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IDE DISCUSSION PAPER No. 805

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December 2020

Abstract

This paper explores how the empirical turning point of regaining domestic value-added embedded in exports corresponds to the theoretical transformation in types of foreign direct investment that host emerging market economies invite. Utilizing panel data from of 72 middle-income countries from 1990 to 2018, compiled from the latest UNCTAD–Eora Global Value Chain Database, non-linear U-shaped curves (alternative smile curves) in the relationships between the domestic value-added share to exports and GDP per capita, derived from an extended version of the knowledge-capital model, were empirically estimated and tested for statistical significance. The results show that manufacturing-based middle-income economies have a meaningful U-shaped curve, with the turning point at approximately $2,000 US GDP per capita. Subsequently, we further examined geographical characteristics and found that the Asian and Latin American middle-income economies have their own curves with different turning points.

Keywords: knowledge-capital model, global value chains, alternative smile curve

JEL classification: F12, F14, F23

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Abstract

This paper explores how the empirical turning point of regaining domestic value-added embedded in exports corresponds to the theoretical transformation in types of foreign direct investment that host emerging market economies invite. Utilizing panel data from of 72 middle-income countries from 1990 to 2018, compiled from the latest UNCTAD–Eora Global Value Chain Database, non-linear U-shaped curves (alternative smile curves) in the relationships between the domestic value-added share to exports and GDP per capita, derived from an extended version of the knowledge-capital model, were empirically estimated and tested for statistical significance. The results show that manufacturing-based middle-income economies have a meaningful U-shaped curve, with the turning point at approximately $2,000 US GDP per capita. Subsequently, we further examined geographical characteristics and found that the Asian and Latin American middle-income economies have their own curves with different turning points.

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1. Introduction

Global value chains (GVCs) have been one of the popular trends in global economic activities over the past two decades. According to UNCTAD (2013), the GVCs are characterized by the fragmentation of production processes and the international dispersion of tasks and activities among economies with diversified development stages that have led to the emergence of borderless production networks. GVCs are considered to boost income because hyper-specialization enhances efficiency and productivity as well as the durable firm-to-firm relationships promote the diffusion of technology and access to inputs along the chains. The World Bank (2020) estimated that a 1% increase in GVC participation would boost per capita income by more than 1%, or by much more than the 0.2% income gain from standard trade.

Koopman, Wang, and Wei (2012), who traced value-added in global production networks by country and measured vertical specialization in international trade, initially proposed the concept of GVCs. Empirical research on GVCs has been extensive because Koopman *et al*. (2012) provided a unified accounting framework for analyzing GVCs. Gereffi (2018) presented a comprehensive study as the seminal work on GVCs by showing the conceptual foundations of GVC analyses with detailed case studies from China, Mexico and other emerging market economies.

Global value chain participation in emerging markets typically means inviting inward foreign direct investment (FDI)—setting up manufacturing factories, importing parts and components, processing and assembling, and exporting the manufactured products to the world market. Baldwin and Lopez-Gonzalez (2014) called this GVC pattern in the form of trade "importing to export" or I2E. In general, it was speculated that GVC integration has contributed to economic development in emerging market economies by creating job opportunities and domestic value-added in their host economies. The World Bank (2016), for instance, emphasized that low- and middle-income countries can specialize in a segment of the international production process without mastering the entire production process through their GVC participation. They can absorb variable foreign technologies and know-how through their GVC involvement.

However, there is a counterargument that GVC participation does not automatically guarantee sustainable economic growth to emerging market economies. The World Bank (2016, 2020) and UNCTAD (2013) both argue that public policies to optimize the economic contributions of GVC participation are needed and that there are also several risks involved in GVC participation. In the initial stage of GVC participation, an underdeveloped economy usually accepts labor-intensive industries and processes, such as assembling activities, due to the lower labor costs of these activities. However, continuous dependence on labor-intensive manufacturing activities does not necessarily guarantee sustainable industrial development for two reasons.

First, the manufacturing and assembling processes are identified as the low end of a value chain producing lower value-added along the so-called smile curve. Shih (1996) and subsequent case studies on individual firms or specific industries, such as Mudambi (2008); Baldwin, Ito, and Sato (2014); Baldwin and Evenett (2015); Rungi and Del Prete (2018); and Meng, Ye, and Wei (2020), have described U-shaped smile curves with the vertical axis representing value-added and the horizontal axis representing production stages in a value chain. This curve suggests that the middle part of the value chain (manufacturing and assembling processes) creates lower value-added than either end of the value chain (concept/R&D and sales/after service) does. Following this argument, accepting only labor-intensive manufacturing activities in the GVCs would produce less value-added in an economy.

Second, the continuous dependence on labor-intensive manufacturing in GVC participation would lead to diminishing returns from production and a slowdown in economic growth. An economy must transform its growth pattern from factor-driven to productivity-driven growth through industrial upgrading to attain sustainable growth. In the context of involvement in GVCs, while an economy accepts FDI in terms of manufacturing activities, it should continuously enhance its domestic value-added by upgrading its domestic industries through obtaining technological transfers from foreign investors. Kuroiwa (2016) described the process of involvement in GVCs as consisting of two phases—participation and upgrading. Both require different development strategies, and the author argues that the second phase is more challenging for many developing countries.

Empirical studies have begun to be conducted on the nationwide process of industrial upgrading in the GVC involvement because the value-added trade data have been developed in recent times by several international organizations. The value-added trade database has made it possible to identify not only the contributions of domestic and foreign value-added embedded in gross exports but also the industrial and country-wise origins of creating value-added in exports. The United Nations Conference on Trade and Development (2013) conducted country-level analyses of GVC impacts from comprehensive angles for the first time. The analysis utilized the UNCTAD–Eora Global Value Chain Database. From a dataset of 125 sample countries, UNCTAD found a distinct GVC development path in host countries participating in GVCs: some economies have regained their domestic value-added shares to exports through upgrading industries, after their declines at the initial stage of GVC participation. Taguchi (2014) and Taguchi and Pham (2019) used OECD value-added trade data and modified the GVC development path by estimating non-linear quadratic curves in the relationships between the domestic value-added share to exports and per capita GDP, with a focus on Asian emerging market economies. Taguchi and Pham (2019) identified the turning point of a non-linear curve for Asia at $2,032 US per capita GDP and verified the active role of the supporting industries in pushing up the domestic value creation in exports.

However, from the theoretical perspective, few studies have provided microeconomic foundations for the industrial upgrading process in emerging market economies involved in GVCs. In emerging market economies, GVC participation has usually accompanied the acceptance of inward FDIs, as shown by the robust correlation between indicators of both GVC participation rates and FDI stocks in UNCTAD (2013). As far as FDI activities are concerned, theoretical modellings and empirical studies have been intensified since the late 1980s. In particular, the knowledge-capital model, which was originally developed by Markusen (1984) and extended steadily by Ekholm, Forslid, and Markusen (2007) and Oyamada (2019), has thoroughly described the developing-country FDI types: the export-platform FDI that works for low-cost developing countries, with their immature markets, in addition to the typical horizontal or vertical FDIs. The model provides economy-wide pictures of aggregated firm-level choices of operational strategies, in a general equilibrium setting with trade and production costs that depend on employment and labor wages in the host countries. A version of this model can be applied to present theoretical descriptions of the industrial upgrading process in developing countries involved in GVCs.

This article introduces and empirically verifies the validity of a non-linear U-shaped curve (an alternative smile curve) that focuses on the relationships between the domestic value-added share to exports and per capita GDP from the economy-wide perspective. This analysis is based on the extended knowledge-capital model presented by Oyamada (2019).[1] The main question is how the empirical turning point of regaining domestic value-added embodied in exports would correspond to the theoretical transformation of FDI types invited by the host emerging market economies, from the export-platform FDI through the vertical to the horizontal. This article also contributes an update to the empirically estimated alternative smile curves by using the latest UNCTAD–Eora Global

[1] The original smile curve proposed by Stan Shih in 1992 focuses on the relationships between value-added and production stages in a value chain with respect to a specific firm or industry. Meng *et al*. (2020) have taken up the case of the information and communication technology industry and identified production stages as the distances from final demand of their products.

Value Chain Database and by providing evidence from world-wide sample economies. Previous studies focused only on emerging Asian economies, but this study adds new findings from various manufacturing development and geographical regions.[2]

The remainder of this paper is structured as follows. Sections 2 and 3 elaborate the theoretical descriptions of the alternative smile curve derived by an extended version of the knowledge-capital model. Section 2 presents a brief overview of the model, and Section 3 explains how to use the model to draw the curve. Section 4 presents the empirical evidence on the updated smile curves from the world-wide sample economies. Finally, Section 5 summarizes and concludes this study.

2. The Model

This section presents a brief overview of the knowledge-capital model that was used in this study to derive an alternative smile curve that captures the relationships between the domestic value-added share to exports and per capita GDP. The knowledge-capital model, originally developed by Markusen (1984) and further extended by Oyamada (2019), is a theoretical model based on numerical simulations that mainly explains the relationships between operational strategies of multi-national enterprises (MNEs) and the wage differences between skilled and unskilled labor available in both home and host countries. On the other hand, neither the technological diffusions via FDI that may enhance productivity growth in a host country nor the transactions between local suppliers and foreign affiliates are considered explicitly in the model. Thus, industrial upgrading is expressed through changes in the operational pattern of MNEs that are either established in or advanced to a country. In the model, changes in the composition of skilled and unskilled labor due to economic development, and/or increases in attractiveness as a final goods' market based on the growth in purchasing power, may affect relational patterns between a country and MNEs. Hence, the proportion of domestic value-added embodied in exports may also be affected.

2.1 Environment

[2] Previous studies have also lacked theoretical backgrounds. The extended knowledge-capital model assigns theoretical underpinnings to the alternative smile curves explored in those previous studies as well.

The model utilized in this study to derive an alternative smile curve is the same as the one that was used in Oyamada (2019) and Oyamada (2020).[3] In the presumed economic environment, there are six types of operational strategies by which a firm obtains access to a foreign market: regular exporting, horizontal FDI, vertical FDI, horizontal export-platform, vertical export-platform, and the complex integration of horizontal FDI and home-returning export-platform. We call the firms that adopt these strategies type-N, H, V, EH, EV, and CI, respectively. For convenience, we categorized this group of firms into MNEs, even though regular exporting firms are included.

There are four countries/regions. Two of them have markets for the final products of MNEs. We call them the market countries. The other two, the non-market countries, engage only in the final assembly process of multi-national production. The finished products are not consumed in the non-market countries but are exported to the market countries. It is also assumed that MNEs are established only in the market countries. We name the market countries "A" and "B" and the non-market countries "C" and "D."

Goods were categorized into X, Y, and Z. The intermediate good (or component) X is used to make the final product Y of an MNE. Good X can be produced by an MNE at its headquarters located in a market country, either A or B. Then, X is sent to a country where the final assembly processing of Y takes place. Not only A and B but also C and D may engage in this production stage. The production of Y is assumed to exhibit the increasing-returns-to-scale (IRTS) technology, so its markets are imperfectly competitive. Each type of MNE—N, H, V, EH, EV, and CI—shares identical technology and productivity within the same group. Whereas MNEs handle X and Y, Z is produced by a representative non-MNE firm in each country and is either consumed locally or exported as a perfect substitute. This production sector exhibits the constant-returns-to-scale (CRTS) technology, so that its integrated market for all four countries, A through D, is perfectly competitive. In the model, good Z is the *numéraire*. Thus, the prices of goods X and Y, in addition to the following production factors, are all normalized by the price of Z.

Skilled labor K and unskilled labor L are primary factors in production.[4] While only K is used to produce the intermediate good X, X and L are used to finalize Y. To produce Z, both K and L are used under Cobb-Douglas technologies. The primary factors K and L are assumed to be immobile across national boundaries. Factor K is regarded as relatively educated human capital in the process of deriving an alternative smile curve.

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[3] Because presenting detailed explanations of the model structure is not the purpose of this study, we provide a brief overview of the model in this section. For details, see Oyamada (2019).
[4] Following Markusen's original theory, physical capital is completely abstracted from the model.

Exports of X or Y incur two kinds of trade-link specific variable costs: transportation costs and import tariffs. The *ad valorem* rates of these trade costs are exogenous. For international transportation services, a certain amount of unskilled labor L is used in the exporting country. The import tariff in the model functions as distortions in prices, so that all of the tariff revenue is transferred to the representative consumer in every country. For simplicity, exports of Z incur no trade costs.

In the IRTS sector, where MNEs operate, two kinds of fixed costs, F and G, are required to start a business and construct a plant. The firm-type/trade-link specific entry costs, F, are needed to establish headquarters and to have a local affiliate in either the home or a foreign country, respectively. These costs are measured in units of skilled labor, K. On the other hand, the country specific setup costs, G, measured in units of unskilled labor, L, are needed to construct an assembly plant in a country, where the firm's local affiliate exists, for producing Y. The levels of F and G are given exogenously.

The representative consumers in the market countries A and B determine the consumption levels of Y and Z, respectively, within their budget funded by the labor income and tariff revenue to maximize Cobb-Douglas utilities. On the other hand, the consumers in the non-market countries C and D only consume Z and spend their entire budget on it.

2.2 Operational Patterns of Multi-National Enterprises

In the IRTS sector, entry and exit of MNEs that adopt operational strategies under scale economy take place. Hence, a combination of firm types operating in an equilibrium is determined. Such combination of firms is called a "regime." If the final assembly process of good Y takes place only in a market country where the headquarters of an MNE are located, the finished products are sold locally and exported to another market country. In this case, the firm type is categorized as type-N, which adopts the regular exporting strategy. For convenience, this firm type is considered as an MNE although no FDI activity occurs.

When the final assembly process of Y takes place in a foreign market country and never goes to a non-market country, the firm type is categorized as either type-H, which adopts the horizontal FDI strategy, or type-V, which adopts the vertical FDI strategy. Type-H has plants both in the home and foreign market countries and produces Y to serve the local markets. In this case, only the intermediate good X is exported from the home country, and the finished product Y is not traded internationally. Type-V has a plant only in a foreign market country to serve both of the foreign local and home markets. Product

X is exported from home, and a fraction of the finished Y is re-exported back home. The rest of Y is sold locally in the foreign country.

If Y is assembled in a non-market country, the finished products are all exported to one or more market countries. This type of operational activity is categorized into either type-EH or type-EV, both of which adopt the export-platform strategy. Type-EH has plants both in the home and foreign non-market countries and produces Y to serve the local home and the foreign market. For the foreign market, the products of a non-market country will be exported. Type-EV has a plant only in a non-market country to serve both the home and the foreign markets. The products of a non-market country are exported to both market countries.

Finally, a combination of type-H and type-EV is denoted as type-CI. For the home market, Y is produced in a non-market country, whereas the production for the foreign market takes place locally. Type-CI appears in limited circumstances where costs on the trade flows between a couple of market and non-market countries are sufficiently low, due either to close physical distance or trade liberalization, under the condition that trade costs for intermediate goods are generally low and those for finished products are high between market countries. Examples of low trade costs for intermediate goods are the international delivery of blueprints from headquarters to a local affiliate via the internet, and the local production of components by remote operation from headquarters using 3D printers installed in an assembly plant.

Among the six types of MNEs' operational strategies, we will focus on only three—type-H, V, and EH—in the process of drawing an alternative smile curve, as will be seen in Section 3.

2.3 Numerical Simulations

Equilibrium solutions are obtained with numerical simulations. Because the extended knowledge-capital model contains many inequalities in addition to equations, corner solutions have to be managed adequately in numerical calculations. Thus, the model has been coded as a General Algebraic Modeling System program to use its PATH solver, which has enabled us to handle the Karush-Kuhn-Tucker complementary slackness conditions (Brooke, Kendrick, and Meeraus, 1992; Ferris and Munson, 1998).

In numerical simulations with the model, equilibrium solutions are calculated with different sets of values of relative labor endowments within either couple of the market or non-market countries. The total amounts of skilled and unskilled labor between two market or non-market countries, respectively, are kept unchanged from exogenously given levels. Then, a box diagram is drawn by plotting the total endowment of skilled labor, K, in the two target countries (either the market or non-market) on the horizontal axis and by plotting the total endowment of unskilled labor, L, on the vertical axis. In a box diagram, there are cells that correspond respectively to a set of relative factor endowments (proportions of the primary factors, K and L, that a country occupies) in either of the market or non-market country-groups. By using those cells to show firms' choices of operational strategies (regimes), relative levels of prices, welfare levels, and other aspects, we can identify characteristics of a set of equilibria. In this study, we focus on both the domestic value-added share to exports and per capita GDP. Finally, factor endowments for the countries, which are out of focus in an analysis, are assumed to be fixed identical (50% split ratios).

3. The Alternative Smile Curve in the Process of Domestic Value Creation

This section shows how we obtain an alternative smile curve, which captures the relationships between the domestic value-added share to exports and per capita GDP, using the extended knowledge-capital model that we introduced previously. We hypothesize a developing country that is not yet attractive to MNEs because of its low income and resultant poor purchasing power but that has plenty of cheap labor available. Because this country has not been matured as a market for good Y, let us start by focusing on a non-market country in the model.

3.1 The Less-Developed Non-Market Stage

A box diagram for two non-market countries looks like Figure 1. In Figure 1, the proportions of skilled and unskilled labor, endowed by country C, are measured respectively from the south-west (SW) corner, whereas those endowed by country D are measured from the north-east (NE) corner. The vertical and horizontal axes correspond to skilled labor, K, and unskilled labor, L, respectively. Then, the magnitudes of the factor endowments (K and L) become identical in two countries at the center of the box.

As shown in Figure 1, MNEs will not build an export-platform in non-market countries but will go straight to a foreign market country in the area along the diagonal line between the SW and NE corners, where compositions of the relative factor endowments in two non-market countries are similar and, thus, the relative prices between skilled and unskilled labor do not differ significantly. In the case of Figure 1, the type-H strategy is dominant among MNEs. In addition, MNEs established in both market countries A and B will have a type-EV export-platform in a non-market country if unskilled labor is sufficiently cheap and available there, as shown around the NW and SE corners. Figure 2 shows this type of export-platform FDI for the case of an MNE established in country A, which is placed on the left-hand side of the image. In the case of an MNE that has its headquarters in country B, the image is reversed from side to side. This is the case in country C in the situation around the SE corner in Figure 1 (the circled area). The non-market country has plenty of sufficiently cheap unskilled labor available but has scarce skilled labor.

Figures 3 and 4, respectively, capture the levels of per capita GDP of country C and the proportions of domestic value-added embodied in the exports of country C, which are calculated corresponding to the cells shown in Figure 1. These figures are viewed from the SW corner of the box diagrams. Therefore, the closest side is the SW corner of a box diagram, while the SE corner, to which we have to pay attention now, is on the right-hand side. The levels of domestic value-added share in exports tend to be low in the SE corner on the right-hand side. This is because the more country C endows unskilled labor that is relatively cheaper than that available in the rival country D and also in the two market countries A and B, the more the type-EV export-platform will be built in country C so that the import demand for intermediate good X increases and, hence, the share of domestic value-added embodied in the exports of the finished good Y is reduced in country C (Figure 4). Thus, per capita GDP decreases as the proportion of unskilled labor increases in the country. This is illustrated in Figure 3 where the levels of per capita GDP tend to be low in the SE corner. On the other hand, these results do not add any meaning other than the fact that a non-market country that has plenty of sufficiently cheap unskilled labor, L, tends to attract more export-platform FDI. It is not easy to determine what happens in the economy of country C as the type-EV export-platform emerges and increases.

Figures 5 and 6 also show the levels of per capita GDP of country C and the proportions of domestic value-added embodied in the exports of country C. In this case, the magnitudes of total factor endowments among the non-market countries have been reduced by half compared to the previous case shown in Figures 3 and 4. In the present case, the effects on the wage labels of a one unit increase of export-platform in country C tend to be intense, especially for unskilled labor, compared to the previously seen case. Construction of an export-platform expands employment demand mainly for unskilled labor, L, so that the relative wage level appreciates and responds more sensitively than in the previous case. Consequently, the area around the right-hand side of Figure 5 rises this time, whereas Figures 4 and 6 show no significant difference. This suggests that an increase in the acceptance of an export-platform may raise the level of per capita GDP of a comparatively small developing country, whereas its domestic value-added share to exports reduces.

In Figures 3 through 6, we can draw the left-hand half of an alternative smile curve. In the situation where the representative non-MNE firm, which produces and exports good Z, operates alone, the domestic value-added share to exports remains at 100%, and the income level of the country remains low. Figure 7 shows the domestic value-added share starting to decrease once the type-EV export-platform emerges and the imports of component X increase. In a Lewis-type dual-sector economy, where overpopulated unskilled labor in the rural area can be employed at a low wage, only the domestic value-added share to exports keeps falling, and the per capita GDP does not increase very much (Lewis, 1954). In this early stage of joining a production network, the smile curve plunges downward almost vertically.

Once the redundant labor supplied by the rural area has been employed fully by MNEs for production of good Y, the wage level of unskilled workers begins to rise. As long as the wage appreciates within the allowable range, MNEs expand the scale of the local plants. Consequently, per capita GDP grows. The curve that came down almost vertically then starts changing course, as shown in Figure 7, in a direction that raises the income level.

Once the unskilled labor wage level starts appreciating and the per capita income expands, country C now becomes attractive to MNEs as a final market for product Y. Then, the former non-market country C turns into a market country.

3.2 The Emerging Market Stage

A box diagram for two market countries looks like Figure 8. The proportions of skilled and unskilled labor endowed by country A are measured, respectively, from the SW corner, whereas those endowed by country B are measured from the NE corner. We theorize that country C has become country A.

Figure 8 shows the following points. First, in the central area, both the physical and relative endowments of two kinds of labor, K and L, do not differ among countries A and B. The economic magnitudes of the two countries and the price levels of the two factors are similar, and firms tend to adopt the type-H strategy. Next, in the areas moving from the central area to either the SW or the NE corners, the two countries become different in size, whereas the relative prices of K and L remain similar. In this case, firms established in country A start adopting the type-N strategy in the NE neighborhood of the central area, whereas those in country B adopt the type-N strategy in the SW neighborhood of the central area. Then, around the NE and SW corners, most of the type-H firms are replaced by type-N firms. Note that the type-N firms established either in a relatively large country, or in a country in which relatively cheap labor is available, tend to occupy production for all markets.

In contrast, the type-V firms are dominant in the areas around either the SE or NW corners, where sufficiently cheap unskilled labor, L, is available in a foreign market country, and the sizes of the market countries are similar. If we take the case of country A as an FDI host, the type-V firms established in country B operate predominantly in the area around the SE corner, as shown in Figure 8. An image of the type-V firm established in country B is given in the left-hand picture in Figure 9. When we drew the left-hand half of an alternative smile curve, we presumed that country C, which was once not attractive for MNEs as a final market but had plenty of sufficiently cheap unskilled labor, L, begins to invite type-EV firms and then turns into a market for good Y as its income level rises. Thus, the former country C has now transformed into country A, from the SE corner of Figure 8 (the circled area), where the relative price of unskilled labor, L, remains low because of its rich availability compared to that of skilled labor, K.

It is possible to consider the economic growth path of a developing country, in which the income level has started to rise through accepting FDI. An increase of per capita income may increase the expenditure on education, which results in the educational level of the labor force rising. Therefore, the number of skilled workers who undergo higher-level vocational training increases in the country, and the expansion of such higher-wage workers further increases the income level. This kind of growth path can be explained by the endogenous growth models presented by Uzawa (1965), Romer (1986), Lucas (1988), and Rebelo (1991). The relative position of country A in Figure 8 moves gradually north (or northwest) from the SE corner (following the arrow from the circled area) by repeatedly following this positive circulation. Although it is limited to the case of China, the appropriateness of our assumption is supported by Kiyota, Oikawa, and Yoshioka (2017), who presented empirical evidence that the employment of high-skilled workers by MNEs has increased dramatically.

The increase in skilled labor, K, reduces the relative supply of unskilled labor, L, so that the wage level of L tends to appreciate in country A. Then, the costs to assemble and export good Y—which require mainly unskilled labor—increase. Consequently, the MNEs established in country B switch their operational strategy from type-V to type-H. An image of the type-H firm established in country B is given in the right-hand picture in

Figure 9. The change of operational strategy from type-V to type-H can also be confirmed in Figure 8.

Figures 10 and 11 show the levels of per capita GDP of country A and the proportions of domestic value-added embodied in the exports of country A. These factors are calculated corresponding to the cells shown in Figure 8, respectively. As the economy grows, the level of per capita GDP and the domestic value-added share to exports, respectively, are repositioned from a certain point in the area around the right-hand side to a point on the farthest side (the opposite bank seen from the closest side). Following this movement, the income level rises in Figure 10. In contrast, Figure 11 shows that the domestic value-added share to exports decreases slightly in the situation wherein the type-V firms are dominant for a while after the conversion to a market country. This is because the number of type-V firms increased based on the expanded availability of relatively cheap skilled labor, K, which is required to set up a local affiliate. There is also an inflated demand for the local sales of finished product, Y, brought by increased income. The proportion of intermediate imports occupies relatively large part of the value of the final product and tends to lessen the proportion of domestic value-added embodied in exports.

Once the wage level of unskilled labor, L, exceeds a certain threshold, MNEs start switching their FDI strategies to type-H from type-V. As shown in the right-hand picture in Figure 9, no export from country A occurs in the type-H strategy. Thus, country A's exports are limited to the regular good, Z, so that the domestic value-added share to exports sharply approaches 100%. This is reflected in the cliff-like shape in Figure 11.

Using Figures 10 and 11, we can draw the bottom right-hand half of an alternative smile curve, although it looks somewhat distorted. The per capita GDP of country A steadily grows after the switch to a market country from a non-market country, but its domestic value-added share to exports tends to decline slightly. During this period, the dominant operational strategy of MNEs is type-V. Once the MNEs start changing their strategy to type-H because of the appreciated rental price of unskilled labor, L, the proportion of domestic value-added embodied in exports soars to 100%. Consequently, the alternative smile curve takes the shape shown in Figure 12. The shape from the bottom to the right-hand half reflects a cut end of the 3D graph in Figure 11 along the line that corresponds to the growth path of skilled labor, K.

3.3 The Sequel Stage

Although an alternative smile curve has been obtained, country A's story continues because it is likely that the economic growth of the country as a market is not yet over.

Moving further to the north (or northwest) in Figure 8, the type-N firms established in country A start operating along with the type-H firms established in country B. Note that the producers of good Y (MNEs in this paper) finally emerge in country A. Furthermore, going north (or northwest) from there implies that the type-H firms will be established in country A. These assumptions can be justified by the empirical evidence reported by Timmer, Miroudot, and de Vries (2018) and de Vries, Chen, Hasan, and Li (2019) that the number of employees in research and development segments in China have been increasing recently. Images of the type-N and type-H firms established in country A are given in Figure 13. As is clear from these images, the proportion of domestic value-added embodied in exports remains unchanged at 100%. Thus, a horizontal part is added to the right-hand side of the smile curve, as shown in Figure 14.

3.4 Turning Points in the Alternative Smile Curve

Finally, let us summarize the several turning points identified in the alternative smile curve. The first point is when the curve that is coming down vertically in the less-developed stage changes course in a direction that raises the income level. At that point, the redundant unskilled labor, L, in the rural area has been employed fully, and its wage level has started to rise. The second turning point is when the host country undergoes a transfiguration from a non-market to a market for the final products of good Y as its income level rises. Beyond this point, the supply of skilled labor, K, expands based on improvements in educational standards. Early in this phase, the domestic value-added share to exports hits bottom. The third point is when the costs of assembling good Y in the host country and re-exporting to home (based on the type-V strategy) start exceeding the costs of producing Y domestically for the home market (based on the type-H strategy). Beyond this point, the proportion of domestic value-added embodied in exports, which has been at the bottom level, starts to increase and runs up to 100%. The final turning point is at the place when firms that produce good Y (MNEs in this study) emerge in the country. At this point, the domestic value-added share will not change and remains constant at 100%, no matter how much the per capita GDP increases.

4. Empirical Evidence

This section describes an empirical study on the alternative smile curve in the process of domestic value creation in exports along with economic development. The theoretical framework described four kinds of turning points in the process of domestic value creation: the point of attaining full employment, the point of transforming from a non-market economy to a market economy, the point of switching the accepting type of FDI from type-V to type-H, and the point of letting MNEs emerge. Both of the turning-edge points (the first and the fourth points) in Figure 14, which seem to belong mainly to low-income and high-income groups, cannot occupy the central part of the curve. In addition, the second turning point tends to be ambiguous in the present framework, which captures the relationships between the domestic value-added share to exports and per capita GDP. Therefore, this empirical estimation focuses on middle-income economies that contain the third turning point. Although the theoretical description of the alternative smile curve is displayed as a kinked curve, including the point in Figure 14, the "empirical" curve in the real world could be estimated as a smoother U-shaped curve because the real economy contains a variety of industries that may have different curves with their specific properties, and nationwide aggregation possibly creates smoothing with a converged turning point. This empirical study tries to verify the existence of a smooth quadratic curve, which approximates the neighborhood of the third turning point, and to identify its "converged" level in terms of per capita GDP. Section 4.1 describes the data and the methodology for estimation and Section 4.2 includes estimation outcomes and discussions.

4.1 Data and Methodology

The key variables for estimating alternative smile curves are the following two indicators: "domestic value-added as a share of gross exports (DVA)" and "per capita GDP (PCY)." The data of DVA are retrieved from the UNCTAD–Eora Global Value Chain Database, and those of PCY are taken from the UNCTADstat series of "gross domestic product per capita, US dollars as constant prices (2010)."

Focusing on the key variables above, we constructed a set of panel data for 1990–2018 using 72 middle-income economies for estimation. The sample range of time series follows the availability of the UNCTAD–Eora Global Value Chain Database.[5] The selection of middle-income economies was based on the 2018 World Bank classification, which contains upper- and lower-middle-income countries.[6] The 72 economies were classified by geographical regions into 21 in Asia, 16 in Latin America, four in Oceania,

[5] In the case that the estimation contains the countries independent of the USSR, the sample range is 1992–2018 due to the data constraints.
[6] See the website: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519.

18 in Africa, six in Europe, and seven in the Middle East (Table 1).[7] Among the sample economies, the present study also focuses on manufacturing-based economies, as the knowledge-capital model assumes that FDI activities take place mainly in the manufacturing sector. In this study, manufacturing-based economies are defined as those in which the value-added of the manufacturing sector as a percentage of GDP was more than 15% in 2017. This covers approximately half of the sample economies, as indicated with the asterisk (*) in the last column in Table 1.

All the sample data for estimation are converted into natural logarithmic form to avoid scaling-related problems. Then, the equation to be estimated with respect to economy *i* in time period *t* is specified as follows:

$$DVA_{it} = \alpha_0 + \alpha_1 * PCY_{it} + \alpha_2 * (PCY_{it})^2 + \alpha_3 * f_i + \alpha_4 * d_t + \alpha_5 * mpo_{it} + e_{it} , \qquad (1)$$

where

f_i is the exogenously given economy-specific factor;

d_t is the time dummy for year *t*;

mpo_{it} is the market potential in country *i* for year *t*;

e_{it} is the residual error term;

α_0 is the constant term; and

α_1 through α_5 are coefficients on the explanatory variables.

This study applies a fixed-effect model (represented by f_i) for the panel estimation. From the statistical perspective, the Hausman-test statistic is generally utilized for the choice between a fixed-effect model and a random-effect model (Hausman, 1978). However, this study places a premium on the existence of exogenously given economy-specific factors that are supposed to affect domestic value creation in exports. For instance, time-invariant factors such as geographical property and political system might differ widely among the sample economies, and these economy-specific factors might also be correlated with domestic value creation in exports. If these factors allow the error terms to be correlated with each other among the sample economies for the given sample period, a specification that ignores this correlation would lead to an inefficient estimation. To capture those factors that are not distributed randomly among the sample economies, a fixed-effect model should be adopted in the present study. The time dummy represented by d_t reflects economic fluctuations due to external shocks such as the Asian financial crises in 1997–1998 and the global financial crises in 2008–2009.

Aside from controlling the time-invariant fixed-effects and the time dummy, this study also handles the time-variant economy-specific effects. There are plenty of

[7] Oil-producing countries that belong to OPEC are excluded from the sample.

candidates for the variables to capture those effects: human capital, labor productivity, policy framework, institutional quality, etc. These factors would indeed affect the shape and turning point of the alternative smile curve. However, if added as variables in the equation, such factors would induce multicollinearity with per capita GDP (PCY) or another endogeneity problem with the error terms. The selection of those variables would also affect the theoretical consistency of the knowledge-capital model. Including the time-variant variables should, therefore, be carefully designed from the empirical and theoretical perspectives, which is beyond the scope of this study. Thus, this study focuses only on the market potential that can be hardly correlated with PCY as the time-variant economy-specific factor and leaves the selection of another variable up to future studies. Market potential has been computed based on the measuring method presented by Krugman (1992): a weighted sum of the partner country's GDP with the weights depending inversely on geographical distance.[8]

The estimation is conducted in a linear form between DVA and PCY in addition to in the quadratic form, as shown in Equation (1), to uniquely identify the alternative smile curve. In the quadratic estimation, the signs and magnitudes of α_1 and α_2 are examined. If the calculated value $-\alpha_1/(2*\alpha_2)$ for the turning point falls within a significant range of per capita GDP for middle-income countries (from \$1,026 to \$12,375 US based on the classification presented by the World Bank in 2018) with $\alpha_1 < 0$ and $\alpha_2 > 0$, a meaningful curve can be obtained.

4.2 Estimation Outcomes and Discussions

Table 2 and Figure 15 report the estimations of the relationship between DVA and PCY. Table 2.1 presents the outcomes of the total economies, the manufacturing-base economies, and the other economies. Table 2.2 shows the outcomes by geographical regions: Asia, Latin America, and Africa. Figure 15 illustrates the identified smile curves of Asia and Latin America.

In Table 2.1, the estimation results of the total economies show that the linear equation has a significantly positive PCY coefficient, whereas the quadratic equation has a negative PCY coefficient and a positive square of PCY (as expected). The turning point is \$405 US per capita GDP, which is too small to be from the middle-income group range. When focusing on the manufacturing-based economies, the linear estimation has an

[8] The GDP and geographical distance were respectively retrieved from the World Bank Open Data (https://data.worldbank.org/) and "dist_cepii" included in the GeoDist database compiled by CEPII (http://www.cepii.fr/cepii/en/bdd_modele/presentation.asp?id=6).

insignificant PCY coefficient, whereas the quadratic estimation has a negative PCY coefficient and a positive square of PCY (as expected). The turning point is $1,860 US per capita GDP, which is a reasonable level within the range of the middle-income group. As for the other non-manufacturing-based economies, the PCY coefficient is significantly positive in the linear equation and the coefficient of the square of PCY has an opposite sign in the quadratic estimation. In sum, it is only in the case of the estimation that focuses on manufacturing-based economies that the meaningful U-shaped curve with a reasonable turning point is identified. This estimated outcome is consistent with the expectation that the extended knowledge-capital model described in Section 3 works well in FDI activities in the manufacturing sector.

Table 2.2 reports the estimation results for only three geographical regions: Asia, Latin America, and Africa, because the other regions—Europe, the Middle East, and Oceania—have a limited number of sample economies. The results for Asian economies reveal that the linear equation has a negative PCY coefficient, whereas the quadratic equation has a negative PCY coefficient and the expected positive one for the square of PCY, with the turning point being $2,731 US per capita GDP, which falls within the range of the middle-income group. The Latin American economies' results also show that the quadratic equation has a negative PCY coefficient and a positive PCY square (as expected), with the turning point being $5,823 US per capita GDP, which falls within the range of the middle-income group, whereas the linear estimation has an insignificant PCY coefficient. In the case of African economies, the PCY coefficient is insignificant in the linear equation, and the coefficient of the square of PCY has an opposite sign in the quadratic estimation.

In summary, a meaningful U-shaped curve with a reasonable turning point was identified for the Asian and Latin American economies, but not for the African economies. The estimation results by geographical regions in Table 2.2 are consistent with those focusing on manufacturing-based economies in Table 2.1. Many Asian economies are manufacturing-based—16 out of 21 sample economies. However, fewer African economies are manufacturing-based—6 out of 18 sample economies. There is also a smaller number of manufacturing-based Latin American economies (5 out of 16), but the average manufacturing ratio to GDP (13.9%) of Latin American economies is larger than is that of African economies (12.1%).

Another point to be discussed is the differences between the turning points of the Asian and Latin American economies' curves: the turning point in the Latin American smile curve (5,823 US dollars) is much higher than is that of the Asian one ($2,731 US). The difference may result from development gaps in the host sample economies and the home countries when considering the FDI activities in Latin American and Asian areas. The sample economies of FDI-hosting countries are mainly upper middle-income economies (12 out of 16 samples) in Latin America. However, most Asian economies are lower middle-income countries (14 out of 21 samples). The FDI activities are also affected by the factor prices in home countries, in addition to those in host countries. The home countries investing in Latin American economies are mainly the US and Canada, whereas those investing in Asian economies are generally Japan, Korea, and China. Looking at per capita GDP as a proxy for factor prices, there are gaps between the two groups: the per capita GDPs of the US and Canada in 2019 were $65,112 and $46,213 US, respectively, whereas those of Japan, Korea and China are $40,847, $31,431, and $10,098 US, respectively.[9]

All these estimations target the overall industry in the variable DVA, domestic value-added share to gross exports, as shown on the vertical axis of Figure 15. For a robustness check, we also conducted an additional estimation targeting the DVA focusing just on the manufacturing sector. The estimation results presented in the Appendix show almost the same patterns as the original results for the overall industry: meaningful U-shaped curves are identified in Asian and Latin American economies with different turning points. It can be speculated that the curves would be affected by the maturity (the degree of upgrading) of the manufacturing sector in sample economies, and the maturity can be confirmed only in Asia and Latin America, but it cannot be confirmed in Africa and the entire sample economies. More extensive investigations are required to explore the factors that create different alternative smile curves combined with industry- and firm-level evidence.

In summary, manufacturing-based middle-income economies have a meaningful U-shaped curve, with the turning point at approximately $2,000 US, as suggested by the extended knowledge-capital model. From the geographical perspective, Asian and Latin American middle-income economies also have U-shaped curves. However, their turning points are different, likely due to the gaps in their economic environments related to FDI activities.

5. Concluding Remarks

This paper has explored how the empirical turning point of regaining domestic value-added embedded in exports corresponds to the theoretical transformation in types of FDI

[9] The data of per capita GDP are retrieved from the World Economic Outlook Database (October 2019) presented by the International Monetary Fund (IMF).

that host emerging market economies invite. Utilizing the 1990–2018 panel data of 72 middle-income countries compiled from the latest UNCTAD–Eora Global Value Chain Database, alternative smile curves in the relationships between the domestic value-added share to exports and per capita GDP—derived from an extended version of the knowledge-capital model—have been empirically estimated and tested for statistical significance.

The estimation results show that manufacturing-based middle-income economies have a meaningful U-shaped curve, with the turning point being at approximately $2,000 US per capita GDP, as suggested by the knowledge-capital model. Further examination of geographical characteristics has shown that the Asian and Latin American middle-income economies have their own curves, although the turning points are different ($2,731 dollars for Asia, and $5,823 US for Latin America). These differing points are likely due to the gaps in their economic environments related to FDI activities. These turning points correspond to the points where the costs of affiliate production begin to be a burden for MNEs because of the appreciated rental price of (unskilled) labor. Beyond these points, MNEs start to change their operational strategies and either withdraw their production facilities back home for the domestic market or just move to another low-cost country. On the other hand, MNEs will stay in the host country, adopting the horizontal FDI strategy as long as the country remains an attractive market.

The knowledge-capital model suggests that policies that enhance a country's attractiveness as a market by expanding domestic demand would go beyond the turning point and enable the economy to grow further. It would also be effective to improve the environment in which high-skilled workers can play active roles by developing human resources through education and other services such as job training.

Acknowledgments

The authors would like to express their sincere gratitude to Kyoji Fukao, Kazunobu Hayakawa, Hitoshi Sato, and Shujiro Urata for their helpful comments and suggestions. The authors are also indebted to Kazunobu Hayakawa for his paramount kindness providing a set of data related to the market potential.

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Table 1. List of Sample Economies

Regions	Economies	Classification	GDP per capita USD in 2018	Manufacturing % of GDP in 2017
Asia	Bangladesh	Lower Middle	1,195	18.3 *
	Bhutan	Lower Middle	3,357	8.2
	Cambodia	Lower Middle	1,200	17.1 *
	China	Upper Middle	7,585	33.9 *
	India	Lower Middle	2,078	16.7 *
	Indonesia	Lower Middle	4,286	21.0 *
	Kazakhstan	Upper Middle	11,274	11.9 *
	Kyrgyzstan	Lower Middle	1,090	16.9 *
	Laos	Lower Middle	1,838	8.4
	Malaysia	Upper Middle	12,107	22.6 *
	Maldives	Upper Middle	7,962	2.5
	Mongolia	Lower Middle	4,179	9.5
	Myanmar	Lower Middle	1,325	23.6 *
	Pakistan	Lower Middle	1,174	12.7
	Philippines	Lower Middle	3,021	19.5 *
	Sri Lanka	Upper Middle	4,013	17.6 *
	Tajikistan	Lower Middle	1,017	19.1 *
	Thailand	Upper Middle	6,342	27.1 *
	Turkmenistan	Upper Middle	7,641	47.2 *
	Uzbekistan	Lower Middle	2,107	24.8 *
	Viet Nam	Lower Middle	1,961	17.0 *
Latin America	Belize	Upper Middle	4,330	8.4
	Bolivia	Lower Middle	2,564	12.1
	Brazil	Upper Middle	10,972	12.1
	Colombia	Upper Middle	7,712	12.3
	Costa Rica	Upper Middle	9,868	12.7
	Cuba	Upper Middle	6,739	13.6
	Dominican Republic	Upper Middle	7,586	14.2
	El Salvador	Lower Middle	3,401	17.8 *
	Guatemala	Upper Middle	3,159	18.5 *
	Honduras	Lower Middle	2,215	17.7 *
	Jamaica	Upper Middle	4,832	9.0
	Mexico	Upper Middle	10,385	18.2 *
	Nicaragua	Lower Middle	1,860	15.2 *
	Paraguay	Upper Middle	4,104	12.4
	Peru	Upper Middle	6,455	14.0
	Suriname	Upper Middle	7,954	14.0

Regions	Economies	Classification	GDP per capita USD in 2018	Manufacturing % of GDP in 2017
Africa	Botswana	Upper Middle	7,985	5.6
	Cameroon	Lower Middle	1,498	16.5 *
	Cape Verde	Lower Middle	3,750	7.4
	Cote dIvoire	Lower Middle	1,689	13.5
	Djibouti	Lower Middle	1,757	5.2
	Egypt	Lower Middle	2,850	16.7 *
	Ghana	Lower Middle	2,397	11.7
	Kenya	Lower Middle	1,197	8.9
	Lesotho	Lower Middle	1,419	15.4 *
	Mauritania	Lower Middle	1,340	9.5
	Mauritius	Upper Middle	10,566	13.3
	Morocco	Lower Middle	3,611	17.8 *
	Namibia	Upper Middle	6,053	11.5
	Sao Tome and Principe	Lower Middle	1,306	7.4
	Senegal	Lower Middle	1,553	17.9 *
	South Africa	Upper Middle	7,445	13.2
	Tunisia	Upper Middle	4,344	16.1 *
	Zambia	Lower Middle	1,673	10.0
Europe	Albania	Upper Middle	5,056	6.8
	Bosnia and Herzegovina	Upper Middle	6,043	15.1 *
	Bulgaria	Upper Middle	8,619	16.6 *
	Montenegro	Upper Middle	8,158	4.6
	Romania	Upper Middle	11,433	23.9 *
	Ukraine	Lower Middle	2,972	14.7
Middel East	Armenia	Upper Middle	4,696	11.2
	Azerbaijan	Upper Middle	5,787	5.1
	Georgia	Upper Middle	4,165	12.2
	Jordan	Upper Middle	3,221	20.2 *
	Lebanon	Upper Middle	6,284	9.2
	Syria	Lower Middle	1,748	4.7
	Turkey	Upper Middle	15,027	19.8 *
Oceania	Fiji	Upper Middle	4,541	12.0
	Papua New Guinea	Lower Middle	2,135	2.4
	Samoa	Upper Middle	3,988	8.4
	Vanuatu	Lower Middle	2,820	3.5

Notes: 1) The classification is based on that of the World Bank in 2018.
2) The per capita GDP is that of 2010 constant prices retrieved from UNCTADstat.
3) The manufacturing as percentage of GDP is retrieved from UNCTADstat. The data for China that are not available in UNCTADstat come from the Key Indicators for Asia and the Pacific 2019 of ADB, in which "manufacturing" is combined with "mining and quarrying," "electricity, gas, steam, and air-conditioning supply," and "water supply, sewerage, waste management, and remediation activities." The "*" symbol denotes that the ratio is more than 15%.

Sources: The World Bank and UNCTADstat.

Table 2. Estimation of the Alternative Smile Curves

[Table 2.1: Total Sample, Manufacturing-based Sample, and Other Sample]

Total Sample Economies	DVA	DVA
Const.	4.188***	4.616***
	(110.975)	(65.174)
PCY	0.025***	-0.102***
	(6.117)	(-5.535)
PCY^2		0.008***
		(7.579)
mpo	-0.006	0.014
	(-0.392)	(0.763)
Turning Point USD (share %)		405 (74.2)
Adj R^{**2}	0.865	0.866
Sample size	1,917	1,917
Manufacturing Based Economies	**DVA**	**DVA**
Const.	4.373***	4.746***
	(68.279)	(35.865)
PCY	-0.006	-0.131***
	(-1.221)	(-3.192)
PCY^2		0.008***
		(3.048)
mpo	0.016	0.045*
	(0.861)	(1.846)
Turning Point USD (share %)		1,860 (76.9)
Adj R^{**2}	0.844	0.845
Sample size	837	837
The Other Economies	**DVA**	**DVA**
Const.	3.966***	3.319***
	(69.112)	(15.599)
PCY	0.066***	0.243***
	(5.065)	(4.293)
PCY^2		-0.011***
		(-3.528)
mpo	-0.060*	-0.079**
	(-1.876)	(-2.329)
Turning Point USD (share %)		
Adj R^{**2}	0.890	0.890
Sample size	1,080	1,080

Note: *, **, and *** denote the rejection of the null hypothesis at the 90%, 95%, and 99% levels of significance. T-statistics are in the parentheses after coefficients.

Sources: UNCTAD–Eora Global Value Chain Database and UNCTADstat.

[Table 2.2: Samples by Geographical Regions]

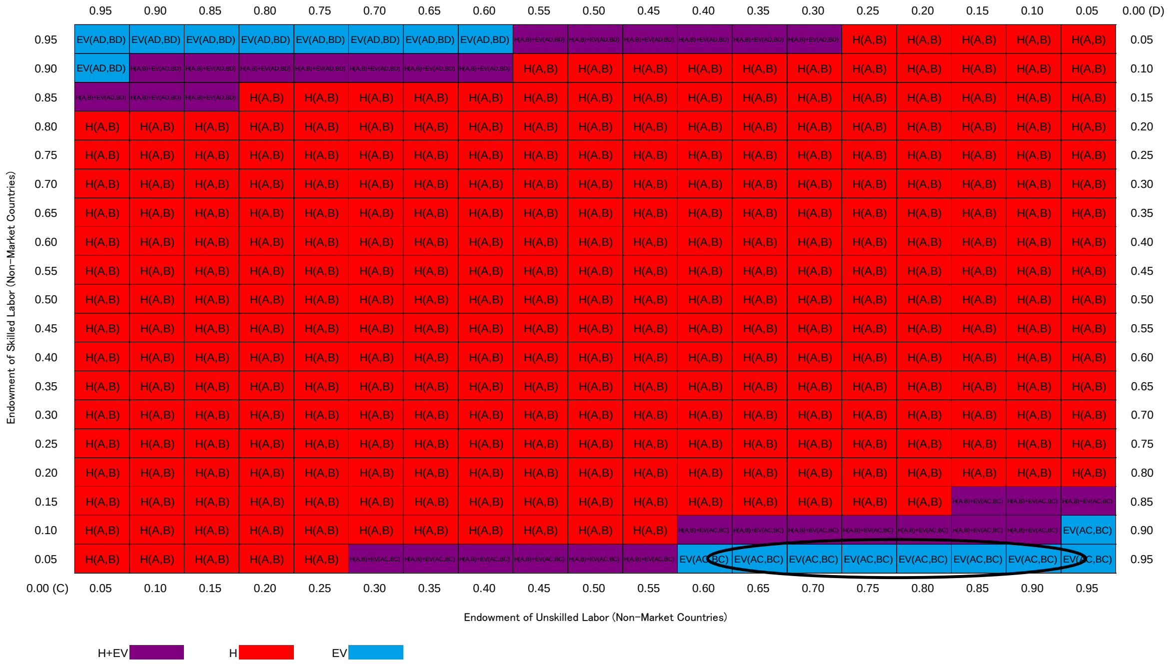
Asian Economies	DVA	DVA
Const.	4.854 ***	5.274 ***
	(44.997)	(53.637)
PCY	-0.035 ***	-0.217 ***
	(-3.936)	(-11.228)
PCY^2		0.013 ***
		(8.800)
mpo	-0.107 ***	-0.025
	(-4.093)	(-0.766)
Turning Point USD (share %)		2,731 (82.7)
Adj R^{**2}	0.899	0.902
Sample size	567	567

Latin American Economies	DVA	DVA
Const.	4.362 ***	5.357 ***
	(43.357)	(23.150)
PCY	-0.009	-0.260 ***
	(-0.930)	(-4.729)
PCY^2		0.015 ***
		(4.652)
mpo	0.061 *	0.085 **
	(1.894)	(2.431)
Turning Point USD (share %)		5,823 (81.4)
Adj R^{**2}	0.901	0.902
Sample size	464	464

African Economies	DVA	DVA
Const.	3.782 ***	2.205 *
	(9.301)	(1.807)
PCY	0.051	0.461 *
	(1.207)	(1.813)
PCY^2		-0.026 *
		(-1.929)
mpo	0.095 *	0.085
	(1.706)	(1.558)
Turning Point USD (share %)		
Adj R^{**2}	0.831	0.833
Sample size	522	522

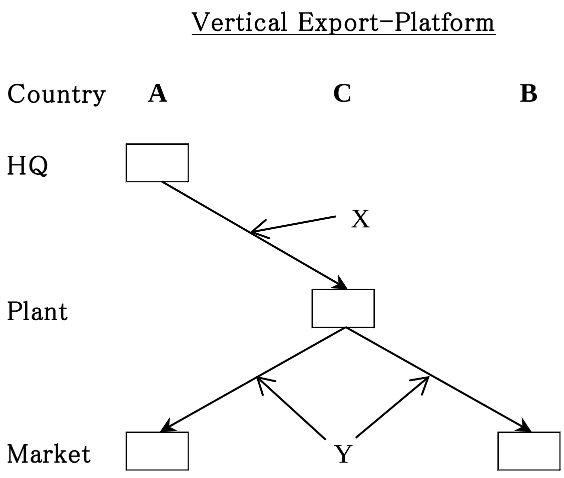
Note: *, **, and *** denote the rejection of null hypothesis at the 90%, 95%, and 99% levels of significance. T-statistics is in the parentheses after coefficients.
Sources: UNCTAD–Eora Global Value Chain Database and UNCTADstat.

Figure 1. Box Diagram for Non-Market Countries



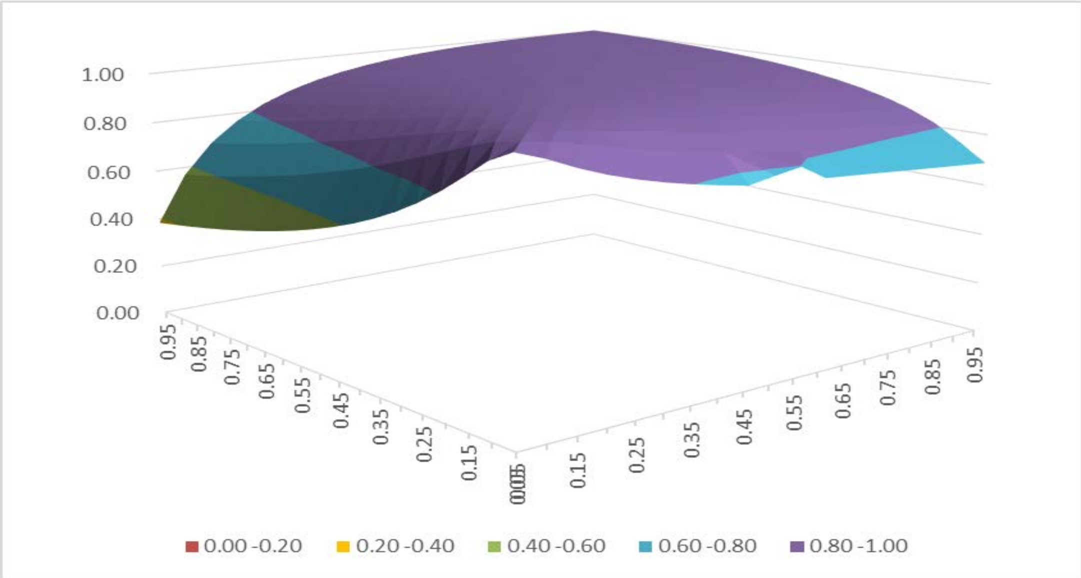
Source: Numerical Simulations by the Authors.

Figure 2. Image of the Vertical Export-Platform Operating in C Established in A



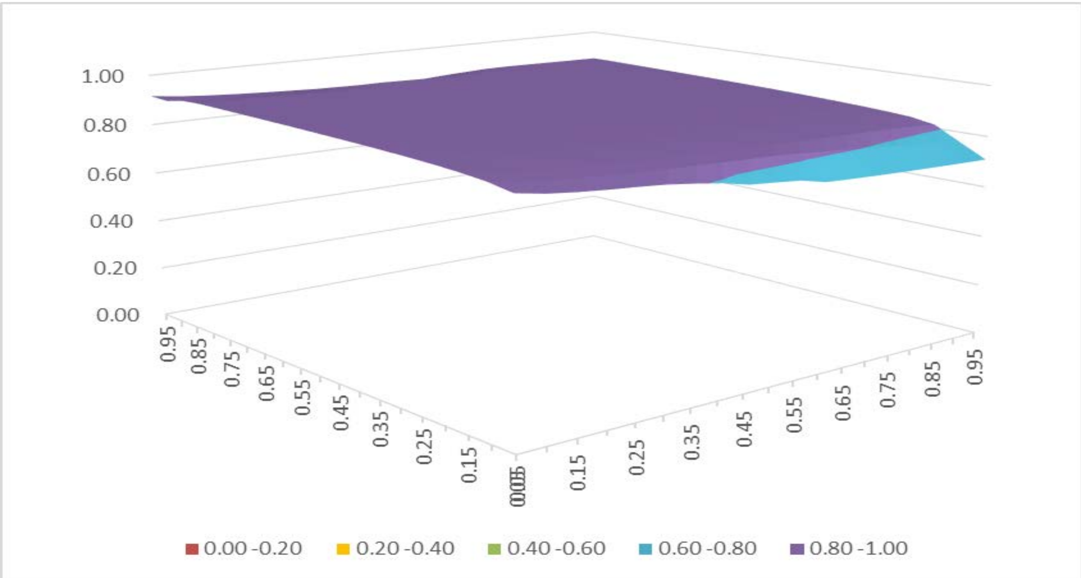
Source: Drawing by the Authors.

Figure 3. Per Capita GDP (Country C)



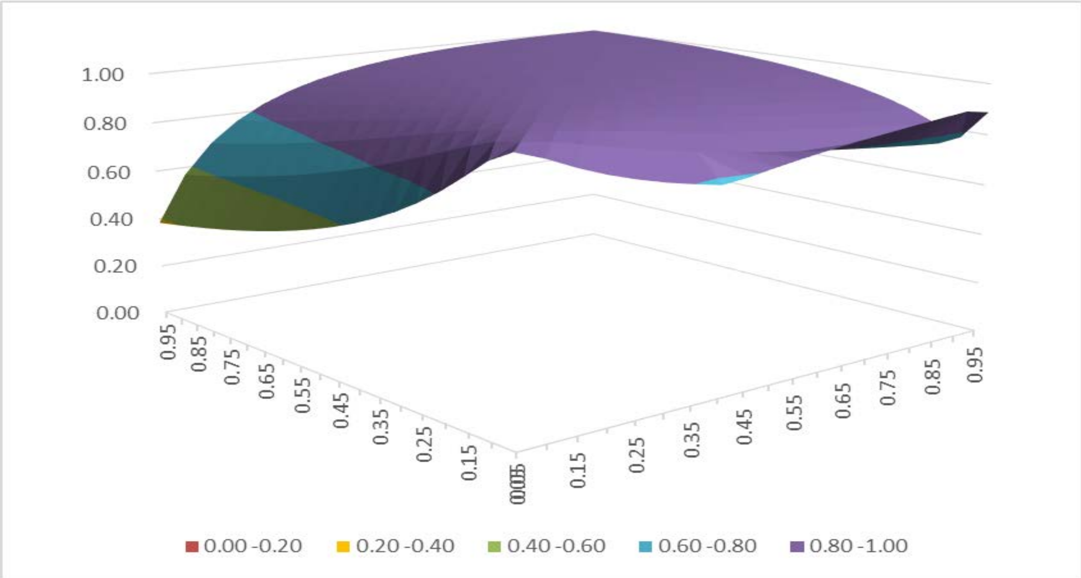
Source: Numerical Simulations by the Authors.

Figure 4. Domestic Value-Added Share to Exports (Country C)



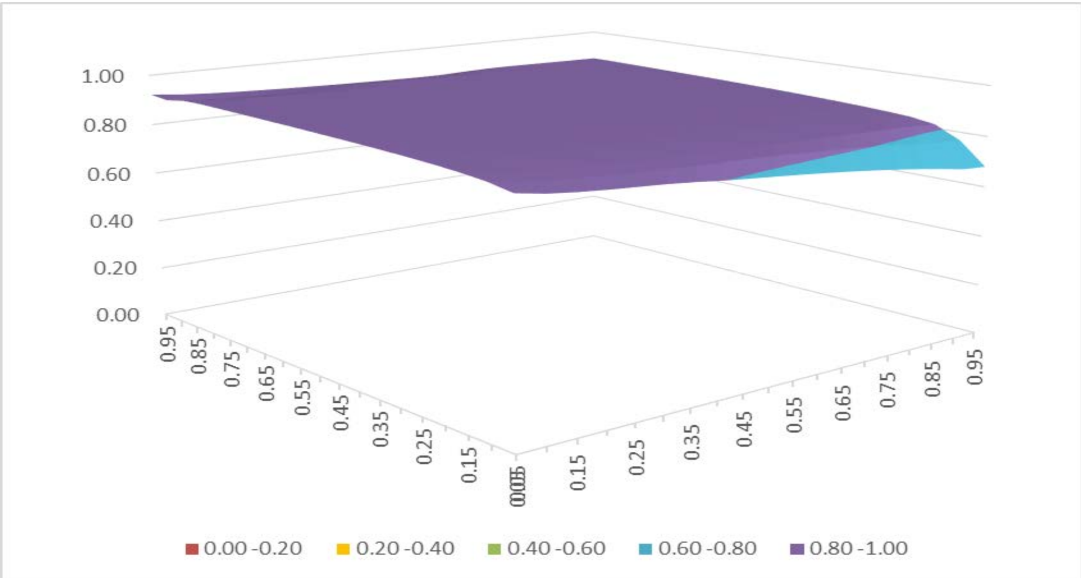
Source: Numerical Simulations by the Authors.

Figure 5. Per Capita GDP (Country C, Small Case)



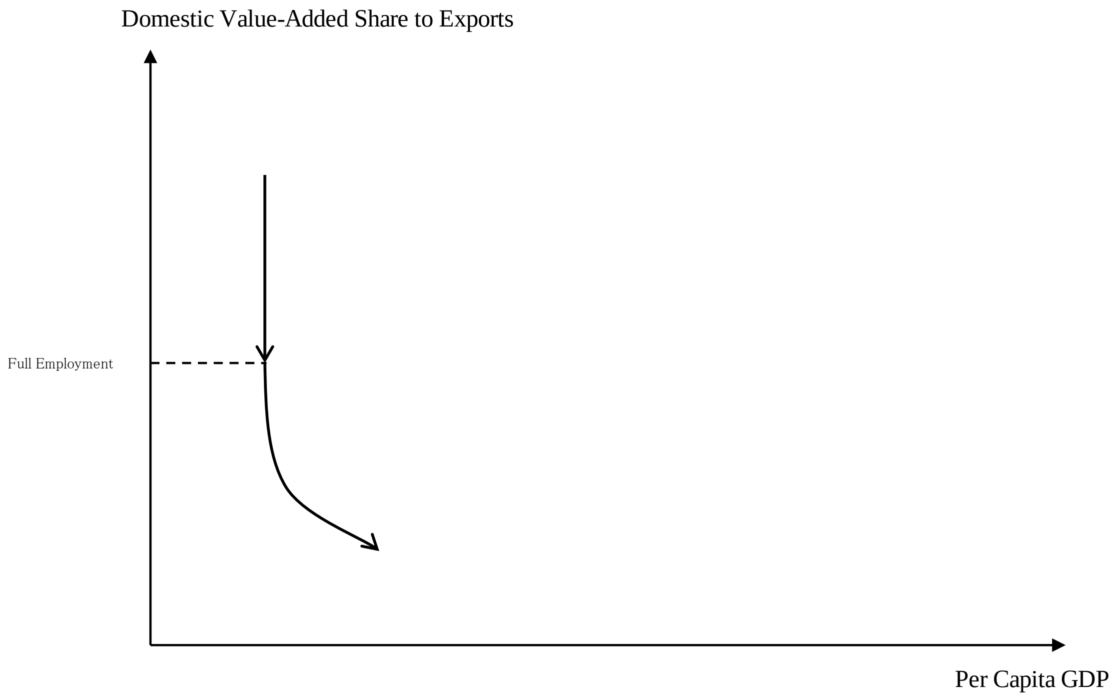
Source: Numerical Simulations by the Authors.

Figure 6. Domestic Value-Added Share to Exports (Country C, Small Case)



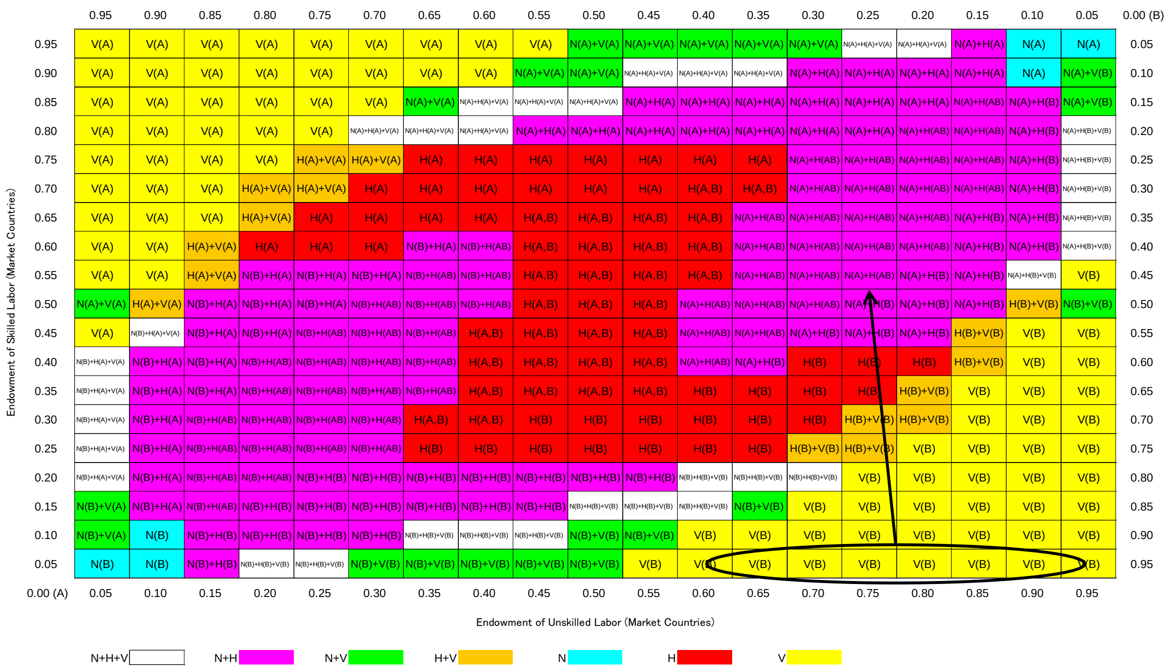
Source: Numerical Simulations by the Authors.

Figure 7. Left-hand-side Half of the Alternative Smile Curve



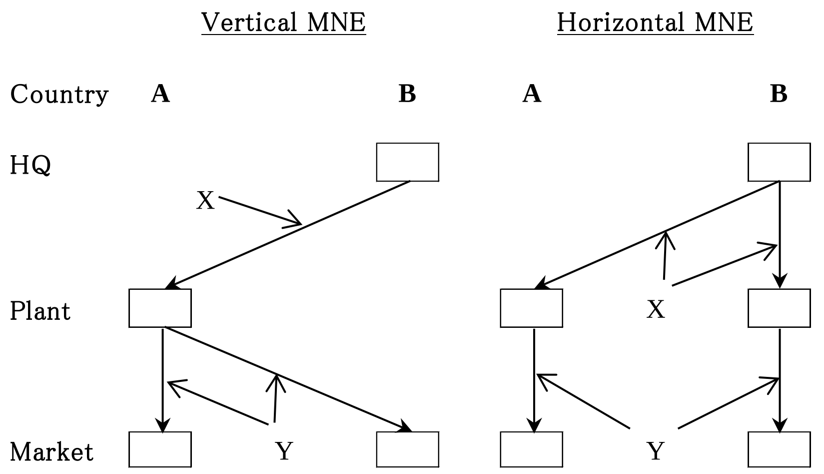
Source: Drawing by the Authors.

Figure 8. Box Diagram for Market Countries



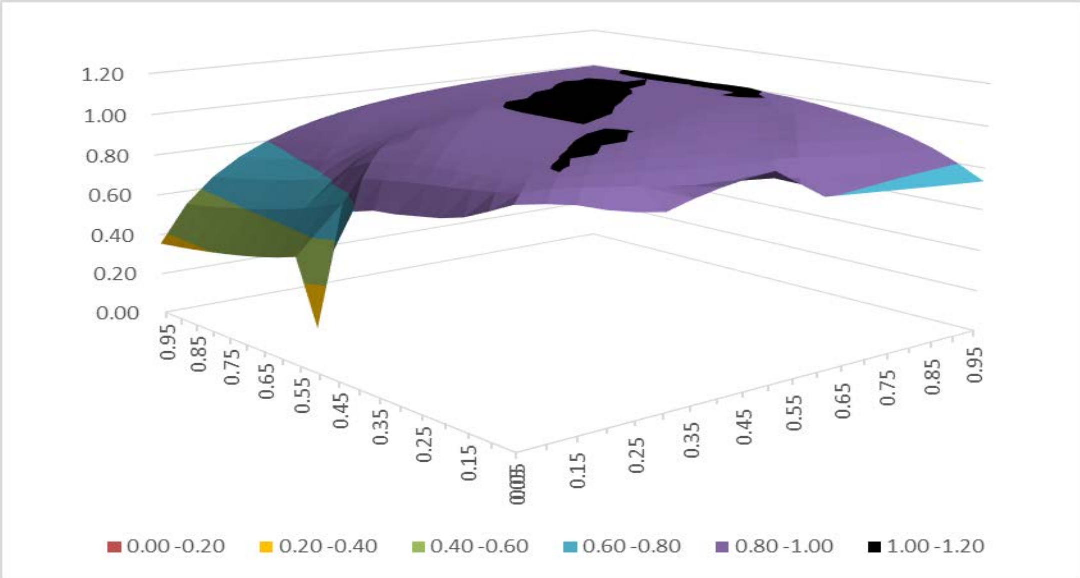
Source: Numerical Simulations by the Authors.

Figure 9. Images of the Vertical and Horizontal MNEs Established in B



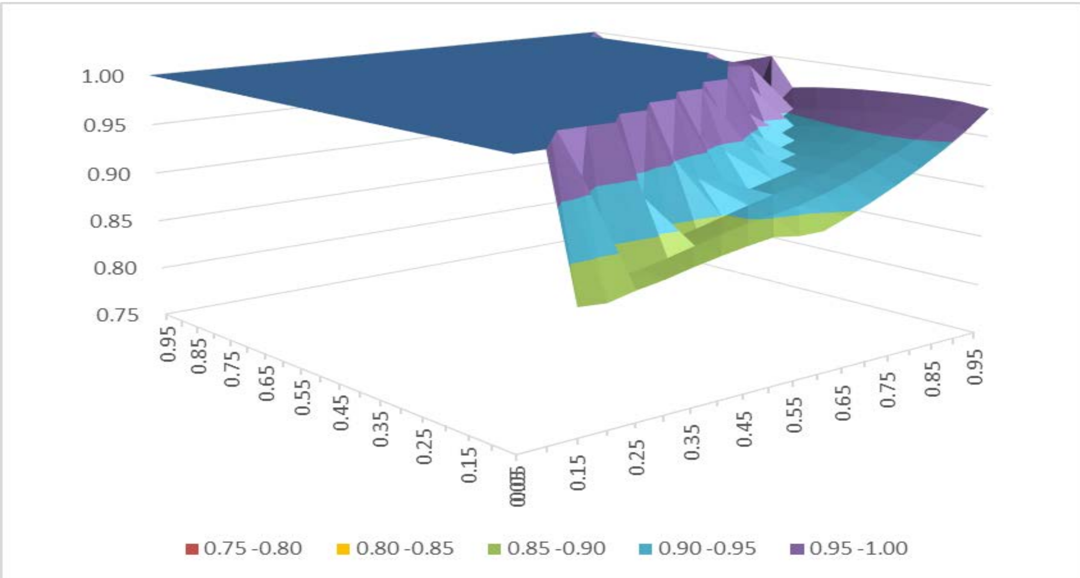
Source: Drawing by the Authors.

Figure 10. Per Capita GDP (Country A)



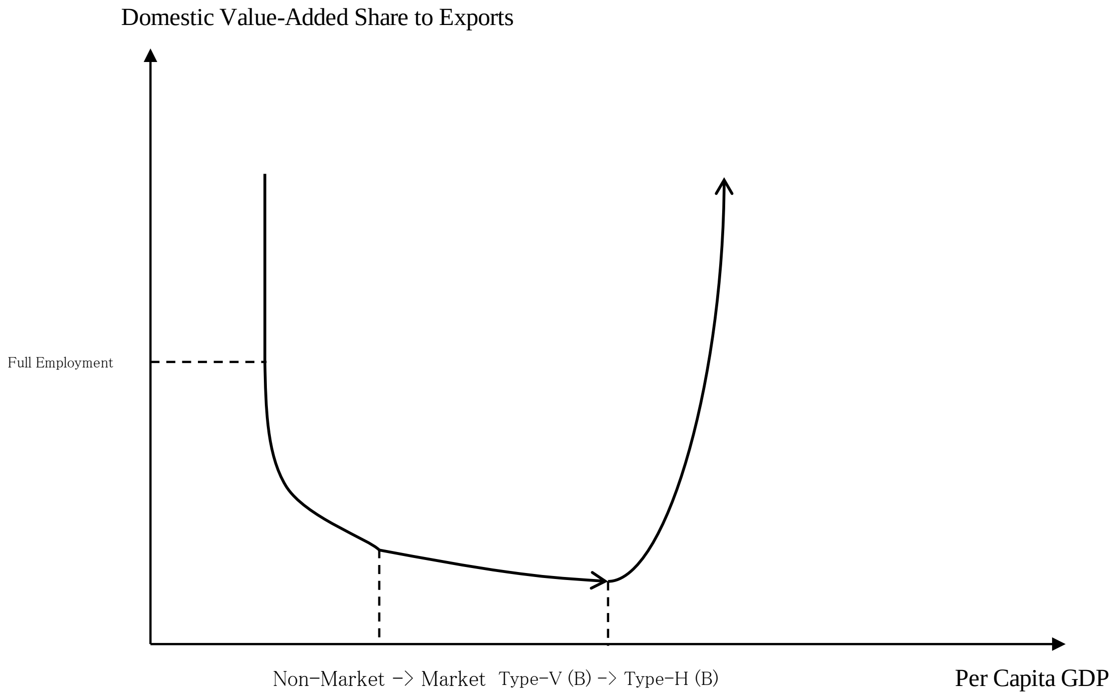
Source: Numerical Simulations by the Authors.

Figure 11. Domestic Value-Added Share to Exports (Country A)



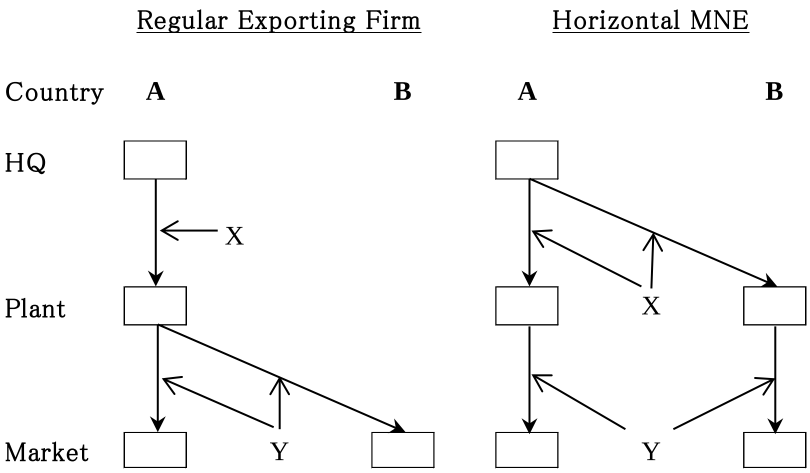
Source: Numerical Simulations by the Authors.

Figure 12. Right-hand-side Half of the Alternative Smile Curve



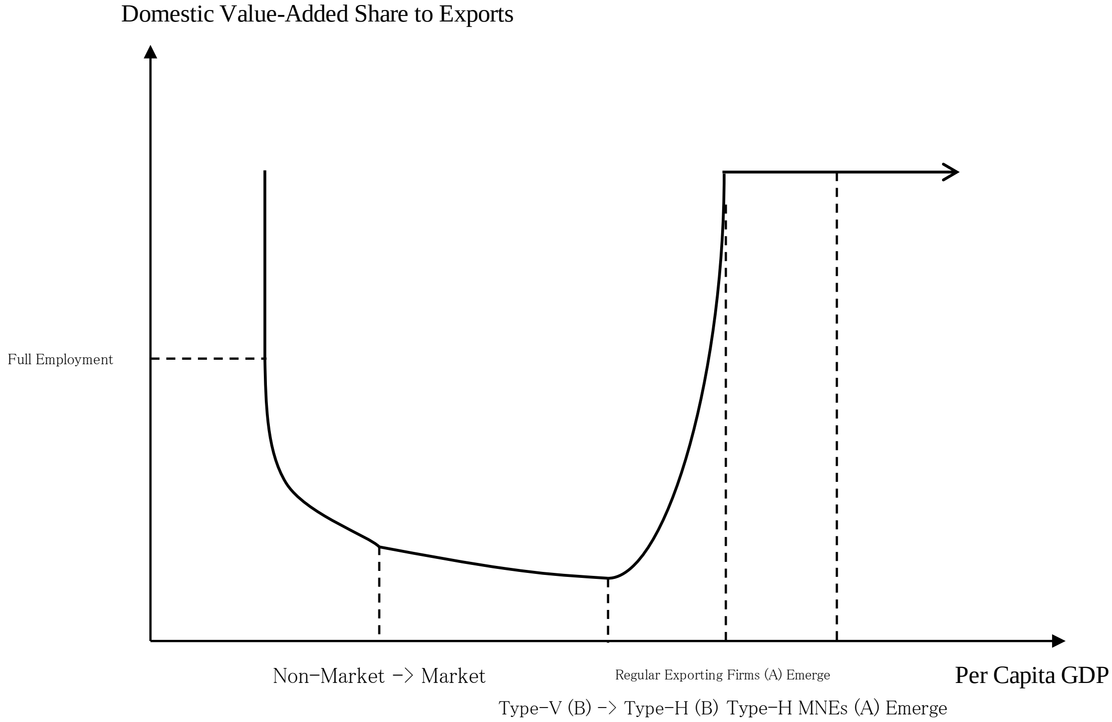
Source: Drawing by the Authors.

Figure 13. Images of the Regular Exporting Firm and Horizontal MNE Established in A



Source: Drawing by the Authors.

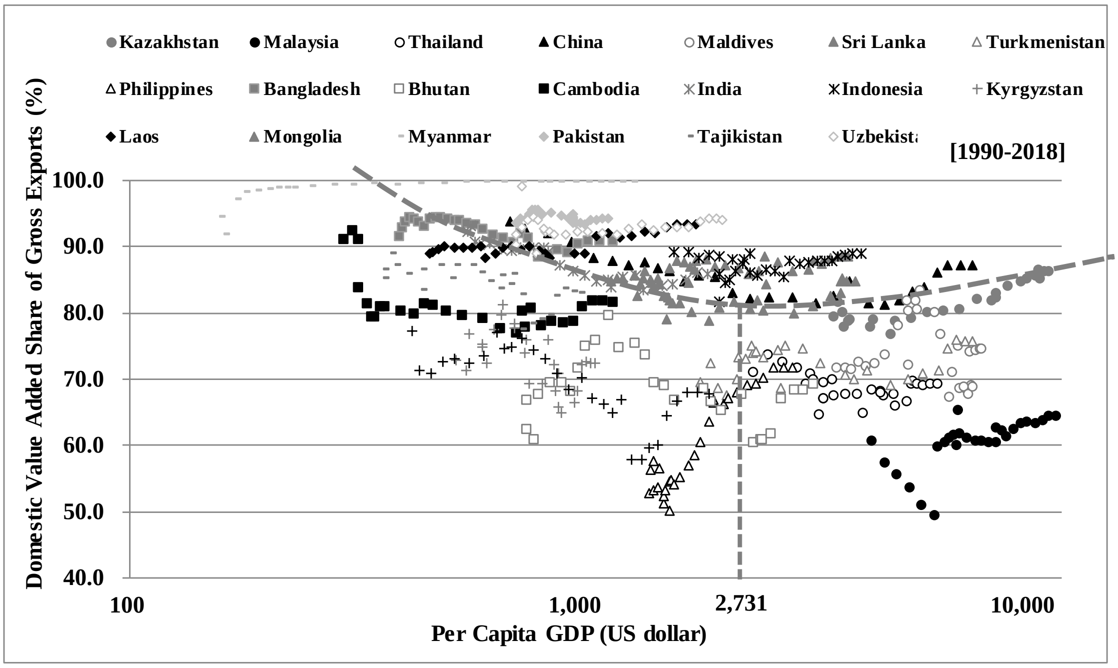
Figure 14. Whole Picture of the Alternative Smile Curve



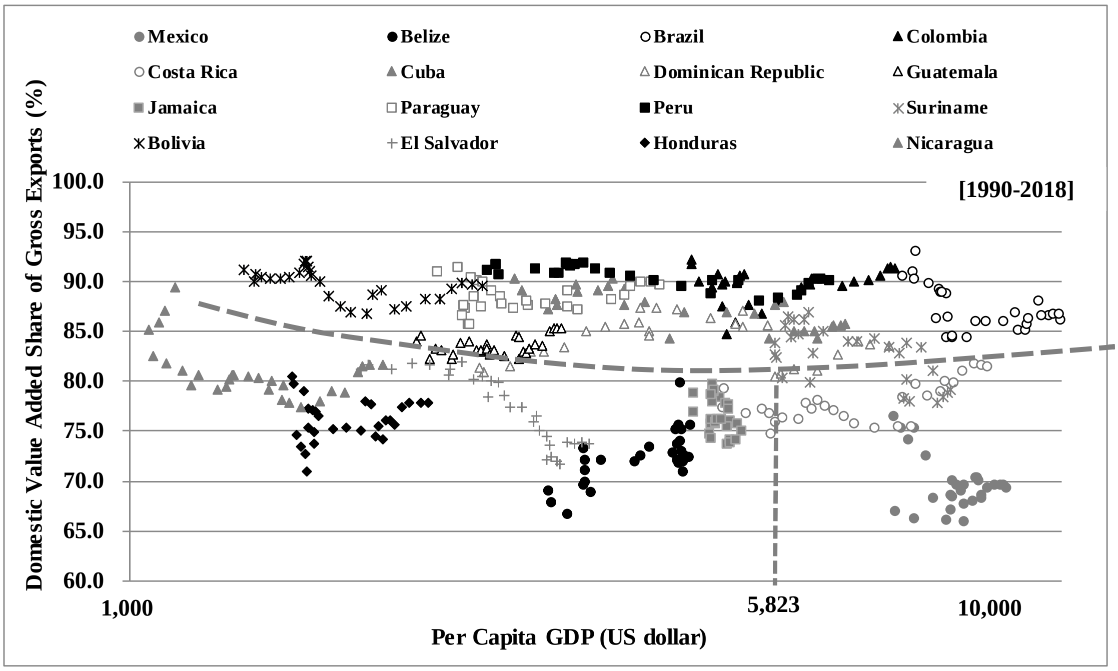
Source: Drawing by the Authors.

Figure 15. Description of the Alternative Smile Curves

[Asian Economies]



[Latin American Economies]



Sources: UNCTAD–Eora Global Value Chain Database and UNCTADstat.

Appendix. Estimation of the Alternative Smile Curves in Manufacturing Sector
[Total Sample and Samples by Geographical Regions]

Total Sample Economies	DVA	DVA
Const.	4.026 ***	4.915 ***
	(96.915)	(73.152)
PCY	0.044 ***	-0.217 ***
	(6.533)	(-11.867)
PCY^2		0.017 ***
		(13.777)
mpo	-0.032	0.003
	(-1.317)	(0.147)
Turning Point USD (share %)		476 (69.8)
Adj R^{**2}	0.860	0.862
Sample size	1,482	1,482

Asian Economies	DVA	DVA
Const.	4.431 ***	4.905 ***
	(57.098)	(43.929)
PCY	-0.017	-0.152 ***
	(-1.310)	(-5.933)
PCY^2		0.009 ***
		(5.685)
mpo	0.005	0.001
	(0.389)	(0.084)
Turning Point USD (share %)		2,916 (73.6)
Adj R^{**2}	0.071	0.045
Sample size	494	494

Latin American Economies	DVA	DVA
Const.	4.865 ***	7.846 ***
	(13.605)	(9.626)
PCY	0.014	-0.735 ***
	(0.719)	(-4.696)
PCY^2		0.044 ***
		(4.738)
mpo	-0.311 *	-0.232
	(-1.719)	(-1.627)
Turning Point USD (share %)		3,878 (77.3)
Adj R^{**2}	0.819	0.829
Sample size	280	280

African Economies	DVA	DVA
Const.	3.475 ***	3.031 *
	(5.505)	(1.794)
PCY	0.040	0.167
	(0.761)	(0.385)
PCY^2		-0.008
		(-0.319)
mpo	0.268	0.249
	(1.420)	(1.193)
Turning Point USD (share %)		
Adj R^{**2}	0.862	0.862
Sample size	420	420

Note: * and *** denote the rejection of the null hypothesis at the 90% and 99% levels of significance. T-statistics are in the parentheses after coefficients. For the estimation of Asian economies, the study uses a "random-effect" model instead of a fixed-effect one, as the fixed-effect model does not create meaningful outcomes because of missing data in some countries.

Sources: UNCTAD–Eora Global Value Chain Database and UNCTADstat.