frac{\beta^2}{\rho^2}$ or $\frac{\sigma_i^t}{\sigma_i^{nt}} = \frac{|\beta|}{|\rho\,|}$. When the coefficient β is larger than the correlation coefficient ρ $(\beta/\rho > 1)$, the degree of specialization increases, which represents an increase in dispersion. When $\beta < \rho$ or $\beta/\rho < 1$, the degree of specialization decreases, which is equivalent to a decrease in dispersion. When $\beta = \rho$, the degree of specialization remains unchanged. Coefficient $\beta < 1$ represents the convergence of the initially low or high value of specialization to the average within sectors. If this change is outweighed by the mobility effect $(\beta > \rho)$, it represents a significant change in the proportional position between sectors towards the narrow-specialized sectors. In contrast, if the change is not outweighed by the mobility effect $(\beta < \rho)$, we observe slow mobility between sectors toward the broad pattern of specialization.

The Pearson correlation coefficient ρ represents the movement between sectors along the NTS distribution. When the mobility effect $(1 - \rho)$ is low (high ρ), the relative position of industries changes slowly between sectors. However, when the mobility effect $(1 - \rho)$ is high (low ρ), their relative position changes significantly. This means that certain industries move towards one another, while others diverge. Industries characterized by strong concentration (weak or negative regression effect) and stability (weak mobility effect) are usually clustered in a handful of established industries. In contrast, industries characterized by more diversification (high regression effect) and significant change (high mobility effect) exhibit changes in specialization patterns.

4. Results

4.1 Analysis of Trade Specialization Patterns at the National Level

Table 1 shows the result of the Galtonian regression analysis of the NTS for the major industries in Cambodia, Thailand and Vietnam. Cambodian industries show cumulative trade specialization in all periods, since the coefficient $\hat{\beta}$ is significantly higher than zero at p-value = 0.01. The value of $\hat{\beta}$ is significantly lower than one, which shows that Cambodia's existing pattern of specialization has changed incrementally. The sectors with initially low levels of trade specialization move slowly towards the

TABLE 1
NTS Indices

Period	$\hat{\beta}$	*Degree of Specialization*	*Regression Effect*	*Mobility Effect*
		Cambodia		
IV-I	.3707*** (.0538)	0.3721	0.6292	0.0037
IV-II	.5857*** (.0555)	0.5880	0.4143	0.0039
IV-III	.7773*** (.0414)	0.7790	0.2227	0.0022
		Thailand		
IV-I	.6304*** (.0393)	0.6319	0.3695	0.0023
IV-II	.7725*** (.0335)	0.7738	0.2275	0.0017
IV-III	.9012*** (.0261)	0.9022	0.0988	0.0010
		Vietnam		
IV-I	.5177*** (.0483)	0.5193	0.4823	0.0030
IV-II	.7486*** (.0391)	0.7501	0.2514	0.0020
IV-III	.8456*** (.0303)	0.8467	0.1543	0.0012

NOTE: Period I = 2001–5, Period II = 2006–10, Period III = 2011–15, Period IV = 2016–19.
*, **, *** are statistically significant at the 0.10, 0.05, and 0.01 level, respectively: H_0: $\beta = 1$
The degree of specialization = $\hat{\beta}/\hat{\rho}$, the regression effect = $(1 - \hat{\beta})$, the mobility effect = $(1 - \hat{\rho})$
SOURCE: International Trade Centre, 2020.

average, while industries with initially high levels of specialization move back to the average within sectors. The degree of trade specialization is less than one, which suggests that Cambodia's specialization pattern has decreased due to a decline in the dispersion of the specialization distribution. In other words, Cambodian industries tend to move slowly towards a broad pattern of trade specialization.

In general, some of the country's key sectors exhibit a notable concentration pattern in the more recent periods as the regression and mobility effect decrease. However, during the entire period of observation, Cambodia shows a slight diversification of specialization with a weak mobility effect. This means that Cambodia is in the process of catching up with its neighbouring countries by diversifying its trade specialization into a wide variety of industries.

Cambodia's pattern is similar to what is observed in Thailand and Vietnam, but with a smaller magnitude. Thailand and Vietnam reveal stickiness and incremental change within and between sectors to a much larger extent than Cambodia. This means that the initial values of their trade specialization indices move more quickly to the average within industries than is the case in Cambodia. In other words, there is quicker mobility between sectors towards the broad pattern of trade specialization in the two countries.

The slow movement within and between sectors found above is a key feature of the learning by doing concept explained by Andersen (2010). When firms in a given industry encounter specific problems in production processes and product requirements, they tend to earn small productivity gains and low profits. As a result, they start a localized search for favourable responses. This process of learning by doing can help boost their production performance and profitability by conducting R&D activities both within the firms and in conjunction with external companies to learn new knowledge and technologies. However, the slow mobility within and between sectors in Cambodia implies that it lacks a robust national innovation system to support trade specialization in both high-tech and low-tech industries.

According to Unger (1988), LDCs, including Cambodia, need a critical mass of Schumpeterian entrepreneurs who can learn and adapt technological and organizational innovations into the local context to cope with the international dynamics of market competition. The standard diffusion model mistakenly assumes that the profit incentives will promote the firms to learn new knowledge and technologies, and that supply of entrepreneurs will automatically increase. This does not happen naturally in LDCs like Cambodia, where the entrepreneurial factor is as scarce as other economic factors.

This inference is similar to UNDP's (2013) finding, which concludes that Cambodia has a small number of entrepreneurs with adequate organizational and technological capabilities. This low representation of entrepreneurs may derive from the fact that policymakers find the returns on natural resource investment to be higher than the returns on investment in productive industries. Moreover, there are very few supporting institutions to help upgrade the organizational and technological capabilities of Cambodian firms.

It must also be noted that the development of the capital goods sector is essential to accumulate the necessary capabilities to support industrial development strategies. The government must support the development of a national innovation system to mobilize the critical mass of domestic firms and upgrade their capabilities for the overall structural transformation of the country.

4.2 Analysis of Trade Specialization Patterns at the Industry Level

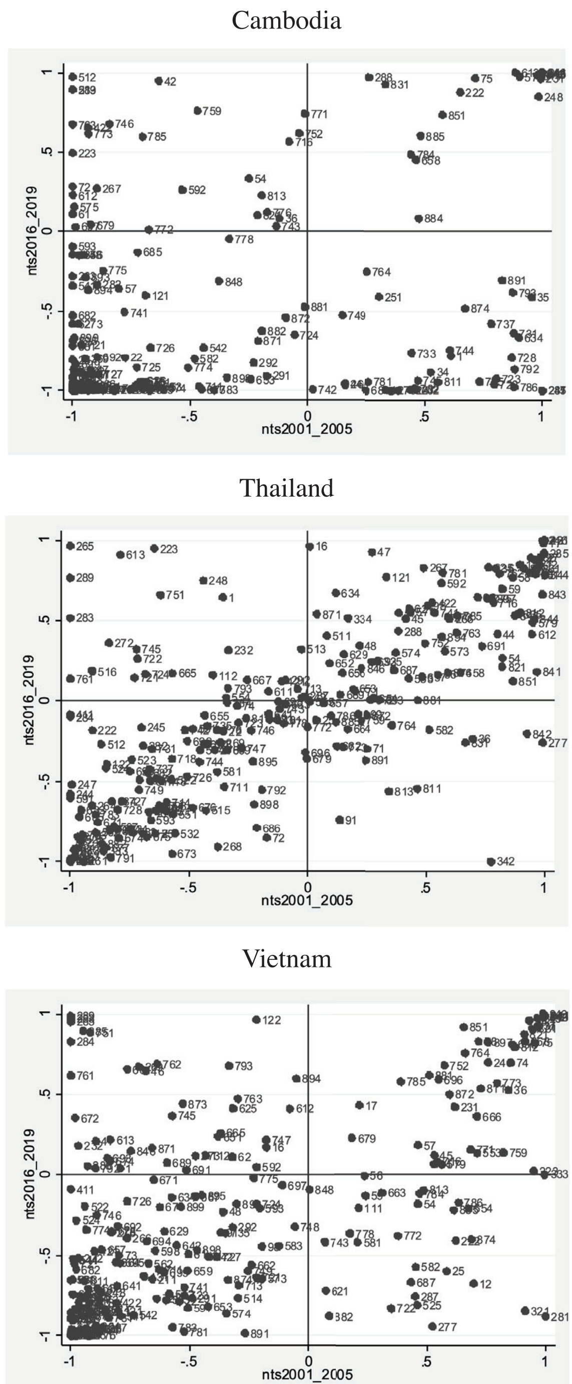
Figure 1 shows the changes in trade specialization for both periods: 2001–5 and 2016–19. The industries located in the upper right quadrant represent cumulative trade specialization. While industries in the lower right quadrant have lost trade specialization, those in the upper left quadrant have gained specialization. Industries in the lower left quadrant exhibit negative trade specialization in both periods.

Cambodia earns foreign exchange from fifteen growing industries in the low-tech segment, including the garment, footwear, travel goods, primary products, agro-based products, and other resource-based product industries (see Appendix). The country enjoys trade specialization in twelve emerging low-tech industries. These include sectors related to primary products, agro-based products, other resource-based manufactures, and non-garment products. Besides, seventy-one marginal low-tech industries have increasing NTS indices.

When compared with neighbouring countries, Cambodia continues to be weaker in terms of low-tech industries. Thailand has sixty growing low-tech, eighteen emerging low-tech, and eighteen marginal industries. Vietnam, on the other hand, has thirty growing low-tech, twenty-nine emerging low-tech, and ninety-four marginal industries.

According to Lall (2000), Cambodian low-technology products show stable and well-diffused technologies because the relevant innovations are embodied in the capital equipment. Since these industries are involved mostly in the production of undifferentiated goods based on price competition, low labour costs play a critical role in gaining competitiveness. For instance, the garment industry in Cambodia is supported by FDI focusing on the low end of the product line, even though the segment has begun diversifying into high-end products in recent years (World Bank 2017). This also happens to other low-tech products.

FIGURE 1
Changes in NTS Indices



NOTE: Growing industries: NTS > 0 in both periods. Emerging industries: NTS < 0 in 2001–5 and NTS > 0 in 2016–19. Losing Industries: NTS > 0 in 2001–5 and NTS < 0 in 2016–19. Marginal Industries: NTS < 0 in both periods but increasing.
SOURCE: International Trade Centre, 2020.

Among Cambodia's high-tech industries, there are five emerging industries involved in electronics, including automatic data processing machines, parts and accessories for machines, electric power machinery and parts, rotating electric plant and parts, and cathode valves and tubes. They also include two marginal high-tech industries other than electronics, such as medicinal and pharmaceutical products, and electrical machinery and apparatus. However, there are three losing high-tech industries, including aircraft and associated equipment, measuring, analysing, and controlling apparatus, and telecommunication equipment and parts. These product subgroups should also be restored since developing them can help promote further industrialization.

Cambodia appears less dominant in high-tech sectors than its neighbouring peers. Thailand is home to five growing high-tech, two emerging electronics, seven marginal high-tech, and just two losing electronics industries. Vietnam operates in many more high-tech industries, including six growing high-tech, four emerging high-tech, seven marginal high-tech, and two losing industries.

According to Lall (2000), the Cambodian electronics industries are made up of labour-intensive final assembly type of multinational firms. Their high value-to-weight ratio helps induce multinational firms to locate there due to the low wage levels. However, the most advanced technology industries in electronics and other high-tech products require adequate national technological infrastructure and specialized skills to support them. They need interaction across firms and between firms and universities/technological centres to learn new knowledge and technologies and adapt them to the local context before diffusing them in the larger economy.

Cambodian medium-tech industries include four growing, twelve emerging, and eight marginal industries. The four growing industries include one automotive, one process, and two engineering sectors. Among the twelve emerging industries, there are one automotive, five process, and six engineering sectors. The eight marginal industries include six process and two engineering ones. However, there are twenty losing medium-tech products (two in automotive, four in process, and fourteen in engineering products).

Cambodia shows weaker trade specialization in terms of medium-tech products when compared with the neighbouring countries. Thailand operates in many more medium-tech industries, including nineteen growing medium-tech, eight emerging medium-tech, thirty-three marginal medium-tech, and seven losing medium-tech industries. Vietnam has eight growing medium-tech, seven emerging medium-tech, twenty-five marginal medium-tech, and twelve losing medium-tech industries.

Even though the relocation of the labour-intensive processes of these medium-tech industries is not widespread in low-wage areas, it is prevalent in Cambodia. According to Lall (2000), medium-tech products tend to have high technology complexities, which need adequate R&D activities, a highly skilled labour force, and long-period learning. Engineering industries, for instance, focus on design and product development. These industries comprise a network of suppliers in which SMEs play an essential role in supplying quality parts and components to support the multinational firms' exporting activities. Likewise, process industries, particularly chemicals and basic metals, deal with stable and undifferentiated products, requiring large-scale facilities and innovation to improve the equipment and instruments.

Overall, we find that Cambodia accommodates many medium-tech and high-tech industries, which require robust science and technology infrastructure to support innovation and diffusion into the national economy. Industrial development strategies should focus on these high-tech industries because they have spillover effects (Hausman and Klinger 2006). Andersen (2010) also explains why high-tech industries should be chosen for government intervention in industrial development strategies. He claims that such industries experience higher world demand than low-tech industries, so entrepreneurs can expect to earn higher profits. Also, investing in high-tech industries is expected to generate higher productivity growth.

Latecomer countries like Cambodia can enter new technology systems as they require low levels of experience, management capabilities, and investment capital (Perez and Soete 1988). However, Cambodia needs to promote a substantial level of locational advantage and stock of scientific knowledge and technologies. While policymakers have focused on the former, improving broad-level technical know-how needs to be prioritized. In Cambodia, new technologies do not necessarily originate from large firms, but from small firms owned by entrepreneurs with adequate university training specializing in science-based industries. These companies can help develop the knowledge and skills necessary for the early and late growth stages, which can later be sold in the market at a specific price during the maturity stage.

According to Perez and Soete (1988), even though Cambodia can enter new high-tech industries, it needs to consider whether existing indigenous knowledge and skills are still relevant when the technology cycles evolve. This is because when new high-tech industries move to the early and late growth stages, they require substantial investment flow and the stock of knowledge and skills to gain trade specialization. Furthermore, success in a high-tech industry is not restricted to individual products but involves a group of products, which demands multiple coordinated technological systems.

Special economic zones (SEZs) have also been recognized to help promote the structural transformation of high- and medium-tech industries in Cambodia. The country has twenty-two SEZs operating in different regions such as Phnom Penh, Sihanoukville, Bavet and Poipet (Warr and Menon 2015). Cambodia appears to be in the early stages of developing industrial clusters to support key technological capabilities at the firm level. Lawmakers have also been implementing supplier development programmes to help strengthen the constituent companies' production capabilities. However, this public support is insufficient to increase the critical mass of important Schumpeterian entrepreneurs needed to increase the degree of industrial specialization.

5. Conclusion

Cambodia has a less developed national innovation system to support important organizational and technological capabilities in high-tech sectors than its neighbouring countries. In terms of high-tech industries, the country has four growing, sixteen emerging and eleven marginal industries. When it comes to low-tech industries, Cambodia is home to eleven growing, twelve emerging, and seventy-one marginal industries.

Cambodian industries display stickiness and incremental change, which means that both the initially less specialized and highly specialized industries slowly move towards the average. They also reveal slow mobility between sectors towards a broad pattern of specialization. This can be attributed largely to the lack of long-term-oriented entrepreneurs with adequate organizational and technological capabilities. This finding supports the claim that Cambodia's national innovation system is emergent and needs a strong push from the government to help the country transform.

Throughout Cambodia, established industries remain concentrated in a few segments, particularly garment, footwear, and travel goods, which collectively represented about 80 per cent of total exports during 2016–19. But trade patterns are changing and the country is diversifying its industrial structure to catch up with regional peers like Vietnam and Thailand.

Cambodia has developed many industrial clusters in the form of SEZs, which have helped domestic firms to upgrade their technological capabilities by: initiating staff training programmes; promoting the implementation of new technologies in cooperation with institutions, domestic firms, foreign firms, clients, and suppliers; and investing in R&D activities. A notable example is the Cambodian rice policy of 2010 which significantly boosted trade specialization. Such policies can also be applied to other potential high-tech sectors to expedite the industrial transformation of the country.

Appendix

TABLE A1
Four Types of Industries

SITC	*Industries*
Growing Industries	
High-tech	
579	Waste, parings and scrap, of plastics (process)
784	Parts & accessories of vehicles of 722, 781, 782, 783 (automotive)
884	Optical goods, n.e.s. (engineering)
885	Watches & clocks (engineering)
Low-tech	
75	Spices (primary)
222	Oil seeds and oleaginous fruits (excluding flour) (primary)
231	Natural rubber & similar gums, in primary forms (primary)
246	Wood in chips or particles and wood waste (primary)
248	Wood simply worked, and railway sleepers of wood (agro-based)
288	Non-ferrous base metal waste and scrap, n.e.s. (other_resource)
613	Furskins, tanned or dressed, excluding those of 8483 (garment)
658	Made-up articles, of textile materials, n.e.s. (garment)
831	Travel goods, handbags & similar containers (garment)
841	Men's clothing of textile fabrics, not knitted (garment)
842	Women's clothing, of textile fabrics (garment)
843	Men's or boy's clothing, of textile, knitted, croche. (garment)
844	Women's clothing, of textile, knitted or crocheted (garment)
845	Articles of apparel, of textile fabrics, n.e.s. (garment)
851	Footwear (garment)
Emerging Industries	
High-tech Industries	
267	Other man-made fibres suitable for spinning (process)
512	Alcohols, phenols, halogenat., sulfonat., nitrat. der. (process)
513	Carboxylic acids, anhydrides, halides, per.; derivati. (process)
575	Other plastics, in primary forms (process)
679	Tubes, pipes & hollow profiles, fittings, iron, steel (process)
716	Rotating electric plant & parts thereof, n.e.s. (electronics)
743	Pumps (excluding liquid), gas compressors & fans; centr. (eng)
746	Ball or roller bearings (engineering)
752	Automatic data processing machines, n.e.s. (electronics)
759	Parts, accessories for machines of groups 751, 752 (electronics)
763	Sound recorders or reproducers (engineering)
771	Electric power machinery, and parts thereof (electronics)
772	Apparatus for electrical circuits; board, panels (engineering)
773	Equipment for distributing electricity, n.e.s. (engineering)
776	Cathode valves & tubes (electronics)

785	Motorcycles & cycles (automotive)
813	Lighting fixtures & fittings, n.e.s. (engineering)
Low-tech Industries	
36	Crustaceans, mollusks and aquatic invertebrates (primary)
42	Rice (primary)
54	Vegetables (primary)
61	Sugar, molasses and honey (agro-based)
72	Cocoa (primary)
223	Oil seeds & oleaginous fruits (incl. flour, n.e.s.) (primary)
289	Ores & concentrates of precious metals; waste, scrap (other_rb)
422	Fixed vegetable fats & oils, crude, refined, fract. (agro-based)
592	Starche, wheat gluten; albuminoidal substances; glues (other_rb)
612	Manufactures of leather, n.e.s.; saddlery & harness (garment)
821	Furniture & parts (lt_other)
Losing Industries	
High-tech Industries	
266	Synthetic fibres suitable for spinning (process)
671	Pig iron & spiegeleisen, sponge iron, powder & granu (process)
722	Tractors (excluding those of 71414 & 74415) (engineering)
723	Civil engineering & contractors' plant & equipment (engineering)
728	Other machinery for particular industries, n.e.s. (engineering)
731	Machine-tools working by removing material (engineering)
733	Mach.-tools for working metal, excluding removing mate. (engineering)
735	Parts, n.e.s., & accessories for machines of 731, 733 (engineering)
737	Metalworking machinery (excludingmachine-tools) & parts (engineering)
742	Pumps for liquids (engineering)
744	Mechanical handling equipment, & parts, n.e.s. (engineering)
745	Other non-electr. machinery, tools & mechan. appar. (engineering)
749	Non-electric parts & accessor. of machinery, n.e.s. (engineering)
764	Telecommunication equipment, n.e.s.; & parts, n.e.s. (electronics)
781	Motor vehicles for the transport of persons (automotive)
782	Motor vehic. for transport of goods, special purpo. (automotive)
786	Trailers & semi-trailers (process)
791	Railway vehicles & associated equipment (process)
792	Aircraft & associated equipment; spacecraft, etc. (ht_other)
793	Ships, boats & floating structures (engineering)
811	Prefabricated buildings (engineering)
874	Measuring, analysing & controlling apparatus, n.e.s. (ht_other)
891	Arms & ammunition (engineering)
Low-tech Industries	
1	Live animals other than animals of division 03 (primary)
12	Other meat and edible meat offal (primary)
34	Fish, fresh (live or dead), chilled or frozen (primary)
35	Fish, dried, salted or in brine; smoked fish (agro-based)

continued on next page

TABLE A1 — *cont'd*

SITC	*Industries*
44	Maize (not including sweet corn), unmilled (primary)
232	Synthetic rubber (agro-based)
245	Fuel wood (excluding wood waste) and wood charcoal (primary)
247	Wood in the rough or roughly squared (agro-based)
251	Pulp and waste paper (agro-based)
281	Iron ore and concentrates (other_rb)
287	Ores and concentrates of base metals, n.e.s. (other_rb)
634	Veneers, plywood, and other wood, worked, n.e.s. (agro-based)
681	Silver, platinum, other metals of the platinum group (primary)
Marginal Industries	
High-tech Industries	
541	Medicinal and pharmaceutical products, excluding 542 (ht_other)
533	Pigments, paints, varnishes and related materials (process)
778	Electrical machinery & apparatus, n.e.s. (ht_other)
581	Tubes, pipes and hoses of plastics (process)
571	Polymers of ethylene, in primary forms (process)
572	Polymers of styrene, in primary forms (process)
591	Insectides & similar products, for retail sale (process)
593	Explosives and pyrotechnic products (process)
672	Ingots, primary forms, of iron or steel; semi-finis. (process)
721	Agricultural machinery (excluding tractors) & parts (engineering)
741	Heating & cooling equipment & parts thereof, n.e.s. (engineering)
Low-tech Industries	
11	Meat of bovine animals, fresh, chilled or frozen (primary)
25	Birds' eggs, and eggs' yolks; egg albumin (primary)
47	Other cereal meals and flour (agro-based)
48	Cereal preparations, flour of fruits or vegetables (agro-based)
57	Fruits and nuts (excluding oil nuts), fresh or dried (primary)
58	Fruit, preserved, and fruit preparations (no juice) (agro-based)
59	Fruit and vegetable juices, unfermented, no spirit (agro-based)
62	Sugar confectionery (agro-based)
81	Feeding stuff for animals (no unmilled cereals) (primary)
91	Margarine and shortening (primary)
98	Edible products and preparations, n.e.s. (agro-based)
112	Alcoholic beverages (agro-based)
121	Tobacco, unmanufactured; tobacco refuse (primary)
122	Tobacco, manufactured (agro-based)
211	Hides and skins (except furskins), raw (primary)
212	Furskins, raw, other than hides & skins of group 211 (primary)
265	Vegetable textile fibres, not spun; waste of them (agro-based)
269	Worn clothing and other worn textile articles (agro-based)
273	Stone, sand and gravel (primary)

277	Natural abrasives, n.e.s. (incl. industri. diamonds) (primary)
278	Other crude minerals (primary)
282	Ferrous waste, scrape; remelting ingots, iron, steel (other-rb)
283	Copper ores and concentrates; copper mattes, cemen (other-rb)
321	Coal, whether or not pulverized, not agglomerated (primary)
322	Briquettes, lignites and peat (other-rb)
325	Coke & semi-cokes of coal, lign., peat; retort carbon (other-rb)
335	Residual petroleum products, n.e.s., related mater. (other-rb)
421	Fixed vegetable fats & oils, crude, refined, fractio. (agro-based)
431	Animal or veg. oils & fats, processed, n.e.s.; mixt. (agro-based)
511	Hydrocarbons, n.e.s., & halogenated, nitr. derivative (other-rb)
514	Nitrogen-function compounds (other-rb)
515	Organo-inorganic, heterocycl. compounds, nucl. acids (other-rb)
531	Synth. organic colouring matter & colouring lakes (other-rb)
532	Dyeing & tanning extracts, synth. tanning materials (other-rb)
551	Essential oils, perfume & flavour materials (other-rb)
611	Leather (garment)
629	Articles of rubber, n.e.s. (agro-based)
642	Paper & paperboard, cut to shape or size, articles (lt_other)
655	Knitted or crocheted fabrics, n.e.s. (garment)
656	Tulles, trimmings, lace, ribbons & other small wares (garment)
657	Special yarn, special textile fabrics & related (garment)
661	Lime, cement, fabrica. constr. mat. (excludingglass, clay) (other-rb)
665	Glassware (lt_other)
667	Pearls, precious & semi-precious stones (other-rb)
673	Flat-rolled prod., iron, non-alloy steel, not coated (lt_other)
676	Iron & steel bars, rods, angles, shapes & sections (lt_other)
678	Wire of iron or steel (lt_other)
682	Copper (primary)
683	Nickel (primary)
684	Aluminium (primary)
685	Lead (primary)
686	Zinc (primary)
687	Tin (primary)
694	Nails, screws, nuts, bolts, rivets & the like, of metal (lt_other)
699	Manufactures of base metal, n.e.s. (lt_other)
846	Clothing accessories, of textile fabrics (garment)
848	Articles of apparel, clothing access., excluding textile (garment)
893	Articles, n.e.s., of plastics (lt_other)
894	Baby carriages, toys, games & sporting goods (lt_other)
895	Office & stationery supplies, n.e.s. (lt_other)
899	Miscellaneous manufactured articles, n.e.s. (lt_other)

SOURCE: International Trade Centre, 2020.

REFERENCES

Andersen, Esben Sloth. 2010. "Approaching National Systems of Innovation from the Production and Linkage Structure". In *National Systems of Innovation: Toward a Theory of Innovation and Interactive Learning*, edited by, Bengt Age Lundvall, pp. 71–96. London New York and Delhi: The Anthem Other Canon Series.
Archibugi, Daniele, and Mario Pianta. 1994. "Aggregate Convergence and Sectoral Specialization of Innovation". In *Journal of Evolutionary Economics*, edited by Uwe Cantner and Bart Verspagen, vol. 4, pp. 17–33. Springer-Verlag.
Balassa, Bela. 1965. "Trade Liberalization and Revealed Comparative Advantage". *The Manchester School of Economics and Social Studies* 2, no. 33.
Dalum, Bent, Keld Laursen, and Gert Villumsen. 1996. "The Long-term Development of OECD Export Specialisation Patterns: De-specialisation and Stickiness". Danish Research Unit for Industrial Dynamics. Working Paper No. 96-14.
Dosi, Giovanni, and Luc Soete. 1988. "Technical Change and International Trade". In *Technical Change and Economic Theory,* edited by G. Dosi et al., pp. 401–31. London and New York: Pinter Publishers.
———, Keit Pavitt, and Luc Soete. 1990. "The Economics of Technical Change and International Trade". Laboratory of Economics and Management, Sant'Anna School of Advanced Studies.
Fagerberg, Jan. 2003. "Innovation: 'A Guide to the Literature'". Center for Technology, Innovation, and Culture. The University of Oslo,
Freeman, Christopher. 1987. *Technology Policy and Economic Performance: Lessons from Japan*. London and New York: Pinter Publishers.
Hart, Peter E. 1976. "The Dynamics of Earnings, 1963–1973". *The Economic Journal* 86, No. 343: 551–65.
Hausman, Ricardo, and Bailey Klinger. 2006. "Structural Transformation and Patterns of Comparative Advantage in the Product Space". KGS Faculty Research Working Paper Series, Harvard University.
Iapadre, Pasquale Lelio. 2011. "Trade and Employment in Italy". OECD Trade Policy Working Papers, No. 126. OECD Publishing.
Japan International Cooperation Agency (JICA). 2007. "The Study on Economic Policy Support in the Kingdom of Cambodia. Final Report Summary". Council for the Development of Cambodia.
Lall, Sanjaya. 2000. "The Technological Structure and Performance of Developing Country Manufactured Exports, 1985–98". *Oxford Development Studies* 28, no. 3: 337–69.
Lee, Keun, and Franco Malerba. 2018. "Economic Catch-up by Latecomers as an Evolutionary Process". In *Modern Evolutionary Economics: An Overview,* edited by Richard Nelson et al., pp. 172–207. Cambridge: Cambridge University Press.
Perez, Carlota, and Luc Soete. 1988. "Catching up in Technology: Entry Barriers and Windows of Opportunities." In *Technical Change and Economic Theory*, edited by Giovanni Dosi et al., pp. 458–79. London and New York: Pinter Publishers.
Royal Government of Cambodia (RGC). 2015. *Cambodia Industrial Development Policy 2015–2025: Market Orientation and Enabling Environment For Industrial Development*. Phnom Penh: Council of Ministers.
Uchida and Cook (2005) [Authors to supply bibliographic information]
UNDP. 2013. "Toward Realizing Industrial Development in Cambodia: An Academic Perspective". Phnom Penh: UNDP Discussion Paper, no. 10: 278–93.
Unger, Kurt. 1988. "Industrial Structure, Technical Change, and Microeconomic Behavior in LDCs"." In *Technical Change and Economic Theory*, edited by Giovanni Dosi et al., pp. 480–95. London and New York: Pinter Publishers.
Vernon Raymond. 1966. "International Investment and International Trade in the Product Cycle". *Quarterly Journal of Economics* 80, no. 2: 190–207.
Vixathep, Souksavanh. 2013. "Cambodia's Comparative Advantage Patterns and Trade Structure from 1985 to 2010". *Journal of Southeast Asian Economies* 30, no. 3.
Warr, Peter, and Jayant Menon. 2015. "Cambodia's Special Economic Zones". Phnom Penh: ADB Economics Working Paper Series.
World Bank. 2017. "Cambodia Economic Update: Cambodia Climbing up the Manufacturing Value Chains". Phnom Penh: World Bank Group.