

Value Chains, Production Networks and Regional Integration: The Case of Indonesia

(Rantai Nilai, Jaringan Produksi dan Integrasi Wilayah: Kes Indonesia)

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ABSTRACT

This study analyses the development of Indonesia within the Global Value Chain (GVC) and the transformation in its pattern of trade as a result of broader regional integration and more active participation within fragmented production networks. By employing an Inter-Country Input-Output model covering 64 countries and 34 different sectors, this study measures the integration of Indonesia within the Global Value Chain by breaking down its gross exports into components of value-added, covering the period of 1995 to 2015. The involvement of Indonesia within the GVC is analyzed through a set of indicators derived from a decomposition of the Leontief Input-Output system that completely splits gross exports into components of value-added. The system allows for differentiating value-added exports through intermediate inputs or final products, as well as direct exports, and indirect ones. The value-added components help to measure multiple-cross-border trade, domestic value, and foreign value embedded in exports, as well as to track how value-added travels across regional and global chains. The results indicate that Indonesian value-added exports expanded by more than 300% from 1995 to 2011, suggesting a change in the pattern of growth as the trade focus was re-directed towards Asian partners, mainly to specific sectors in East Asia: within mining (33% of the increase) and within manufacturing (41% of growth). Indonesia shifted towards exports of intermediate inputs within the initial section of the GVC. A substantial share of value-added goods traveled via regional partners towards international markets, although most of the domestic value-added remained in Asia. Indonesia differs from its ASEAN partners as it incorporates larger shares of domestic value-added in its exports than they do; it has a stronger role than they in exports of intermediate goods; it is more oriented towards regional partners; and has a lower presence than others within high technological exports.

Keywords: Global Value Chain; Production Networks; Regional Integration; Value-added trade; Vertical Specialization

ABSTRACT

Kertas ini menganalisis pembangunan Indonesia dalam Rangkaian Nilai Global (GVC) dan transformasi dalam pola perdagangan akibat daripada adanya integrasi wilayah yang lebih luas dan penglibatan yang lebih aktif dalam fragmentasi jaringan produksi. Dengan menggunakan model Input-Output Antara Negara yang terdiri daripada 64 buah negara dan 34 buah sektor yang berbeza, kajian ini mengukur integrasi Indonesia dalam Rangkaian Nilai Global (GVC) dengan memecahkan pertumbuhan eksport kepada komponen nilai tambah yang meliputi tahun 1995 hingga 2015. Penglibatan Indonesia dalam Rangkaian Nilai Global (GVC) dianalisis melalui sejumlah indikator yang diterbitkan dari penguraian sistem Input-Output Leontief yang membahagikan pertumbuhan eksport kepada komponen nilai tambah. Sistem tersebut mampu membezakan nilai tambah eksport melalui input pengantaraan dan produk terakhir, begitu juga dengan eksport langsung dan tidak langsung. Komponen nilai tambah dapat membantu untuk mengukur gandaan lintas batas perdagangan, nilai domestik dan nilai asing terbenam dalam eksport dan juga untuk mengesan bagaimana nilai tambah berjalan melangkaui rantaian daerah dan global. Hasil membuktikan bahawa nilai tambah eksport berkembang melebihi 300% daripada tahun 1995 hingga ke 2011, mencadangkan perubahan dalam corak pertumbuhan dan focus perdagangan diarahkan semula ke rakan kongsi Asian, kebanyakannya kepada sektor yang spesifik di Asia Timur: perlombongan (33% peningkatan) dan perkilangan (41% pertumbuhan). Peralihan Indonesia kepada input pengantaraan pada bahagian awal GVC. Perkongsian kekayaan bagi nilai tambah barang adalah dalam lingkungan wilayah sehingga pasaran antarabangsa, walaupun kebanyakan nilai tambah domestik kekal di Asia. Indonesia berbeza daripada rakan kongsi ASEAN kerana menggabungkan nilai tambah domestik yang lebih besar dalam eksportnya berbanding apa yang dilakukannya; ia mempunyai peranan yang lebih besar daripada mereka dalam eksport barang perantaraan

Keywords: Jejaring Produksi; Integrasi Regional; Indonesia; Rantai Nilai Global; Nilai Tambah Eksport



INTRODUCTION

Exports from Indonesia expanded more than 300% from 1995 to 2015, with Indonesia experiencing changes in its pattern of trade and finding new sources of growth as it re-directed export efforts towards Asian partner (Southeast and East Asia Networks), focusing on exports within the natural resource sectors and re-orienting attention towards intermediate inputs and raw goods rather than final products. The rapid development of fragmented production networks in Asia most likely influenced the deeper internationalization of Indonesia. Additionally, between 1995 and 2011, Indonesia benefited from a sharp increase in the prices of commodities (where the country possessed a clear advantage); from a vast expansion in demand for exports across Asia; and from its more active and conscious policy towards trade liberalization and integration. With the rapid growth of the fragmented networks across Asia, demand for intermediate parts and components (hereafter IPC) throughout the region increased, leading to the formation of 'Factory Asia' (Baldwin & Lopez-Gonzalez, 2015).

Although countries within Asia have changed in the way they participate within the vertical trade and fragmented networks (World Bank 2019), Indonesia seems to rely on large exports of one-way trade, which means it is missing out on being part of those fragmented networks where production is carried out in multiple locations, accounting for nearly 70% of total trade by 2015. Indonesia is playing an active role within the initial stage of the Global Value Chain (GVC), relying more on exports of intermediate parts, and strengthening its participation within Asian networks, but lagging in the sectors employing high technology, where its ASEAN partners are doing better (Padilla et al. 2019). Indonesia's long-forgotten participation in the GVC (especially in the manufacturing sector) suggests the need for a further analysis of how sectors across Indonesia might integrate into the GVC.

This study questions whether Indonesian sectors are becoming more interconnected within the GVC, whether fragmentation of production networks from Indonesia was mainly directed at regional partners or across regional blocs. While Indonesia expanded in gross export terms to regional Asian partners, it is less known to what extent production fragmentation has led Indonesian value-added exports to global markets (non-Asian). The study aims to understand: how extensive the change in participation across sectors in Indonesia is within the GVC; which sectors have experienced the most profound benefits from fragmentation in production networks; how the value-added exports from Indonesia travel across value chains (regional and global).

Several studies covering trade analysis within the context of production networks and vertical

specialization and integration, offer contributions to value-added measurements Koopman et al. (2014), participation in GVC across countries and sectors (Los et al. 2015), and the determinant factors stimulating more extensive involvement within the GVC (Rasiah et al. 2016). On the other hand, this paper deals with a single country case as trade data is far-reaching, and literature in the field of Global Value Chain has rarely thoroughly examined how Indonesia integrates with other countries in the GVC. Previous studies, including Indonesia, have presented regional comparisons, but were limited in scope, and missed giving a complete picture of where Indonesia stands. Indonesia plays a different role in the GVC when compared to its Southeast Asian (ASEAN) and other Asian partners, following a different path of growth, as commonly suggested in the literature (Kiyota et al. 2017; López González 2017; Purwono et al. 2019). Few papers have emphasized the gains offered by the GVC across the export sectors in Indonesia; the changes in Indonesia's participation in vertical trade; the threats created by liberalization; or the opportunities offered by fragmented networks. The GVC impact analysis missing at both the sectoral level and across Indonesia's top regional partners, opens an empirical gap.

The implications of Indonesia's greater integration within the GVC are important, not only as such participation impacts the structure of production and specialization, but also as it has to do with gains/threats in changes to global demand. Bems et al. (2011) point out that vertical linkages in the GVC account for a large share of the decline in international trade after 2011. Simola (2019) finds that GVC is a channel in which shocks due to tariff wars or economic shocks could be transmitted across countries. Besides, a clear understanding of how sectors participate within the GVC has implications for the incomes of workers (Aswicahyono et al. 2011), job creation, the participation of small and medium enterprises (SMEs), and industrial upgrading (Baldwin & Lopez-Gonzalez 2015; World Bank 2019).

Employing a World Input-Output table (OECD) covering 64 countries and 34 different sectors, this paper uses the Koopman et al. (2014) model to break down exports into indicators of value-added trade. The methodology allows separating value-added exported goods from intermediate inputs or final goods, direct and indirect exports (value-added), and domestic and foreign value-added that were embedded in exports for the years 1995 and 2011. Additional indicators are provided for the year 2015. However, this study focuses on the 1995-2011 period, which accounts for Indonesia's large expansion in global trade, whereas a decline in global trade characterizes the 2011-2015 period. From the different value-added terms, indicators of vertical specialization are derived and used to analyze integration within the GVC, the role played by sectors in vertical trade and patterns of integration across partners.

LITERATURE REVIEW

The vigorous growth of fragmented networks within Asia has attracted attention to the literature covering the global value chain. The dynamic development of cross-border trade, the more active participation (inclusion) of developing countries in regional and global contexts, adjustments from global to regional trade, and changes in leadership in global trade, suggest that Asian countries have gained in terms of relevance when it comes to vertical trade (R. Banga 2014). The widespread integration-liberalization in Asia, the significant reduction in tariffs, and the more coordinated implementation of facilitation measures seem to explain part of the rapid growth in regional trade in recent decades (Athukorala 2012; Baldwin & Lopez-Gonzalez 2015). Nevertheless, the literature covering fragmented networks suggests that linking producers to the global value chain is not sufficient for them to benefit from growth in the vertical specialization chain, as a substantial share in value-added (nearly 67%) originates from OECD members (R. Banga 2014). Emerging countries have expanded their participation within GVCs, but often retain significant dependency on the foreign intermediate parts and components needed to produce their exports (Esquivias Padilla et al. 2017). While substantial dependence on foreign inputs could drain the gains of developing countries participating in the GVC, the opposite (limited access) could constrain the ability of those countries to engage more deeply in fragmented production networks by preventing the exporters from achieving the strategic inputs required to be more competitive (López González 2017).

A significant challenge in measuring integration and participation in global trade now appears as the growth of fragmented structures has substantially increased over time (Hummels et al. 2001; Johnson & Noguera 2012; Timmer et al. 2014). More fragmented trade implies multiple cross-border transactions under the form of back-and-forth trade, and numerous intuitive accounting of value-added across different countries (Koopman et al. 2014). For instance, capturing a more precise indicator of vertical specialization requires decomposing gross exports into components of value-added.

Several studies offering an assessment of participation within vertical trade across countries and sectors are available (R. Banga 2014; Kowalski et al. 2015). Others, like that of Timmer et al. (2014), have decomposed value-added at a product level, focusing on gains of factors of production (labor and capital). However, studies covering Indonesia in more detail are missing, opening an empirical gap that needs to be filled about finding the potential gains to be made on Indonesia's deeper integration in vertical trade. A more precise analysis of Indonesia could allow comprehension of the benefits to be enjoyed from

its greater participation within the GVC, and a better understanding of how liberalization and integration are re-shaping production activity across sectors. Issues at sectoral and country-level often remain beyond the scope of most GVC literature, where the focus tends to be multi-country.

Literature covering Indonesia has identified the critical role that the country plays as a producer of intermediate goods, which constituted nearly 60% of its exports in 2012, thereby locating Indonesia within the initial section of the global value chain (Esquivias Padilla et al. 2017). Compared to regional partners within the ASEAN, Indonesia exports much larger shares of domestic value-added (88%), while it remains less vertically integrated (32%) versus ASEAN country partners (55%) (Padilla et al. 2019). The dissimilarity between Indonesia and its regional partners suggests the former's lower engagement in fragmented networks, its lower share of exports from manufacturing sectors, and reflects an inevitable delay in the adoption of strategies oriented towards exports (Athukorala 2011; 2012). Apart from that, Indonesia remains focused on sectors employing large shares of natural resources where domestic value-added is elevated (Koopman et al. 2014; López González 2017).

A large share of domestic value-added through natural resource sectors is linked to the strong forward position that Indonesia plays within the GVC, mainly as a supplier of raw goods and intermediate inputs. By contrast, ASEAN partners participate more actively through backward links (more common across higher technological sectors), which include large shares of foreign parts and components (Rasiah et al. 2016; World Bank 2019). Another characteristic of Indonesia is that it has lower engagement in sectors characterized by a widespread vertical sharing, which is noticeable with its lower access to foreign inputs needed in sectors such as automotive, electronics, machinery, and others (López González 2017). Malaysia, Singapore, Thailand, and Vietnam have expanded more rapidly within the GVC via backward participation and increasing sophistication of exports (World Bank 2019), with almost 40% of value-added in exports originating from foreign inputs (Esquivias Padilla et al. 2017).

By contrast, Indonesia has gained far more in global integration through forward linkages (Esquivias Padilla et al. 2017; López González 2017). While it is positive to have large domestic value-added content in exports, the low participation of Indonesia in vertical trade through backward linkages suggests that the country may be missing potential growth in exports, jobs, and income from more rapidly expanding export-oriented sectors' (López González 2017). The case of India displays similarities with Indonesia, indicating that lower gains can arise from joining the GVC (K. Banga 2016). Studies such as that of Rasiah et al. (2016b) covering the automotive sector in Indonesia,

suggest that regional links have supported the country's upgrading of its technological capabilities, suggesting that stronger backward and forward integration could help to increase Indonesia's competitiveness and greater participation in GVC.

More recently, the increasing integration of Indonesia with Asian countries has raised the issue of Indonesia's dependency on the sourcing of crucial inputs for its value-added exports from East Asian countries. Indonesia has increased its links with countries in East Asia, and in doing so, both developing a dependency on them for parts and components needed for domestic industries and increasing its dependence on markets (Athukorala & Yamashita 2006; Haddad 2007; Padilla et al. 2019).

The broad differences across sectors' participation in the GVC have opened an empirical gap for Indonesia. While the mining, food, and some manufacturing sectors are more vertically integrated within the GVC, others (e.g., electronics, transportation, machinery, and chemicals) have been outpaced by more competitive regional partners with implications of Indonesia growing at lower rates of expansion in global trade. Indonesia reports low involvement in the worldwide trade in services (nearly 20%) when compared with OECD countries (more than 50%), as noted by Banga (2014), thereby missing an opportunity to grow faster in global trade.

While regional studies covering ASEAN or East Asia are highly valuable, the conclusions raised at the local level may not reflect the role of Indonesia in terms of vertical trade. Implications arising from issues such as the share of foreign inputs included in a country's exports (Upward et al. 2013), and the position of a country/industry within the GVC (Los et al., 2015) need to be cautiously analyzed with respect to cases such as that of Indonesia.

METHODOLOGY

The objective of this paper is to estimate and analyze the development of Indonesia within the global value chain and to look at changes taking place within the pattern of trade arising from the fragmentation of production and the extension of vertical trade. The study considers the years of 1995 – 2015, although the focus centers on the 1995-2011 period (expansion in GVC). The engagement or participation of Indonesia in the GVC is measured by breaking down its gross exports into a set of value-added components to distinguish between the origin of the value-added and the final destination of value that travels through exports of intermediate inputs and final goods. Decomposing gross exports allows researchers to recognize the stage of production of the export item, either raw-intermediate or final, and to identify the industries and countries that serve as paths for the goods before reaching the final point

of consumption. A set of measurements and indicators of global value chain participation are derived by an additional elaboration of the Leontief input-output model that completely decomposes exports into different elements of value-added in exports. The methodology allows for the identification of intermediate parts and components or final goods and differentiation between direct trade, indirect flows and multiple cross-border trade. Additionally, the domestic content of value-added in goods and the foreign share of value is also captured. By distinguishing value-added in exports across the different sectors and across the different trade partners, it is possible to identify whether there is a new pattern of trade in Indonesia, whether new challenges have arisen, and to assess the potential impacts of further liberalization of trade and further integration.

Trade figures are presented in million USD (current prices), while the indicators are mainly reported in percentage terms. This study uses the data provided in the Trade in Value Added TiVA dataset by the OECD and the WTO, covering 64 countries and a total of 34 sectors. The Inter-Country Input-Output (ICIO) model serves as a framework and includes a set of matrices of inputs and output linking the 64 countries and the 34 sectors through flows of intermediate inputs and final demand for goods. A particular contribution of this study originates in the measuring and presenting of value-added trade indicators tracing the origin of value-added and the final point of consumption, with specific attention given to links between Indonesia and the largest trading partners, captured in blocs: South East Asian countries (ASEAN), the European Union (EU 15), the North American bloc (NAFTA), and countries within East Asia (. Particular focus is given to the ASEAN community, a regional agreement within South East Asia, where Indonesia belongs.

A more detailed methodology is found in Koopman et al. (2014). Following the Leontief Input-Output mode, this methodology splits gross exports into nine components of value-added based on the origin of the value-added and the flow of products across sectors and nations. The first step is to construct an input-output matrix. It is considered that countries (G) create products across different sectors, N . Goods are either intermediate inputs or final products, and both could be traded domestically or internationally

$$X_s = \sum_r^G (A_{sr} X_r + Y_{sr}), \quad r, s, \dots, G \quad (1)$$

X_s represents the gross output matrix of the country s of $N \times 1$ dimension. The vector Y_{sr} of $N \times 1$ dimension captures the demand for final goods in country r that originated in country s . The input-output coefficient vector is represented by A_{sr} of $N \times N$ dimension, indicating country r 's use of intermediate inputs produced in s (Koopman et al. 2014).

A further decomposition of equation (1) considering the gross output vector, the G-nation, N-sector production-trade system, and a matrix capturing value-added is presented as a block matrix as in Koopman et al. (2014).

$$\begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_G \end{bmatrix} = \begin{bmatrix} A_{11} & A_{12} \dots & A_{1G} \\ A_{22} & A_{22} \dots & A_{2G} \\ \vdots & \vdots \ddots & \vdots \\ A_{G1} & A_{G2} \dots & A_{GG} \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_G \end{bmatrix} + \begin{bmatrix} Y_{11} + Y_{12} + \dots + Y_{1G} \\ Y_{22} + Y_{22} + \dots + Y_{2G} \\ \dots \dots \dots \\ Y_{G1} + Y_{G2} + \dots + Y_{GG} \end{bmatrix} \quad (2)$$

and rearranging,

$$\begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_G \end{bmatrix} = \begin{bmatrix} I - A_{11} & -A_{12} \dots & -A_{1G} \\ -A_{21} & I - A_{22} \dots & -A_{2G} \\ \vdots & \vdots \ddots & \vdots \\ -A_{G1} & -A_{G2} \dots & I - A_{GG} \end{bmatrix}^{-1} \begin{bmatrix} \sum_r^G Y_{1r} \\ \sum_r^G Y_{2r} \\ \vdots \\ \sum_r^G Y_{Gr} \end{bmatrix} \quad (3)$$

$$= \begin{bmatrix} B_{11} & B_{12} \dots & B_{1G} \\ B_{21} & B_{22} \dots & B_{2G} \\ \vdots & \vdots \ddots & \vdots \\ B_{G1} & B_{G2} \dots & B_{GG} \end{bmatrix} \begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_G \end{bmatrix}$$

$$\begin{bmatrix} X_{11} & X_{12} \dots & X_{1G} \\ X_{21} & X_{22} \dots & X_{2G} \\ \vdots & \vdots \ddots & \vdots \\ X_{G1} & X_{G2} \dots & X_{GG} \end{bmatrix} \quad (4)$$

$$= \begin{bmatrix} B_{11} & B_{12} \dots & B_{1G} \\ B_{21} & B_{22} \dots & B_{2G} \\ \vdots & \vdots \ddots & \vdots \\ B_{G1} & B_{G2} \dots & B_{GG} \end{bmatrix} \begin{bmatrix} Y_{11} & Y_{12} \dots & Y_{1G} \\ Y_{21} & Y_{22} \dots & Y_{2G} \\ \vdots & \vdots \ddots & \vdots \\ Y_{G1} & Y_{G2} \dots & Y_{GG} \end{bmatrix}$$

The vector Y_s of dimension $N \times 1$ captures the foreign use of final goods produced by country s . B_{sr} is the total requirement matrix of $N \times N$ dimension, known as the Leontief inverse matrix. The vector X_{sr} is the gross output vector indicating that the output originated in s and was taken in by r .

To capture the value-added content in goods produced, the V_s matrix is incorporated, indicating the direct share of domestic content in the output of the country s .

$$\hat{V} = \begin{bmatrix} \hat{V}_1 & 0 \dots & 0 \\ 0 & \hat{V}_2 \dots & 0 \\ \vdots & \vdots \ddots & \vdots \\ 0 & 0 \dots & \hat{V}_G \end{bmatrix} \quad (5)$$

Multiplying the V_s matrix with the Leontief inverse matrices results in the VB , the value share vector.

$$VB = \begin{bmatrix} V_1 B_{11} & V_1 B_{12} \dots & V_1 B_{1G} \\ V_2 B_{21} & V_2 B_{22} \dots & V_2 B_{2G} \\ \vdots & \vdots \ddots & \vdots \\ V_G B_{G1} & V_G B_{G2} \dots & V_G B_{GG} \end{bmatrix} \quad (6)$$

To estimate the domestic value-added in each country's gross output, the value share vector is multiplied by the gross output vector, generating a new matrix of dimensions of $GN \times GN$ that contains along the diagonal components, the direct value-added terms (matrix). The off-diagonal coefficients contain the value-added, which is incorporated in exports.

$$\hat{V}BY = \begin{bmatrix} \hat{V}_1 & 0 \dots & 0 \\ 0 & \hat{V}_2 \dots & 0 \\ \vdots & \vdots \ddots & \vdots \\ 0 & 0 \dots & \hat{V}_G \end{bmatrix} \begin{bmatrix} X_{11} & X_{12} \dots & X_{1G} \\ X_{21} & X_{22} \dots & X_{2G} \\ \vdots & \vdots \ddots & \vdots \\ X_{G1} & X_{G2} \dots & X_{GG} \end{bmatrix} \quad (7)$$

$$= \begin{bmatrix} V_1 \sum_r^G B_{1r} Y_{r1} & V_1 \sum_r^G B_{1r} Y_{r2} \dots & V_1 \sum_r^G B_{1r} Y_{rG} \\ V_2 \sum_r^G B_{2r} Y_{r1} & V_2 \sum_r^G B_{2r} Y_{r2} \dots & V_2 \sum_r^G B_{2r} Y_{rG} \\ \vdots & \vdots \ddots & \vdots \\ V_G \sum_r^G B_{Gr} Y_{r1} & V_G \sum_r^G B_{Gr} Y_{r2} \dots & V_G \sum_r^G B_{Gr} Y_{rG} \end{bmatrix}$$

From the off-diagonal components, it is possible to capture the total value embodied in exports by each country as in:

$$VT_{s*} = \sum_{r \neq s}^G V X_{sr} = V_s \sum_{r \neq s}^G \sum_{g=1}^G B_{sg} Y_{gr} \quad (8)$$

Equation (8) is modified according to where the value-added travels, and how the value-added is incorporated: as intermediate good or as a final good. Rewriting equation (8), the total exports (gross) in each country is expressed as:

$$VT_{s^*} = V_s \sum_{r \neq s}^G B_{ss} Y_{sr} + V_s \sum_{r \neq s}^G B_{sr} Y_{rr} + V_s \sum_{r \neq s}^G \sum_{t \neq s, r}^G B_{sr} Y_{rt} \quad (9)$$

Equation (9) identifies the value-added incorporated in exports through three components (channels). The first term indicates the value-added in final goods exported from country *s* to *r*. The second term captures the value-added in intermediate inputs exported by country *s* to country *r*, destined to remain in country *r*. The last term computes value-added exports of intermediate goods exported from country *s* to *r*, to be re-exported by country *r* to third countries *t*. The cross-border exports of country *s* is then presented as :

$$E_{s^*} = \sum_{r \neq s}^G E_{sr} = \sum_{r \neq s}^G A_{sr} X_r + Y_{sr} \quad (10)$$

E_{sr} includes the intermediate goods exported by country *s* to *r*. Gross exports captured in equation (10) are decomposed according to the destination where inputs (IPCs) and final products are consumed.

$$\begin{aligned} uE_{s^*} &= V_s B_{ss} E_{s^*} + \sum_{r \neq s}^G V_r B_{rs} E_{s^*} \\ &= VT_{s^*} + \left\{ V_s \sum_{r \neq s}^G B_{sr} Y_{rs} + V_s \sum_{r \neq s}^G B_{sr} A_{rs} X_s \right\} \quad (11) \\ &+ \left\{ \sum_{t \neq s}^G \sum_{r \neq s}^G V_t B_{ts} Y_{sr} + \sum_{t \neq s}^G \sum_{r \neq s}^G V_t B_{ts} A_{sr} X_r \right\} \end{aligned}$$

Equation (11) contains five terms; the first (VT_{s^*}) denotes the value-added exports in final products, while the other four components indicate value added in intermediate goods according to the final destination. To identify the destination of value added, the output identity of each nation is employed, expressed as:

$$X_s = (I - A_{ss})^{-1} Y_{ss} + (I - A_{ss})^{-1} E_{s^*} \quad (12)$$

$$X_r = (I - A_{rr})^{-1} Y_{rr} + (I - A_{rr})^{-1} E_{r^*} \quad (13)$$

Finally, substituting X_s and X_r in equation 11, a new equation with nine terms is obtained as :

$$\begin{aligned} uE_{s^*} &= \left\{ V_s \sum_{r \neq s}^G B_{ss} Y_{sr} + V_s \sum_{r \neq s}^G B_{sr} Y_{rr} + V_s \sum_{r \neq s}^G \sum_{t \neq s, r}^G B_{sr} Y_{rt} \right\} \\ &+ \left\{ V_s \sum_{r \neq s}^G B_{sr} Y_{rs} + V_s \sum_{r \neq s}^G B_{sr} A_{rs} (I - A_{ss})^{-1} Y_{ss} \right\} \\ &+ V_s \sum_{r \neq s}^G B_{sr} A_{rs} (I - A_{ss})^{-1} E_{s^*} \quad (14) \\ &+ \left\{ \sum_{t \neq s}^G \sum_{r \neq s}^G V_t B_{ts} Y_{sr} + \sum_{t \neq s}^G \sum_{r \neq s}^G V_t B_{ts} A_{sr} (I - A_{rr})^{-1} Y_{rr} \right\} \\ &+ \sum_{t \neq s}^G V_t B_{ts} A_{sr} \sum_{r \neq s}^G (I - A_{rr})^{-1} E_{r^*} \end{aligned}$$

The step-by-step proof of how value-added exports are decomposed is offered in Koopman et al. (2014). Exports (in value-added terms) are grouped into three blocks, and sliced into nine terms that account for gross exports of each country. The number represents the term position in equation (14). The first three terms account for direct value-added exports. The fourth and fifth terms capture value-added in exports through intermediate goods that ultimately return to the country of origin. The seventh and eighth terms include the value-added incorporated in exports, as domestic players employ foreign inputs. The sixth and the ninth terms are components of the value-added that are accounted for by two countries' (double-counting value-added), arising from back-and-forth trade.

Combinations of the nine different terms are employed to derive indicators on Global Value Chain participation. Domestic Value-Added exports = (1) + (2) + (3) + (4) + (5) + (6). Multiple Cross Border trade (more than one border) includes elements from the fourth to the ninth terms, also denoted as a share of vertical specialisation. Domestic Value-added in exports (VT) = (1)+(2)+(3); Foreign value-added content in exports (VS = 7 + 8 + 9). Gross Domestic Product in Exports (GDP Ex = 1 + 2 + 3 + 4 + 5). Multiple cross border trade (MCB = 4 + 5 + 6 + 7 + 8 + 9). Indirect Value in Foreign Exports (VS1); Total Vertical Specialization (VS + VS1).

RESULTS AND DISCUSSION

CHANGES IN PATTERNS OF GROSS EXPORTS

From 1995 to 2011, total exports from Indonesia increased from almost US\$58 billion to nearly US\$233 billion. Higher integration of Indonesia in the Global Value Chain seems to play a role in explaining the three-fold growth in exports. Total cross-border exports of merchandise reached nearly 78.5%, expanding by more than 325% from the year 1995. Three sectors account for nearly 65% of the total expansion, namely, mining goods contributing with 35% of growth, exports of food contributing with nearly 15% of growth, and chemicals with close to 12%. If two other sectors are added, metals and agro goods, the combined contribution to total growth in exports reaches 75%. It is noticeable that all five sectors are mainly natural resource-related, and raw goods dominate the exports. Production fragmentation related to natural resource goods expanded more rapidly than other products, partly as prices have surged, but also because natural resources that are traded tend to have fewer available substitutes (Los et al. 2015). However, the fall in prices and a decrease in global demand after 2011 drove the same three sectors to experience the largest flop on trade (Table 1).

TABLE 1. Gross Exports, share of final products, and share of intermediate parts and components from Indonesia

Sector	Gross Exports (US\$ million)			% of total Growth		Share of Final Products to Total Exports (%)		% of total Growth		Share of Intermediate inputs to Total Exports		% of total Growth			
	1995	2011	2015	1995-2011	2005-2011	1995	2011	2015	1995-2011	2005-11	1995	2011	2015	1995-2011	2005-2011
Mining, quarrying	11.684	73.770	36.998	35%	-68%	1%	4%	3%	2%	-1%	99%	96%	97%	34%	-65%
Agriculture, Forestry, Fishing	2.620	9.806	5.034	4%	-9%	11%	35%	38%	2%	-1%	89%	65%	62%	2%	-6%
Manufacturing	26.436	110.858	98.362	48%	-23%	41%	43%	45%	21%	-2%	59%	57%	55%	27%	-18%
- Food, beverages, tobacco	3.000	29.140	27.650	15%	-3%	70%	62%	66%	9%	0%	30%	38%	34%	6%	-3%
- Chemicals, non-metallic minera	4.119	23.225	16.640	11%	-12%	31%	18%	18%	2%	-1%	69%	82%	82%	9%	-10%
- Basic metals, fabricated meta	1.669	12.657	8.547	6%	-8%	11%	5%	5%	0%	0%	89%	95%	95%	6%	-7%
- Computer, electronic, optical	2.253	7.177	5.104	3%	-4%	41%	49%	40%	1%	-1%	59%	51%	60%	1%	-1%
- Computers, electronic, electrical	1.839	9.786	7.382	5%	-4%	41%	48%	41%	2%	-1%	59%	52%	59%	2%	-1%
- Textiles, Leather, Footwear	7.053	14.683	14.930	4%	0%	62%	65%	57%	3%	-1%	38%	35%	43%	1%	2%
- Wood, Paper, Printing	5.939	8.359	8.609	1%	0%	8%	13%	12%	0%	0%	92%	87%	88%	1%	0%
- Transport equipment	545	4.583	5.057	2%	1%	54%	71%	70%	2%	0%	46%	29%	30%	1%	0%
Total *	57.845	232.992	178.825	303%		36%	30%	36%	27%		64%	70%	64%	73%	

Source Data processed from Trade in Value Added database (OECD-WTO).

The expansion of Indonesian exports was most reliable in the intermediate parts and components (including raw goods) section, as they account for nearly 75% of the total increase in exports, which claim is in line with the findings of Bems et al. (2011), who also reported that IPCs accounted for the largest growth of trade after 1990 via vertical specialization. As an example, 96% of the exports within the mining sector were intermediate goods, 83% of chemicals were also intermediate inputs, and more than 95% of metals were raw goods. The substantial contribution of those three sectors to total exports illustrates the large concentration of exports within the intermediate goods sections rather than in the final goods category. A large concentration of exports within a few categories and markets could lead to sharp declines in times of price or economic shock, as noted in Lee (2019), perhaps explaining why those three sectors (mining, chemicals, and metal) reported a large drop after 2011. Among manufacturing sectors, electrical and optical equipment reported large shares of exports in parts and components (more than 60%) and displayed more resilience in the period 2012-2015.

The substantial expansion of exports under parts and components was unusually large towards the ASEAN markets (Table 2), where they expanded nearly 550%. Exports of IPC to countries within East Asia also grew by more than 300%, suggesting a profound integration of Indonesia in the regional production networks, a claim in line with Baldwin and Lopez-Gonzalez (2015), who support that production networks expanded regionally during the same period of analysis. Most noticeable are the four sectors that strengthened their role as exporters of parts and components: metals, chemicals, electrical equipment, and wood (Table 1).

Related to exports of final goods, a change in the pattern of exports is noticed in agriculture, which substantially increased its share of exports of final products (to 31% of exports), and was previously characterized by exporting mainly raw goods (Table 2 and Table 3). Some other sectors that reported substantial shifts in the share of exports from raw goods to final products are food goods (57% growth in the share of final products), textiles (88% growth), transportation equipment (65%), and miscellaneous manufacturing (more than 55%).

As noted in Pangestu et al. (2015) a large share of the growth in exports in Indonesia after the 1997 financial crisis was supported by a weak Indonesian Rupiah (massive depreciation), substantial reforms in trade policies (e.g., removal of tariffs and non-trade barriers (NTBs), removal of export bans, export taxes, and domestic content requirements), a surge in demand for raw materials (e.g., palm oil, rubber, coal), and relatively competitive labor-intensive sectors (e.g., textiles, apparel, and furniture). Nevertheless, after 2004, the labor-intensive sectors entered into a considerably more pressurised export market due to

the rise of stronger rivalry from China and other Asian countries (World Bank, 2012). The share of trade (exports and imports) to both the European Union and NAFTA fell during the 1995-2011 period suggesting Indonesia's lower dependency on its traditional partners in the West and a shift of attention to the East (Table 2). Lower shares to the West are also linked to China's large global trade expansion, meaning a loss in competition for Indonesia's labor-intensive exports.

On the other hand, exports of services increased at a significantly lower share (180%) than merchandise exports in the 1995-2011 period, suggesting that Indonesia may be missing further gains in trade as it lacks competitiveness within services. Exports of services are beyond the scope of this study.

VALUE-ADDED TRADE ACROSS GLOBAL PRODUCTION NETWORKS

By employing gross exports, some shifts in the pattern of trade were identified in the previous section. Nevertheless, to trace how value-added travels across the GVC, gross exports are decomposed into three main blocs: value-added, originating in Indonesia (domestic content, DVA); second, foreign content of value-added in exports (FVA); and back-and-forth trade. From 1995 to 2011, the Indonesian value-added content in exports (domestic value-added) expanded by more than 300%, reporting nearly US\$200 billion value-added exports. The largest share of domestic value-added was shipped to East Asian partners, who consumed nearly 47% of the total increase in domestic value-added (DVA) of Indonesia. The second-largest destination of domestic value-added exports was ASEAN, which absorbed 17% of the total DVA expansion, suggesting that 65% of the expansion in domestic value-added remained within East and Southeast Asia. Aggregated by sectoral groups, exports of mining and quarrying recorded 33% of the total DVA of Indonesia. In comparison, manufacturing exports accounted for more than 40% of DVA exports and services for less than 20% (Table 2 and Table 3).

The pattern of domestic value-added content in final goods within natural resources changed from 1995 to 2011 in two sectors, previously characterized as being exporters of raw commodities, that increased their share of value-added in final products, agricultural exports, and wood & paper. The increase in the domestic value-added in final goods is most likely related to technological upgrades that natural resource-based sectors experienced, as well as to impacts from policies launched during the period, aimed at increasing the participation of local producers as well as aiming at higher processing of goods within national borders. Removal of export bans, a depreciation of the Rupiah (after 1997), high global prices, and changes in the investment environment supported the expansion of investment and trade within natural resources (Pangestu et al. 2015).

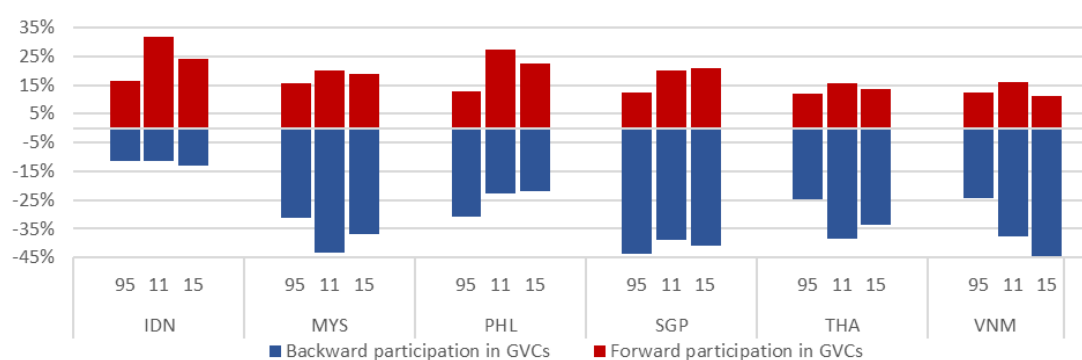
TABLE 2. Share of Gross Exports and Value-added Exports from Indonesia to Main Trading Blocks 1995 and 2011

	ASEAN (%)			East Asia (%)			EU (%)			NAFTA (%)		
	1995	2011	2015	1995	2011	2015	1995	2011	2015	1995	2011	2015
Gross exports, partner shares												
Agriculture, forestry and fishing	12,2	8,4	13,9	17,7	35,5	30,2	24,0	14,8	11,3	25,9	23,1	22,4
Manufacturing	14,3	17,5	14,3	32,5	28,1	28,6	19,5	10,7	8,6	21,1	13,1	15,4
Mining and quarrying	5,1	10,9	14,2	82,7	69,2	57,4	2,4	2,3	1,5	4,3	1,7	2,7
Total services	14,7	17,4	17,9	31,5	33,4	31,5	19,6	12,6	11,6	15,4	10,5	11,4
TOTAL	12,4	15,0	15,0	41,9	42,3	35,2	16,3	8,5	7,9	16,2	9,5	12,1
Gross imports, partner shares												
Agriculture, forestry and fishing	1,1	4,8	2,7	8,8	11,2	14,1	3,7	1,1	1,6	37,6	26,9	25,9
Manufacturing	10,7	27,2	26,4	39,0	45,0	47,5	23,9	7,6	8,4	11,2	5,7	4,5
Mining and quarrying	9,2	25,7	18,4	5,0	1,2	4,4	5,0	0,6	0,6	5,0	1,0	1,2
Total services	17,5	23,0	23,2	35,0	25,1	23,6	17,0	15,1	16,6	12,9	13,4	13,7
TOTAL	12,4	25,2	24,2	35,6	36,4	37,3	20,5	8,7	10,0	12,5	8,1	7,6
Domestic value added (DVA) in gross exports,partner shares												
Agriculture, forestry and fishing	12,2	8,4	13,9	17,7	35,5	30,2	24,0	14,8	11,3	25,9	23,1	22,4
Manufacturing	13,5	17,2	14,0	33,5	28,2	28,8	19,8	10,7	8,6	20,6	12,6	14,8
Mining and quarrying	5,1	10,9	14,2	82,7	69,2	57,4	2,4	2,3	1,5	4,3	1,7	2,7
Total services	14,6	17,3	17,8	31,5	33,4	31,5	19,6	12,7	11,6	15,5	10,7	11,5
TOTAL	11,9	14,7	14,9	43,0	43,4	35,7	16,2	8,4	7,8	15,6	9,0	11,6
Domestic value added (DVA) in exports of intermediate products (IPC), partner shares												
Agriculture, forestry and fishing	12,6	6,8	11,5	16,9	36,4	31,7	24,8	15,1	11,6	26,0	26,5	26,8
Manufacturing	14,7	20,7	17,0	40,8	36,5	38,9	15,5	10,1	8,1	18,0	7,6	10,7
Mining and quarrying	5,0	11,0	14,0	83,1	70,2	57,5	2,4	2,4	1,6	4,3	1,7	2,7
Total services	11,1	19,2	20,3	48,2	41,3	36,7	19,0	12,3	11,8	11,5	6,4	8,1
TOTAL	10,5	15,5	16,5	55,0	52,7	44,4	12,5	7,1	6,7	12,5	5,5	8,0
Domestic value added in foreign final demand, partner shares												
Agriculture, forestry and fishing	8,9	8,5	9,0	30,4	27,8	26,4	21,4	13,2	10,1	20,3	15,5	15,2
Manufacturing	11,4	10,9	10,1	30,2	27,9	27,7	20,6	11,9	9,7	22,7	15,8	17,7
Mining and quarrying	5,6	7,6	9,2	70,7	52,0	44,4	6,3	6,4	5,4	9,4	8,5	10,4
Total services	11,2	11,0	11,1	32,8	31,2	30,1	19,7	12,6	11,1	18,5	14,8	16,0
TOTAL	9,8	9,5	10,1	40,2	37,4	32,3	17,2	10,3	9,2	17,9	12,9	15,2
Backward participation in GVCs		2,0	2,1		3,7	4,6		1,1	1,2		1,0	1,1
Forward participation in GVCs	3,4	7,4	6,5	6,6	14,2	9,7	3,1	3,0	2,5	1,7	1,3	1,4

Note: Domestic Value-Added (DVA), Final Goods (FG), Intermediate Parts, and Components (IPC), Foreign Value-Added (FVA). ASEAN (Association of Southeast Asian Countries), East Asia (EASIA), European Union (EU15), North America FTA (NAFTA)

On the other hand, sectors within manufacturing experienced less dynamic changes as the domestic value-added in exports of final goods, and intermediates remained similar in 2011 (at 43%) to what it had been in 1995 (at 41%). The share of foreign inputs embedded in exports also remained at nearly 20%, a substantially lower percentage than that of Indonesia's Top ASEAN neighbors (almost 45% of FVA in exports), who expanded more rapidly in trade within manufacturing (Padilla et al., 2019). Two exceptions within manufacturing sectors that experienced significant

shifts in larger value-added exports in final goods (1995-2011) were: 1) computers, electronics, and optical, and 2) transportation equipment. Rasiah et al. (2016) found that stronger regional linkages, larger investment flows, and institutional support within the automotive sector in Indonesia supported improvements in technological capability and competitiveness. Deregulation, which allowed foreign investment and reduced domestic content requirements, along with liberalization in the late 1990s - early 2000s, attracted foreign producers of IPC and supported greater processing of goods at home



Note. Backward Linkage display with negative sign for the purpose of friendly visualization. Backward and Forward participation as percentage of total gross exports per country. Indonesia (IDN), Malaysia (MYS), Philippines (PHL), Singapore (SGP), Thailand (THA), and Vietnam (VNM)

FIGURE 1. Backward and Forward Participation Top ASEAN countries. 1994, 2011, and 2015

and a lowering of the use of foreign inputs (Pangestu et al. 2015).

Nevertheless, the commodity boom of 2003-2012 led Indonesia towards a re-orientation to natural resources (entering a new stage of Dutch Disease, Pangestu et al. (2015), while failing to implement important industrial reforms. During the last two decades, the share of manufacturing to total GDP and total exports fell (Sugiharti et al. 2019). Additionally, the percentage of value-added exports of final goods within manufacturing decreased for most trading partners in the West and shifted mainly towards ASEAN countries and East Asia.

The concepts of forward and backward participation help to assess the role played by Indonesia in the GVC. For instance, the forward linkage measures the value-added content of Indonesia embedded in exports of partner countries. Indonesia reported a substantial increase in forward linkages, which increased from 16% in 1995 to nearly 33% in 2011. The largest expansion in forward participation came from stronger links with ASEAN members, rising from 3.4% in 1995 to 7.4% in 2011. Forward participation with East Asian countries also increased from 6.6% in 1995 to 14.2%. While the forward links with Asia are extensive (23% of total value-added exports), those with NAFTA and the European Union are relatively small, remaining at a comparable level with those of 1995. Forward linkages (IPCs) expanded to a greater extent than backward linkages, as noted in Esquivias Padilla et al. (2017), driven by the growth of Asian partners. Five sectors recorded the most substantial improvements in forward linkages: 1) wood, pulp, and paper; 2) coke; 3) rubber; 4) machinery equipment; and 5) transport equipment. Nevertheless, industrial players in downstream positions (forward links) often experience larger effects amid economic shocks (Lee, 2019), perhaps explaining why the drop in Indonesian exports during the collapse of commodity prices and the economic slowdown of 2009

was larger than that of its ASEAN neighbors (Fitrianti 2017; Sugiharti et al. 2020).

In 1995 nearly 75% of DVA from Indonesia were direct exports (one-way trade), while nearly 13% were indirect domestic exports (exporting firms at home demanding goods and services from other local players). Indirect domestic exports increased more significantly within basic metals, machinery, and equipment. López González (2017) pointed out that SMEs could reach foreign markets by indirectly exporting through Multinational Enterprises (MNEs) or larger firms at home. For instance, a key policy in manufacturing in Indonesia (automotive) was to further promote the internationalization of SMEs by strengthening links with MNEs (Rasiah et al. 2016).

Another set of indicators to assess the participation of a country in the GVC are those illustrating multiple cross-border trade, either in the form of re-exports foreign, re-exports domestic, or re-imports (Table 4). Though total exports increased, Indonesia has relatively low participation in sectors characterized by multiple-cross-border trade, staying as a player in one-way trade. Re-exports from foreign indicates the domestic value-added exports in IPC re-processed in foreign countries and re-exported to third countries. The value-added of Indonesian IPCs through re-exports increased by nearly 290% to nearly US\$40 billion in the year 2011. Sectors that recorded the largest expansion were: 1) food, beverages, and tobacco; 2) chemicals; 3) metals; and 4) electric and optical equipment. Regional value chains across Asia are essential drivers of trade for Indonesia, helping it to both increase its regional presence and reach global markets. As an example, stronger links from ASEAN to China helped increase value-added exports through indirect channels (Yu & Cui 2017).

The re-exports from the domestic market include those foreign IPCs that will be employed by local firms and re-exported to third countries. The total value of re-exports expanded by nearly 2.5 times from 1995 to

TABLE 3. Domestic and Foreign Value-Added Export Shares in Indonesian Exports 1995 and 2011

	Domestic value added in exports of intermediate products, partner shares												Domestic value added in foreign final demand, partner shares																			
	ASEAN				EASIA				EU15				NAFTA				ASEAN				EASIA				EU15				NAFTA			
	1995	2011	2015	2015	1995	2011	2015	2015	1995	2011	2015	2015	1995	2011	2015	2015	1995	2011	2015	2015	1995	2011	2015	2015	1995	2011	2015	2015	1995	2011	2015	2015
Agriculture and fishing	13	7	11	17	36	32	25	15	12	26	27	27	9	9	9	9	30	28	26	26	21	13	10	10	21	13	10	10	16	15	15	15
Mining and quarrying	5	11	14	83	70	58	2	2	2	4	2	3	5,6	7,6	9,2	71	52	44	6	6	6	6	5	5	9	8	10	10				
Total services	11	19	20	48	41	37	19	12	12	12	6	8	11	11	11	33	31	30	30	30	20	13	11	11	19	15	16	16				
Manufacturing	15	21	17	41	37	39	15	10	8	18	8	11	11	10	10	30	28	28	28	28	21	12	10	10	23	16	18	18				
- Basic metals and fabricated	25	32	26	44	41	45	9	5	3	16	4	7	23	15	13	35	34	35	35	35	13	9	7	7	19	12	16	16				
- Chemicals and non-metallic	23	20	21	37	38	35	13	11	7	12	8	10	13	11	12	33	34	34	31	31	18	12	9	9	19	14	17	17				
- Computers, electronic, electric	28	19	16	9	38	37	13	10	11	49	16	22	11	9	8	15	28	29	20	20	14	14	14	14	44	20	23	23				
- Food, beverages, tobacco	9	20	14	33	23	25	36	14	12	10	6	10	13	10	9	32	20	20	20	20	23	12	9	9	14	8	10	10				
- Machinery and equipment	32	34	33	19	24	16	5	8	5	36	18	17	22	21	19	30	32	24	13	13	6	5	22	22	11	12	12	12				
- Other manufacturing	27	16	15	32	16	22	13	19	16	23	14	16	20	7	6	18	24	23	22	22	17	14	27	27	25	29	29	29				
- Textiles, apparel, leather	11	6	5	17	34	38	23	17	14	35	10	14	6	3	3	15	14	20	29	29	17	14	35	35	40	37	37	37				
- Transport equipment	30	47	44	16	26	32	28	5	5	12	7	6	26	35	27	21	18	17	21	21	6	4	15	15	11	13	13	13				
- Wood and paper	6	8	6	62	55	65	11	6	3	10	7	7	7	8	7	49	40	48	15	15	10	7	14	14	13	13	13	13				
TOTAL	11	15	17	55	53	44	12	7	7	13	6	8	10	9	10	40	37	32	17	17	10	9	18	18	13	15	15	15				

Note Domestic Value-Added (DVA), Final Goods (FG), Intermediate Parts and Components (P&C), Foreign Value-Added (FVA), ASEAN (Association of Southeast Asian Countries), East Asia (EASIA), European Union (EU15), North America Free Trade Agreement (NAFTA)

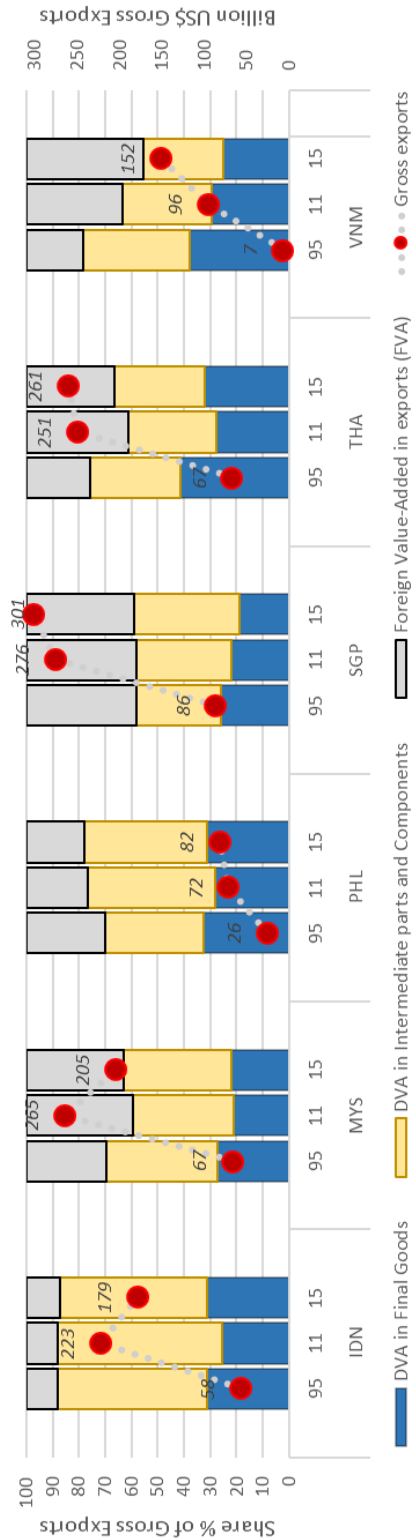


FIGURE 2. Value-Added in Gross Exports. Six Top ASEAN Countries 1995, 2011, and 2015

2011, although, as a percentage of total IPCs, it remains similar to that in the 1995-2011 period. The sector most actively involved in re-exports (as a percentage of total sectoral IPCs) was textiles, chemicals, and machinery. Sectors such as metals, electrical and optical goods, reported substantial growth (Table 4). The Indonesian government has launched policies aimed to increase export-oriented investments, likely attracting firms that require imported inputs to support exports. Although the government has also supported policies to boost domestic value-added content in exports, there are no apparent signs of successful implementation of such policies. Incoming Foreign Direct Investment (FDI) within manufacturing has supported vertical spillovers (across sectors) through backward and forward linkages (Sari 2019), but not positive horizontal ones (effects within the same sector).

Finally, the concept of re-imports captures those goods initially exported but returning home after being re-processed abroad. In Indonesia, value-added through re-imports increased nearly fifteen times from 1995 to 2011, although the amounts are low compared with regional partners (from US\$22 million to nearly US\$464 million). Three sectors accounted for most of the growth in 2011: primary and fabricated metals (more than US\$ 80 million in 2011), electrical and optical, and chemical non-metallic exports. Although re-imports remained small in value terms, the rate of growth was extremely rapid, a characteristic of GVCs (Table 4).

Exports within the GVC commonly employ multiple-cross-border trade, meaning that connectivity, coordination, and the logistic cost is essential. Although the three components of multiple cross-border trade are low relative to those of advanced countries or even relative to ASEAN champions of trade, they signal that Indonesia is expanding through its integration with other Asian countries in the regional value chain, and taking part in fragmented production networks (López González 2017).

OPPORTUNITIES FOR FURTHER EXPANSION AND INTEGRATION WITHIN THE GVC

This section highlights which sectors benefited the most from vertical integration and helps to assess which sectors may offer Indonesia the largest potential for further expansion. Flows of exports to major trade blocs help to identify the significance of regional and global integration. Changes in the patterns of value-added exports are more noticeable in the following aspects. First, five sectors gained from participation within the GVC by supplying larger value-added exports embedded in final goods: 1) agricultural products; 2) computer, electronics and optical; 3) textiles; 4) wood, paper and pulp; and 5) transportation equipment (Tables 1 and 4). Second, groups that participated more actively in the GVC by supplying intermediate parts

and components were food products, machinery and equipment, electrical and optical, and metals. Policies to increase FDI, the lowering of export bans, and export taxes are likely to have benefited these three groups (Pangestu et al. 2015). Third, exports that increased the share of foreign content (FVA share) were textiles and footwear, along with products related to wood, paper, and pulp. Larger portions of FVA are often associated with gains on more competitive inputs (case of textiles, footwear, and wood), or with participation in sectors which are highly fragmented and specialized as in computers, electronics, and transportation, where Indonesia also expanded exports (López González, 2017). On the other hand, Indonesia has developed a certain level of dependency on the supply of inputs from East Asia (computers, machinery, and transport), perhaps explaining why exports from East Asia to Indonesia have increased more rapidly over time than the other way around (Ing & Kimura 2017).

The liberalization of markets in Indonesia, although offering broader access to ASEAN and East Asia countries, also brings stronger competition at home (Yu & Cui 2017). Indonesia lost in specific sectors to the more open markets of East Asian and ASEAN countries (Padilla et al. 2019; World Bank 2012). As opposed to the ASEAN markets, Indonesia's share of exports in agricultural goods, chemical products, miscellaneous manufactured goods, electrical and optical equipment, transportation goods, and wood-paper, fell as it faced considerable competition from other ASEAN countries or East Asian ones. A possible explanation for the drawback for Indonesia derives from the late liberalization and diversification of trade which mainly started in 1995, as a result of incorporation to the WTO and the implementation of the ASEAN Free Trade Agreement AFTA (Pangestu et al. 2015). Besides, productivity growth in former champion sectors in Indonesia (mainly labor-intensive ones) are lagging, as opposed to the growth in its rivals in Asia, as wages rose too fast, skills remained low and technological absorption capability remains weak (Sugiharti et al. 2019; World Bank 2012).

The re-focus of exports to regional Asian partners has been clear, either because gross exports expanded more rapidly to Asian partners than to non-Asian ones, or because Indonesia's backward and forward linkages are mainly within Asia. Exports to ASEAN partners grew more than three times during the period of this study, suggesting that implementation of the ASEAN Free Trade Agreement (AFTA), removal of non-tariff barriers, and other regional deals, supported trade integration (Ing & Kimura, 2017).

The last two decades introduced Indonesia to the booming fragmented networks that were expanding across Asia, initially steered by Japan but more recently led by China (Padilla et al. 2019; Yu & Cui 2017). At the end of 2011, nearly 60% of value-added exports

TABLE 4. Back-and-Forth Trade Concepts Indonesia 1995 and 2011 (US\$ 000)

	Direct DVA % of gross exports			InDirect DVA % of gross exports			FVA % of gross exports			Re-exported IPC imports as % of IPC imports			Re-imported DVA content of gross exports		
	1995	2011	2015	1995	2011	2015	1995	2011	2015	1995	2011	2015	1995	2011	2015
Agriculture	90,3	89,1	89,5	4,7	4,6	5,0	5,0	6,3	5,5	13,0	21,3	20,1	0,5	11,9	3,1
Mining, quarrying	91,5	89,1	85,4	4,1	4,7	7,0	4,5	6,2	7,6	25,2	30,5	25,6	2,2	90,8	29,5
Total services	81,9	83,9	84,9	11,5	7,7	8,0	6,6	8,3	7,1	24,2	22,4	20,1	4,8	64,5	30,3
Manufacturing	60,5	62,5	63,8	20,2	18,2	18,6	19,3	19,3	17,6	22,2	23,3	21,2	20,1	296,9	138,3
-Food, beverages, tobacco	67,9	69,4	70,2	23,2	21,4	21,8	8,9	9,2	8,0	13,1	17,0	16,8	0,9	33,5	16,6
-Chemicals	58,5	61,1	62,7	20,2	17,2	17,6	21,3	21,7	19,7	24,5	25,3	22,3	3,5	81,2	29,8
-Basic metals	62,6	67,5	65,7	13,9	18,4	19,3	23,5	14,1	15,0	11,3	19,7	18,4	0,8	24,4	10,2
-Computers, electronic	38,1	46,6	56,3	27,0	17,9	14,3	34,9	35,5	29,5	47,9	21,4	16,6	2,3	40,1	14,7
-Textiles, apparel, leather	64,0	62,8	61,4	18,2	15,1	16,3	17,8	22,1	22,2	41,8	35,6	38,0	5,4	38,4	22,8
-Wood, paper products	67,3	72,3	70,0	19,8	14,8	16,9	12,9	12,9	13,1	22,0	23,7	24,4	2,8	15,2	9,5
-Transport equipment	55,7	52,2	59,6	17,5	17,1	15,8	26,9	30,7	24,6	17,3	15,3	16,8	0,6	17,9	9,8
-Machinery, equipment,	39,1	39,1	42,1	21,1	25,1	24,7	39,9	35,8	33,3	24,7	26,2	22,7	1,1	23,9	11,2
-Other manufacturing;	52,8	64,7	64,2	21,4	16,5	17,1	25,8	18,8	18,7	33,1	21,8	20,4	1,3	10,8	8,6
TOTAL	75,1	76,2	74,0	12,9	11,0	13,1	12,0	12,8	12,9	22,4	23,7	21,3	27,9	464,0	201,3

Notes. Direct Domestic value-added (DVA) share (%) of gross exports; InDirect Domestic value-added share of gross exports; Foreign value-added share of gross exports (FVA); Re-exported intermediate imports as % of intermediate imports; Re-imported domestic value-added content of gross exports (in \$ USD 000)

stayed either with ASEAN and East Asian countries, as did nearly 62% of gross imports. More significantly is the point that nearly 69% of total value-added in parts and components remained within the region, an increase from the previous 41% in the year 1995. The findings strongly suggest that Indonesia has gained through regional rather than global integration. Although, the re-orientation of Indonesia's export trade and its greater immersion in the regional production networks also supported larger shares of Indonesian exports going out to the World, as indirect exports increased substantially.

A consequence of greater immersion in GVC is that although gross exports from Indonesia to East Asia increased in most sectors, the share of domestic value-added reported a decrease, and the share of foreign inputs increased. Other cases, like that of Vietnam, have had greater impacts on dependency on foreign inputs, although gross exports from Vietnam expanded more rapidly than total exports from Indonesia (Ing & Kimura 2017).

SECTORAL GAINS ARISING FROM PRODUCTION FRAGMENTATION IN THE GVC

Additional gains and losses experienced in Indonesia at sectoral level are as follows. First, three sectors increased contributions to total value-added exports to the three principal trading blocs: food products, mining and quarrying, and basic metals. However, the three groups of products also faced acute adverse effects due to volatility in prices, exchange rate, and demand to a higher degree than non-commodities after 2011 (Sugiharti et al. 2020). Second, the share of exports of textiles and transport equipment decreased for almost all regional partners, partly as China was incorporated into the WTO, and more competitive Asian neighbors emerged (World Bank 2012). Third, in agricultural exports, chemicals, and electrical-optical equipment, Indonesia increased total exports and shares to all destinations but ASEAN (meaning, extra-ASEAN trade gains). Fourth, sectors that have gained substantially

from deeper participation in the GVC by way of exports of parts and components are metal goods, machinery equipment, and inputs within the transport sector. Fifth, Indonesia benefited from higher demand from East Asian production networks within agricultural goods, mining, metals, chemicals, and wood (Table 3). Indonesia improved its relations with East Asia by increasing the share of value-added exports in parts and components in all but food and miscellaneous manufacturing sectors.

Challenges are revealed as Indonesia lowered the share of exports to ASEAN countries in different sectors. First, in 1995, 8% of the total value-added exports of Indonesia were recorded under exports of electrical equipment to ASEAN countries; that share fell to 5% in 2011. Second, within textiles, leather, and footwear, the value-added exports previously absorbed by ASEAN fell from 7% of total DVA exports to only 1% in 2011. Third, the sector of transportation and machinery lowered its role in total value-exports from 11% to 5%. Products within wood, paper, and pulp also collapsed, decreasing from 6% to 3%. The loss across sectors in exports to ASEAN may indicate a loss in competition against ASEAN partners or East Asian countries. The Global Value Chain has opened new possibilities for countries, but competition has tightened as well. Yu and Cui (2017) found that stronger integration between China and ASEAN leads both to complementarity and competition - substitution effects.

DISCUSSION

A loss in share of exports could be attributed to a loss in competition compared to other emerging countries, a reorientation of production activities (driven by commodity prices and changes in comparative advantage) and a change in industrial and trade policy (Yu & Cui 2017). Those three factors most likely played a role in loss of export share, as noted in the literature related to Indonesian industrial and trade development (Aswicahyono et al. 2011; Esquivias 2017; Kis-Katos & Sparrow 2015).

The share of value-added Indonesian exports through final goods to Southeast Asia, Europe, and NAFTA decreased in almost all sectors. Exports from Indonesia rely more on parts and components and downstream links and less on final products. Larger shares of parts and components imply the stronger forward integration of Indonesia in regional value chains, with some implications. The first of these, the value-added of Indonesia, needs to cross multiple borders before getting to its final point of consumption, putting pressure on more efficient service links. A second implication is that Indonesia may face stronger effects arising from global variation: either adverse shocks or positive effects from demand and prices (Lee 2019; Sugiharti et al. 2020). The third implication

is that the multiple cross-border trade will demand higher costs for transportation and require stronger coordination of policies with trade partners. The fourth implication is that taking the role of a large supplier of parts and components may be associated with low profits, as the highest returns in value are either from supplying high tech intermediates or from engaging in the last segments of the supply chain (Banga 2014). For instance, Indonesia was able to upgrade its integration with the GVC by moving from mainly being an exporter of commodities (1990s) to being an exporter of simple manufacturing goods (World Bank 2019). Nevertheless, ASEAN neighbors (e.g., the Philippines, Thailand, and Malaysia) make deeper transformations (higher backward linkages) moving to exports of advanced manufacturing.

As noted in Los et al. (2015), fragmentation took place more rapidly in capital intensive sectors related to metals, electronics, chemicals, transportation goods, than in labor-intensive and light manufacturing ones (food, textiles, and leather). Differences in transportation – coordination cost, tariffs, and prices of inputs are factors influencing differences in the speed and degree of fragmentation. Indonesia has a larger share of manufacturing in low skill, labor-intensive, and light sectors, partly explaining why fragmentation is low relative to ASEAN neighbors.

Benefits arising from Indonesian exports will most likely be linked to deeper regional ties with production networks in East Asia. The stronger connections are also made manifest in the greater participation of ASEAN and East Asian countries as suppliers of inputs to Indonesia (Yu & Cui 2017). Most sectors in Indonesia saw an increase in the share of inputs from East Asia or ASEAN countries in 1995-2011, with few exceptions but that of transportation equipment. The implementation of the ASEAN agreements with six strategic partners in East and South Asia have led to deeper Indonesian integration in trade agreements with its neighbors (Ing & Kimura 2017).

In sectors that are highly fragmented (e.g., electrical, machinery, and transportation), Indonesia was left behind by southeast Asian partners who created stronger regional links within the GVC. ASEAN countries with large shares of exports within manufacturing sectors tend to be more vertically specialized, as is the case with Malaysia (32% of vertical trade), Vietnam (nearly 23%), and Thailand (18%). Additionally, the small and medium enterprises in ASEAN countries gained more from integration within the GVC through indirect exports than Indonesian ones (López González 2017). Higher skill and higher-tech sectors commonly require a high share of strategic foreign inputs (FVA). Although foreign inputs expanded by nearly 215% in Indonesia, only a few sectors accounted for most of the change: agricultural goods, chemicals, metals, and electrical-optical.

A deeper integration in the GVC requires more policy efforts to improve the development of fragmented structures across sectors. Similarly, creating a more conducive environment for multinationals (MNE) and supporting infrastructure to facilitate logistics and coordination could support Indonesia's deeper links with global players. Efforts to connect domestic players with foreign firms operating in Indonesia via vertical links should continue, helping domestic firms to meet quality and volumes. Nevertheless, the lack of evidence of horizontal spillover effects arising from FDI suggests that technological transfers from foreign firms remain weak (Sari 2019), either as technological absorption capability in Indonesia remains low, or as foreign firms are unwilling to support the efforts. For instance, efforts to attract FDI that can support the increase in capital, technology, and skills are crucial (World Bank 2019).

Indonesia has practiced the picking-winner approach since the liberalization of markets in the 1990s. However, changes in sectors, priorities, incentives, and targets resulted in poor achievements in industrialization efforts and greater participation in the GVC. The volatility of global prices affecting key sub-sectors (e.g., coal mining, edible oils, rubber, cocoa, and metals), the more aggressive competition from global players (e.g., textiles, footwear, and furniture), and the lack of technological capability and local supplies (e.g., electronics, machinery, shipbuilding) have forced the constant re-orientation of priority sectors in the last two decades.

Changes in the export structure from the final good to intermediate parts and components during the 1995-2011 period required a better policy environment to encourage higher export growth as a consequence of higher economic growth targets. One policy agenda that still requires a breakthrough is in the area of ease of doing business. Exports can grow higher if the Indonesian government can consistently improve the facilitation of export activities in terms of reducing costs and time for handling export documents (EoDB 2020). At the same time, to improve stronger backward connections with the global market, simplification of documents, and more efficient time for import activities is needed. The World Bank Report (2020) states that Indonesia ranks 116th in the performance of trading across borders among the 190 countries studied. Another aspect of doing business that needs to be improved is licensing in starting a business, which is still far behind compared to other ASEAN countries.

Liberalization of markets, implementation of trade facilitation, and the removal of non-tariff barriers could promote the further integration of Indonesia within GVC (Ing & Kimura 2017). Such changes should be accompanied by structural transformation reform by providing tax allowances and tax holidays, for pioneer industries in the upstream sector may support further upgrading of Indonesia within the GVC. This step

would increase the capacity of the domestic industry to increase domestic value-added in sectors that offer higher gains (World Bank 2019) while encouraging industries that export intermediate parts and components. At the same time, reforms in the labor market to loose labor regulations are needed, as they have remained too rigid compared to other ASEAN. Besides, appropriate labor reforms could support higher innovation and trade competitiveness (Ing & Kimura 2017). Labor reforms accompanied by vocational training as a response to industry requirements could support simultaneous improvements in wages and skills. Yu and Cui (2017) pointed out that improvements in labor productivity are crucial for greater participation in GVC for ASEAN countries.

A deeper integration in the GVC requires more policy efforts to improve the development of fragmented structures across sectors. Similarly, creating a more conducive environment for multinationals (MNE) and supporting infrastructure to facilitate logistics and coordination could support Indonesia's deeper links with global players. Though total exports increased, Indonesia has stayed as a player in one-way trade within intermediate goods. A more strategic industrial and trade policy for Indonesia, directed to build more widespread and specialized domestic networks, could support the country's participation in GVC and higher gains from trade. Regional value chains across Asia are essential drivers of trade for Indonesia, helping it to both increase its regional presence and reach global markets. A stronger regional integration could drive additional demand for Indonesian exports through re-export channels.

CONCLUSION

This study analyses the development of Indonesia within the global value chain and looks at the changes across sectors and partners arising from deeper regional integration and wider fragmentation of production. The paper uses an Inter-Country Input-Output dataset (TiVA) comprising 64 countries and 34 sectors, covering the 1995-2015 period, although the main focus is on 1995-2011 (the large expansion). The study decomposes the value-added content in exports into domestic and foreign shares, as well as into different indicators to study vertical specialization, and participation in the global value chain. The total value-added exports from Indonesian expanded by more than 300% within the 1995-2011 period, suggesting significant changes in export patterns as larger flows were re-oriented towards regional partners (Asia). Value-added to East Asia grew particularly fast, accounting for 47% of the total expansion. Particular sectors such as that of mining and some within manufacturing also grasped considerable benefits. Indonesia became more focused

on exports of intermediate parts and components rather than of final goods. Countries within Asia account for almost three-quarters of the total value-added exports from Indonesia. Stronger links with the dynamic Asian fragmented networks have been identified, as Indonesia increased exports/imports of parts and components, which signals more robust integration with regional value chains. Besides, its larger exports to Asia were a path towards larger exports to the World, as re-exports notably increased.

Some fundamental transformations in Indonesia have been identified. First, the share of domestic content in exports was large in 1995-2011 (almost 42%) as raw goods, and natural-resources largely dominated exports. Second, most of the fast-growing sectors were those belonging to the natural resources; sectors like agriculture, food, chemicals, metals, and most importantly, minerals, expanded particularly fast within the GVC. Third, the labor-intensive sectors lost steam (textile, wood, and miscellaneous manufacturing), most likely as competition from Asian countries became stronger, and industrial policy shifted to natural resources. Fourth, there were only small improvements within higher technological manufacturing activities where global value chains tended to be more dynamic (e.g., electrical-optical, machinery, and transportation equipment). Fifth, as opposed to its Southeast Asian partners, Indonesia had a large share of domestic value-added and a low share of foreign content, which suggests lower participation in vertical trade. Sixth, Indonesia strengthened its role as a downstream player, increasing its share in forward linkages, mainly within Asia. Finally, an expansion occurred in the share of services to total DVA, even though it remains small in comparison with advanced countries (20% compared to the 50% of the advanced countries).

The implementation of multiple regional trade agreements under the ASEAN umbrella may have supported stronger regional integration in the value chain, with the largest gains in natural resource-based sectors and, to some extent in, transportation and electrical components. Nevertheless, liberalization also drove strong competition in textiles-footwear, transportation, and wood-paper within the Asia region in final products. Exports of natural resources suffered greatly after 2011, suggesting that they are highly sensitive to prices and demand shocks.

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