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**Global Value Chain Integration and Business Cycle
Synchronisation: Evidence from Selected
ASEAN Countries**

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Abstract: *This study examines the relationship between global value chain (GVC) integration and business cycle synchronisation in selected Association of Southeast Asian Nations (ASEAN) countries from 2007 to 2021. Using a panel fixed effects approach, we discover the following key findings: First, we find that GVC integration is associated with both output synchronisation and desynchronisation in ASEAN countries. Second, we notice that the outcomes differ depending on the type of GVC integration, such as forward integration, backward integration, or two-sided integration. Third, for a more in-depth understanding, we conduct an industry-specific analysis. We examine three major industry categories: manufacturing, services, and high-technology industries. The findings show mixed evidence of an association between GVC integration and BCS in these industries. The findings highlight the shock transmission associated with GVC integration.*

Keywords: Global value chains; Business cycle synchronisation; Fixed effects; Industries; ASEAN

JEL Classification: F1, C5, L6, L8

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1. Introduction

The link between trade and business cycle synchronisation (BCS) has been widely examined in the literature (Gerlach, 1988; Backus and Kehoe, 1992; Baxter, 1995; Frankel and Rose, 1997; Canova and Marrinan, 1998; Imbs, 2004; Baxter and Kouparitsas, 2005; Kumakura, 2006; Inklaar, Pin, and Haan, 2008; Park and Shin, 2009; Abiad et al., 2013). The findings reveal mixed outcomes. The high levels of BCS have mostly occurred against the backdrop of rapidly expanding trade and financial integration in the global economy. Since the 1960s, international trade growth has outpaced world production growth in the vast majority of years, with the overall rise in trade volumes being more than three times that of world output growth (Kose et al., 2003).

Global manufacturing and trade have moved in recent decades toward increasingly interconnected production chains (Hummels, Ishii, and Yi, 2001; Johnson and Noguera, 2012; Koopman, Wang, and Wei, 2014). Global value chains (GVCs) have grown in significance, increasing the degree of interdependence across economies (Borin, Mancini, and Taglioni, 2021). This transition has had an impact on both output and trade. Foreign inputs are being used in a greater proportion of production. As a result, trade currently consists mostly of intermediary goods. Greater GVC integration is critical in conveying not just demand shocks but also supply shocks across borders.¹ For example, a positive foreign shock reduces the cost of intermediate inputs originating from that country, hence encouraging demand in nations and industries that use those inputs. Simultaneously, a positive shock in a foreign nation reduces the price of the final products provided by that country, hence lowering the demand for final goods produced by countries that compete with it in the market for final goods.

Few studies have investigated the recent changes in global production structure, both theoretically and experimentally (Antràs et al., 2012; Antràs and Chor, 2013; Antràs and Chor, 2018). Studies have shown that production sharing and the structure of production across borders play an important role in shaping the volatility and transmission of shocks from one country to another (di Giovanni and Levchenko, 2010; Acemoglu et al., 2012; di Giovanni, Levchenko, and Mejeanet, 2018; Miranda-Pinto, 2019; Huneus, 2019). Studies have also shown that firms producing intermediate goods are more strongly affected by the shocks than firms producing final goods (Altomonte et al., 2012). Most research on the causes of BCS has ignored the importance of GVC integration, where goods cross borders multiple times. Further, GVCs are a distinct kind of trade that is distinguished not just by cross-national production sharing but also

¹ In this research, we use the terms GVC participation, GVC integration, GVC linkages, and GVC-related trade interchangeably.

by cross-national technology sharing (Branstetter, Fisman, and Foley, 2006; Baldwin, 2016; Bilir and Morales, 2020; Rigo, 2021). Growing GVC integration across nations (particularly amongst Association of Southeast Asian Nations (ASEAN) countries) and the rising complexity motivate us to examine the impact of GVC integration and its components on BCS in ASEAN countries.² We also explore whether ASEAN countries differ significantly from other country pairs in terms of GVC integration and BCS.

The novelties of our proposed study are as follows: First, we diverge from all previous research by focusing on GVC-related output measures of GVC integration rather than GVC-related trade. GVC-related output measures take into account the entire supply chain, irrespective of its direct involvement in export activities, whereas GVC-related trade only takes into account the exporting sector and ignores the producing sector, underestimating the actual extent of GVC integration and biasing the measurement of risk exposure in GVCs (Borin, Mancini, and Taglioni, 2021). GVC-related output measurements help us better understand GVC involvement in the following ways. To begin, they enable the capture of previously unnoticed indirect participation, such as those industries and nations whose output flows into GVCs despite a limited direct engagement in cross-border trade. This is true of many professional services, which are often given primarily as inputs to industrial sectors that engage directly in GVCs. Failure to capture the full amount of their engagement in GVCs results in a significant underestimation of overall services GVC integration. Second, it enables the identification of scenarios in which a country's exposure to GVCs is restricted since trade accounts for a tiny proportion of total domestic production. In other words, there is a significant level of engagement in GVCs, but the majority of economic activity remains domestic. The use of GVC output measurements will be critical in determining the robust effect of GVC integration on BCS.

Second, the research shows that higher forward (backward) engagement in GVCs is associated with increased sensitivity to demand (supply) shocks. Furthermore, the impact of trade flows on BCS is dictated not just by trade volume but also by trade structure. Beyond GVC integration, this study explores the type of GVC integration (backward or forward integration) and its impact on BCS. Backward integration in a GVC refers to tracing activities at the end of the value chain, whilst forward integration in a GVC refers to tracing actions at the beginning of the value chain.

Third, we also examine the influence of intermediate activities or two-sided integration on BCS. The recent framework proposed by Borin, Mancini, and Taglioni (2021) allows us to

² Recent evidence shows that ASEAN nations' economic integration and value-added contributions have increased immensely (Zhong and Su, 2021).

identify the two-sided integration between countries. All processes, including the selling and sourcing of intermediates, are tracked through two-sided integration. Countries in the intermediate stages of GVC integration are vulnerable to both supply and demand shocks (Borin, Mancini, and Taglioni, 2021).

Finally, as previously indicated, two countries may have positive comovement if key sectors/industries in both economies experience correlated shocks, and we also consider an industry analysis. Due to a lack of industry-level cross-country comparison data, most of the literature on BCS has been at the aggregate level. We conduct this study because of the availability of industry-level cross-country data and the improved methodology to decompose gross trade flows (Borin, Mancini, and Taglioni, 2021). Broadly we consider three industry groupings: manufacturing, services, and high-technology intensive industries. We consider the instantaneous quasicorrelation measure that was proposed by Abiad et al. (2013) to calculate BCS. In comparison to measures based on the correlation of a selected cyclical component of output measure (such as the industrial production index or gross domestic product), the ‘instantaneous quasicorrelation’ measure is considered superior.

Theoretically, the effects of trade on BCS are unclear: According to conventional trade theory, trade liberalisation should result in increasing specialisation across nations. Insofar as this holds true, more trade integration should lower BCS. Alternatively, if intra-industry trade dominates patterns of specialisation and trade, more trade integration should be linked with a larger degree of production comovement. In the literature, two distinct kinds of shocks have been recognised. The first is the immediate demand shock associated with sales of finished goods. The second is the indirect demand shock resulting from the sale of intermediate goods. Using the GVC paradigm, the current research focuses on the indirect demand shock.

A GVC refers to a ‘series of phases involved in manufacturing an item or service, including at least two stages generated in separate countries’ (World Bank Group et al., 2017). The activities include design, manufacturing, marketing, distribution, and customer service. It also refers to making products and services competitive on a global scale. Reduced transportation and communication costs are driving the acceleration of GVCs (Baldwin and Robert-Nicoud, 2014). GVCs have created several prospects for nations to engage and gain, whether by creating a whole product or by doing a specific task.

Greater trade integration has also been shown in studies to possibly spread productivity shocks via foreign direct investment (Lichtenberg and Pottelsberghe, 1998) or technology diffusion (Coe and Helpman, 1995). The GVC integration framework is based on the paradigm described by Backus, Kehoe, and Kydland (1992), in which end products are formed by

combining local and foreign intermediate inputs. As final demand rises, so does the demand for foreign intermediates. The nature of trade has changed considerably in recent years. It is no longer trade in final or intermediate goods, but trading in tasks, a finer level. This has not been thoroughly examined in the literature. According to Calderon, Chong, and Stein (2007) and Shin and Wang (2004), the type of trade is important. Although some research studies have examined BCS with various kinds of trade, the evaluated measurements do not capture the complex GVC integration (Borin, Mancini, and Taglioni, 2021).

The following are the primary contributions of this suggested study: First, the study will add to the empirical evidence on the role of GVC integration on BCS. This finding is significant from the standpoint of policymakers for developing suitable measures to protect against external shocks. Second, the findings add to the discussions of which type of GVC integration promotes the greatest amount of BCS. For example, does a country's two-sided integration lead to higher BCS, or does backward integration contribute to higher BCS? Third, the industry-level analysis sheds information on the transmission of a shock from one industry in one country to another industry in another country. This assists policymakers in developing industry-specific policies to minimise the vulnerability of the economy to fluctuations. The findings show mixed evidence of synchronisation and desynchronisation between GVC integration and BCS across ASEAN countries.

The following Section 2 explains the methodology and data sources. Section 3 presents the preliminary findings and empirical results. Finally, Section 4 presents the conclusions and policy implications.

2. Data and Empirical Approach

2.1. Data

The proposed research considers a panel of nine ASEAN nations (Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, the Philippines, Singapore, Thailand, and Viet Nam) over a period from 2007 to 2021. Measures of GVC integration are based on data from the Asian Development Bank (ADB). The ADB database provides data for 35 sectors. The 35 sectors are further grouped into three major groupings: manufacturing, services, and high-technology intensive industries. The list of sectors and groupings is provided in the Appendix. The measures of output are also sourced from ADB. To measure BCS, we use the instantaneous quasicorrelation measure as suggested by Abiad et al. (2013).

$$OCORR1_{ijt} = \frac{(Output_{it} - Output_i^*)(Output_{jt} - Output_j^*)}{\sigma_i^{Output} \sigma_j^{Output}} \quad (1)$$

Where $OCORR1_{ijt}$ represents the quasicorrelation between the output growth of country i and country j in year t . $Output_{it}$ is the output growth of country i in year t ; $Output_i^*$ and σ_i^{Output} indicate the mean and standard deviation of country i 's output growth during the sample period, respectively. This instantaneous quasicorrelation measure is favoured above others for the following reasons: First, the suggested measure calculates the comovement at each given time rather than across a time interval. Second, the period average of this indicator asymptotically converges to the usual Pearson correlation coefficient. Third, we compute correlations using actual output growth rather than detrended output, since the latter is highly dependent on the filtering techniques used. Finally, it is not constrained between -1 and 1, making it suitable for use in regression analysis. For robustness, we also consider an alternative proxy for BCS ($OCORR2$), calculated as the absolute value of the output growth difference between country i and j at time t .³

$$OCORR2_{ijt} = |(\ln Output_{it} - \ln Output_{it-1}) - (\ln Output_{jt} - \ln Output_{jt-1})| \quad (2)$$

where 'ln' is the natural logarithm. The majority of previous research has focused on trade indicators such as the trade intensity index and the export concentration index. However, as trade has become more complicated and GVCs have emerged, the above-stated measurements no longer capture the linkages. The following indices will be considered in this regard.

(a) Forward integration (FI): FI tracks the value-added created by a nation and sold directly overseas by the country or indirectly via domestic chains before being re-exported by the partner country. In other words, it is the nation from which the value-added is created, the very first link in a chain. The FI between two nations is determined as follows:

$$FI_{ijkt} = \frac{(DVA_t^{ijk} + DVA_t^{jik})}{(Output_{it} + Output_{jt})} \quad (3)$$

Where FI_{ijkt} represents the forward integration of a country pair i and j in industry/sector k at time t . $Output_{it}$ represents the output of country i at time t . DVA_t^{ijk} signifies the proportion of country i 's intermediate exports that are directly or indirectly reflected in country j 's exports in industry/sector k at time t . FVA_t^{ijk} signifies the proportion of country j 's intermediate imports incorporated in country i 's exports in industry/sector k at time t .

³ For more discussion on this, refer to Giannone Lenza, and Reichlin (2010) and Kalemli-Ozcan, Papaioannou, and Perri (2013).

(b) Backward integration (BI): BI tracks the imported inputs purchased by a nation directly from abroad or indirectly via local chains and integrated into final products and services output supplied to domestic customers. The BI between two nations is determined as follows:

$$BI_{ijkt} = \frac{(FVA_t^{ijk} + FVA_t^{jik})}{(Output_{it} + Output_{jt})} \quad (4)$$

Where BI_{ijkt} represents the backward integration of a country pair i and j in industry/sector k at time t .

(c) Two-sided integration (TI): TI tracks domestic inputs acquired by a nation, sold directly or indirectly overseas, and re-exported by a partner; or imported inputs acquired directly or indirectly by the nation and sold directly or indirectly overseas. The TI in a GVC between two countries is determined as followed:

$$TI_{ijkt} = \frac{(Int_t^{ijk} + Int_t^{jik})}{(Output_{it} + Output_{jt})} \quad (5)$$

Where TI_{ijkt} is the two-sided integration of a country pair i and j in industry/sector k at time t . Int_t^{ijk} represents the sourcing and selling of intermediates of a country pair i and j in industry/sector k at time t .

(d) GVC integration (GVC): The GVC integration of two nations is determined as the total of their forward integration (FI), backward integration (BI), and two-sided integration (TI).

$$GVC_{ijkt} = FI_{ijkt} + BI_{ijkt} + TI_{ijkt} \quad (6)$$

Where, GVC_{ijkt} represents the GVC integration of country pairs i and j in industry/sector k at time t .

2.2. Methodology

The approach used in this research is based on panel regressions with fixed effects. This enables us to control for common global shocks by introducing pairs of country-specific fixed effects that account for unobservable idiosyncratic characteristics and gravity-type variables. The model is given by:

$$OCORR_{ijt} = \alpha_{ijk} + \beta_t + \gamma T_{ijkt-1} + \epsilon_{ijkt} \quad (7)$$

where $OCORR_{ijt}$ is the ‘instantaneous quasicorrelation’ between country i and j at time t ; α_{ijk} is the fixed effect of country pair i and j in industry/sector k ; β_t represents the time-varying common factors that affect all countries. T_{ijkt-1} captures the GVC integration with a one-period lag (and the type of GVC integration, such as FI, BI, or TI). One-period lagged GVC integration is considered to avoid the reverse causation whereby more synchronised business cycles tend to

participate in more GVC integration (Inklaar, Pin, and Haan, 2008; Duval et al., 2014). For the robustness of our results, we undertake an industry-level analysis comprising three major industry groups, namely, manufacturing, services, and high-technology intensive industries. To examine the impact of the COVID-19 shock on BCS, we introduce a dummy variable for the years 2020 and 2021. Equation (7) is modified as follows:

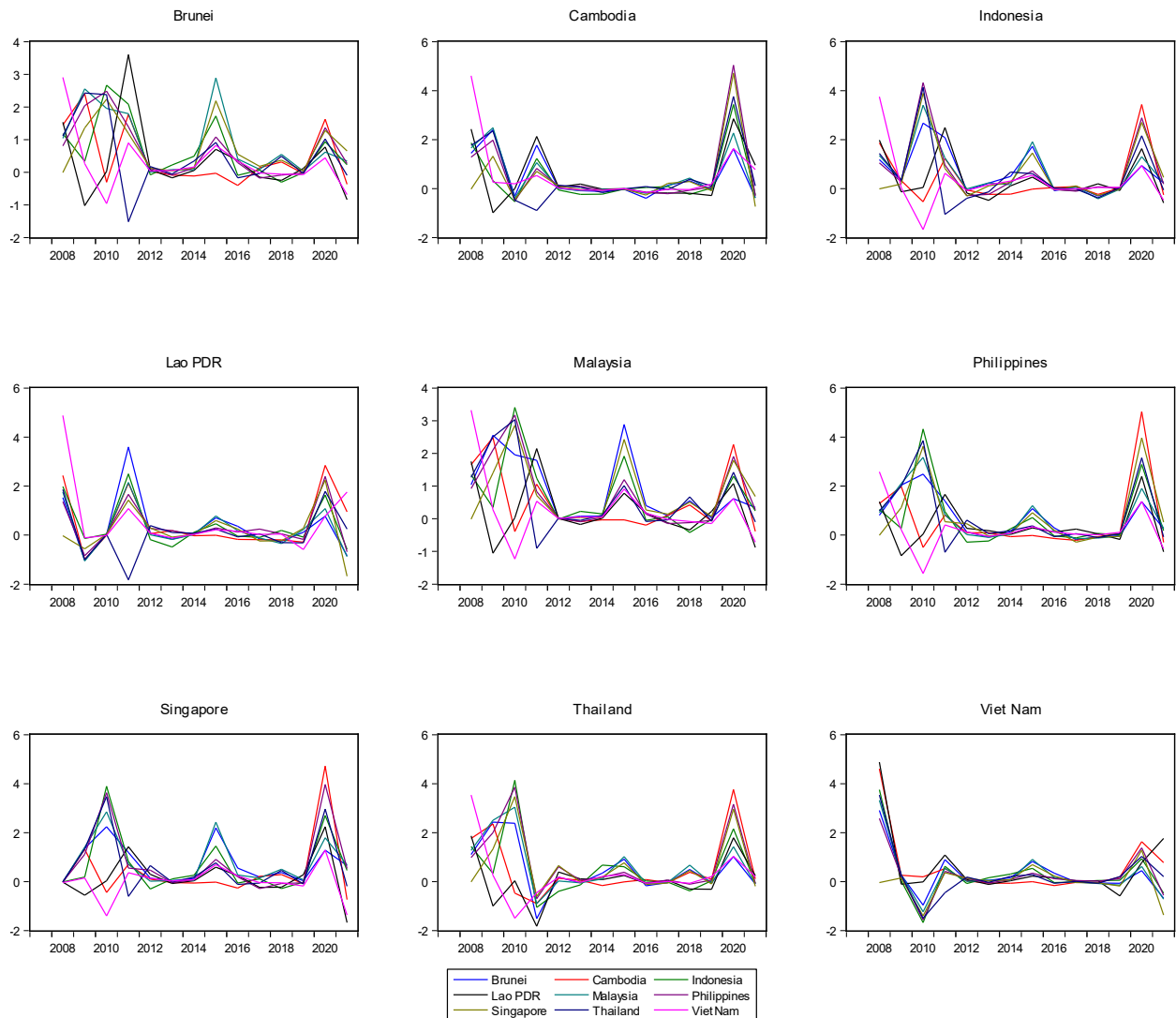
$$OCORR_{ij} = \rho_{ij} + \theta_1 T_{ijkt-1} + \theta_2 COVID_{ij} + \theta_3 T_{ij} * COVID_{ij} + \vartheta_{ij} \quad (8)$$

Where ρ , θ , and ϑ are the coefficients to be estimated.

3. Empirical Findings

Before presenting the empirical findings, we present the preliminary findings of the business cycle synchronisation (BCS) and global value chain (GVC) integration. The BCS calculated using Equation (1) is shown in Figure 1. The graph compares each country's BCS to ASEAN countries. The trends show that similar output comovement exists in the majority of cases.

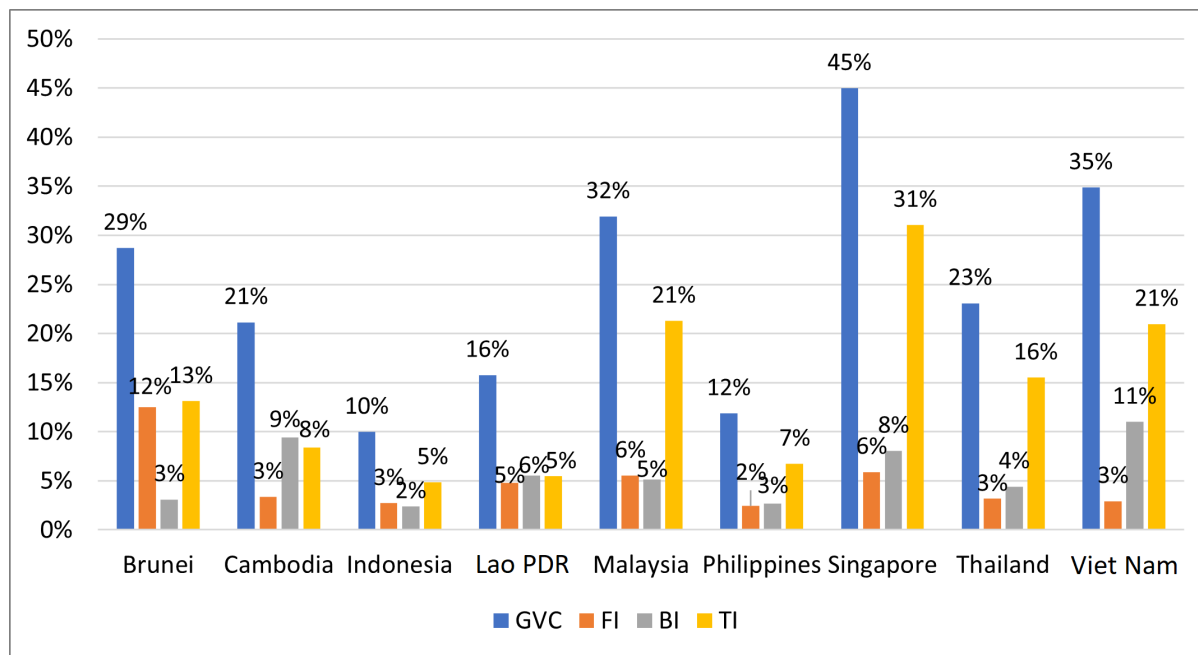
Figure 1: Business Cycle Correlations amongst Selected ASEAN Countries



Source: Authors.

Figure 2 presents the shares of GVC integration amongst selected ASEAN countries. Amongst these selected ASEAN countries, Singapore has the highest share of GVC (computed as a percentage of total output), whilst Indonesia has the lowest share of GVC. Since the type of linkage is crucial, we present the forward integration (FI), backward integration (BI) and two-sided integration (TI) in GVCs. From Figure 2, it is evident that Brunei has the highest share of FI, Viet Nam has the highest share of BI, and Singapore has the highest share of TI.

Figure 2: GVC Integration amongst Selected ASEAN Countries



Note: GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC. All the values are taken as a percentage of total output.

Source: Authors.

Now we validate the impact of GVC integration on BCS across selected ASEAN countries using Equation (7). We employ panel regressions with a fixed effects model. First, we examine the influence of GVC integration on BCS. Table 1 shows the results for Brunei. Column (2) reveals that the GVC coefficient is positive and statistically significant, indicating that increased GVC integration improves output synchronisation between Brunei and the other eight ASEAN nations. In other words, a 1% increase in GVC integration between Brunei and the ASEAN countries increases the output growth correlations by 1.45%. The findings for Cambodia, Indonesia, the Lao PDR, Malaysia, the Philippines, Singapore, Thailand, and Viet Nam are presented in Table 2–Table 9, respectively. Only Malaysia and the Philippines have a statistically significant relationship between GVC integration and BCS when compared to other ASEAN countries. Second, we examine the FI on BCS amongst nine ASEAN countries. The findings are presented in Column (3), Tables 1–Table 9. The findings show that the coefficient of FI is positive and statistically significant for only Brunei and Malaysia. In other words, FI makes ASEAN nations' outputs move together more in the case of Brunei and Malaysia. Third, we investigate the BI on BCS in nine ASEAN nations. The results are reported in Column (4), Tables 1–Table 9. The results indicate that the coefficient of BI is statistically insignificant for all the countries. In other words, we cannot establish statistically whether BI promotes more

synchronisation amongst ASEAN nations' outputs. Finally, the impact of TI on BCS in nine ASEAN countries is analysed. The results are shown in Column (5), Table 1–Table 9. Brunei, Malaysia, the Philippines, and Thailand all have positive and statistically significant TI coefficients. However, in the case of Viet Nam, the TI coefficient is negative and statistically significant, indicating that TI does not facilitate output comovement but desynchronisation. Only a few ASEAN countries have shown statistically significant evidence of synchronisation between GVCs and output comovement.

Using Equation (7), we now investigate whether COVID-19 altered the outcomes associated with GVCs on output comovements across ASEAN countries. The findings are reported in Tables 1–9, Columns 6–9. The findings from Column (6) of Table 1 reveal that the coefficient of GVC is positive and statistically significant, indicating that GVC integration increases output synchronisation between Brunei and the other eight ASEAN nations. However, the coefficient for COVID is negative but statistically insignificant. The interaction of COVID with GVC is also negative but statistically insignificant. The findings are similar for the majority of the ASEAN countries. The inclusion of the dummy variable for the COVID-19 shock results in the majority of the previously insignificant results becoming significant. In summary, the findings show a mixed picture of synchronisation and desynchronisation across different types of GVC integration and ASEAN countries.

Table 1: BCS of Brunei with Selected ASEAN Countries

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|--------------|---------------------|---------------------|-------------------|--------------------|---------------------|---------------------|-------------------|--------------------|
| GVC (-1) | 1.452** (0.031) | | | | 1.719** (0.025) | | | |
| FI (-1) | | 1.072** (0.015) | | | | 1.335** (0.011) | | |
| BI (-1) | | | -0.235 (0.649) | | | | -0.258 (0.658) | |
| TI (-1) | | | | 1.236** (0.047) | | | | 1.450** (0.040) |
| COVID | | | | | -0.530 (0.500) | 0.169 (0.929) | 0.284 (0.849) | -0.521 (0.561) |
| GVC*COVID | | | | | -0.394 (0.424) | | | |
| FI*COVID | | | | | | -0.036 (0.950) | | |
| BI*COVID | | | | | | | 0.126 (0.796) | |
| TI*COVID | | | | | | | | -0.281 (0.491) |
| Constant | 2.694*** (0.007) | 3.841*** (0.005) | -0.148 (0.925) | 3.104** (0.015) | 3.072*** (0.006) | 4.602*** (0.004) | -0.204 (0.909) | 3.530** (0.014) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|-----|-----|-----|---------|-----|-----|-----|
| GVC (-1) | 1.452** | | | | 1.719** | | | |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. *** and ** refer to significance level at 1% and 5% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table 2: BCS of Cambodia with Selected ASEAN countries

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| GVC (-1) | 1.146 | | | | 1.841** | | | |
| | (0.203) | | | | (0.037) | | | |
| FI (-1) | | 0.581 | | | | 1.346** | | |
| | | (0.347) | | | | (0.025) | | |
| BI (-1) | | | 1.019 | | | | 0.490 | |
| | | | (0.137) | | | | (0.503) | |
| TI (-1) | | | | 0.462 | | | | 1.626* |
| | | | | (0.595) | | | | (0.059) |
| COVID | | | | | 0.477 | -0.113 | 0.088 | 0.747 |
| | | | | | (0.610) | (0.965) | (0.959) | (0.477) |
| GVC*COVID | | | | | -0.562 | | | |
| | | | | | (0.334) | | | |
| FI*COVID | | | | | | -0.463 | | |
| | | | | | | (0.539) | | |
| BI*COVID | | | | | | | -0.393 | |
| | | | | | | | (0.497) | |
| TI*COVID | | | | | | | | -0.313 |
| | | | | | | | | (0.504) |
| Constant | 2.211 | 2.373 | 3.484* | 1.453 | 3.067** | 4.653** | 1.753 | 3.696** |
| | (0.106) | (0.239) | (0.085) | (0.427) | (0.021) | (0.017) | (0.419) | (0.040) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ** and * refer to significance level at 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table 3: BCS of Indonesia with Selected ASEAN Countries

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|------------------|------------------|-------------------|------------------|--------------------|-------------------------|-------------------|--------------------|
| GVC (-1) | 0.248 (0.741) | | | | 1.865* (0.072) | | | |
| FI (-1) | | 0.391 (0.504) | | | | 2.050** (0.012) | | |
| BI (-1) | | | -0.880 (0.278) | | | | -0.678 (0.535) | |
| TI (-1) | | | | 0.389 (0.598) | | | | 1.883* (0.052) |
| COVID | | | | | 0.553 (0.784) | 6.318 (0.376) | 3.949 (0.296) | 0.115 (0.954) |
| GVC*COVID | | | | | -0.201 (0.828) | | | |
| FI*COVID | | | | | | 1.323 (0.481) | | |
| BI*COVID | | | | | | | 0.975 (0.354) | |
| TI*COVID | | | | | | | | -0.305 (0.672) |
| Constant | 1.042 (0.493) | 1.910 (0.352) | -2.530 (0.371) | 1.568 (0.421) | 4.151** (0.043) | 7.529** * (0.007) | -1.879 (0.619) | 5.363** (0.033) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ***, ** and * refer to significance level at 1%, 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms. Source: Authors.

Table 4: BCS of Lao PDR with Selected ASEAN Countries

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|-----------|------------------|------------------|------------------|------------------|-------------------|--------------------|-------------------|------------------|
| GVC (-1) | 0.641 (0.373) | | | | 0.945 (0.220) | | | |
| FI (-1) | | 0.724 (0.170) | | | | 1.082** (0.048) | | |
| BI (-1) | | | 0.262 (0.674) | | | | -0.195 (0.771) | |
| TI (-1) | | | | 0.151 (0.824) | | | | 0.577 (0.434) |
| COVID | | | | | 0.524 (0.550) | -0.792 (0.713) | 2.414 (0.128) | 0.425 (0.663) |
| GVC*COVID | | | | | -0.017 (0.975) | | | |
| FI*COVID | | | | | | -0.425 (0.510) | | |
| BI*COVID | | | | | | | 0.650 | |

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| | | | | | | | (0.211) | |
| TI*COVID | | | | | | | | -0.055 |
| | | | | | | | | (0.899) |
| Constant | 1.306 | 2.664 | 1.124 | 0.652 | 1.688 | 3.725** | -0.325 | 1.472 |
| | (0.235) | (0.118) | (0.552) | (0.651) | (0.148) | (0.034) | (0.873) | (0.341) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ** refers to significance level at 5%. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table 5: BCS of Malaysia with Selected ASEAN Countries

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|----------|---------|---------|----------|----------|-----------|---------|----------|
| GVC (-1) | 2.336*** | | | | 3.560*** | | | |
| | (0.001) | | | | (0.000) | | | |
| FI (-1) | | 1.536** | | | | 3.390*** | | |
| | | (0.034) | | | | (0.001) | | |
| BI (-1) | | | 1.107 | | | | 1.519 | |
| | | | (0.313) | | | | (0.248) | |
| TI (-1) | | | | 2.120*** | | | | 2.979*** |
| | | | | (0.000) | | | | (0.000) |
| COVID | | | | | -0.363 | -0.333 | -0.888 | -0.490 |
| | | | | | (0.772) | (0.938) | (0.764) | (0.736) |
| GVC*COVID | | | | | -0.801 | | | |
| | | | | | (0.368) | | | |
| FI*COVID | | | | | | -0.401 | | |
| | | | | | | (0.762) | | |
| BI*COVID | | | | | | | -0.350 | |
| | | | | | | | (0.720) | |
| TI*COVID | | | | | | | | -0.647 |
| | | | | | | | | (0.408) |
| Constant | 3.498*** | 5.233** | 3.903 | 4.135*** | 4.911*** | 10.697*** | 5.109 | 5.469*** |
| | (0.000) | (0.017) | (0.235) | (0.000) | (0.000) | (0.001) | (0.193) | (0.000) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. *** and ** refer to significance level at 1% and 5% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table 6: BCS of Philippines with Selected ASEAN Countries

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|--------------|--------------|---------|--------------|
| GVC (-1) | 1.337* | | | | 2.572** * | | | |
| | (0.065) | | | | (0.001) | | | |
| FI (-1) | | 0.866 | | | | 2.484** * | | |
| | | (0.205) | | | | (0.001) | | |
| BI (-1) | | | 1.054 | | | | 0.990 | |
| | | | (0.211) | | | | (0.247) | |
| TI (-1) | | | | 1.096* | | | | 2.308** * |
| | | | | (0.074) | | | | (0.001) |
| COVID | | | | | 1.011 | 5.430 | 1.973 | 0.775 |
| | | | | | (0.436) | (0.226) | (0.448) | (0.568) |
| GVC*COVID | | | | | -0.160 | | | |
| | | | | | (0.812) | | | |
| FI*COVID | | | | | | 1.076 | | |
| | | | | | | (0.378) | | |
| BI*COVID | | | | | | | 0.327 | |
| | | | | | | | (0.674) | |
| TI*COVID | | | | | | | | -0.246 |
| | | | | | | | | (0.653) |
| Constant | 2.960** | 3.601 | 4.095 | 3.109** | 4.950** * | 8.995** * | 3.759 | 5.680** * |
| | (0.022) | (0.129) | (0.144) | (0.028) | (0.000) | (0.001) | (0.185) | (0.000) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ***, ** and * refer to significance level at 1%, 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms. Source: Authors.

Table 7: BCS of Singapore with Selected ASEAN Countries

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|-----------|---------|---------|---------|---------|---------|---------|---------|---------|
| GVC (-1) | -0.332 | | | | 1.637 | | | |
| | (0.840) | | | | (0.347) | | | |
| FI (-1) | | -0.812 | | | | 0.734 | | |
| | | (0.450) | | | | (0.555) | | |
| BI (-1) | | | -0.659 | | | | -0.106 | |
| | | | (0.466) | | | | (0.907) | |
| TI (-1) | | | | 0.697 | | | | 2.625 |
| | | | | (0.702) | | | | (0.162) |
| COVID | | | | | 0.065 | 3.618 | -1.700 | -0.264 |
| | | | | | (0.955) | (0.412) | (0.554) | (0.856) |
| GVC*COVID | | | | | -0.787 | | | |
| | | | | | (0.468) | | | |
| FI*COVID | | | | | | 0.874 | | |

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| | | | | | | (0.541) | | |
| BI*COVID | | | | | | | -0.913 | |
| | | | | | | | (0.385) | |
| TI*COVID | | | | | | | | -0.820 |
| | | | | | | | | (0.409) |
| Constant | 0.183 | -1.909 | -1.254 | 1.501 | 2.046 | 2.582 | 0.120 | 4.087 |
| | (0.913) | (0.552) | (0.606) | (0.560) | (0.243) | (0.484) | (0.961) | (0.121) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table 8: BCS of Thailand with Selected ASEAN Countries

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|---------|----------|
| GVC (-1) | 2.028 | | | | 3.032** | | | |
| | (0.148) | | | | (0.040) | | | |
| FI (-1) | | -0.888 | | | | -0.229 | | |
| | | (0.366) | | | | (0.828) | | |
| BI (-1) | | | 0.788 | | | | 0.219 | |
| | | | (0.362) | | | | (0.809) | |
| TI (-1) | | | | 2.720** | | | | 4.642*** |
| | | | | (0.047) | | | | (0.002) |
| COVID | | | | | 0.693 | 5.538 | 3.035 | 0.200 |
| | | | | | (0.708) | (0.390) | (0.403) | (0.922) |
| GVC*COVID | | | | | -0.115 | | | |
| | | | | | (0.925) | | | |
| FI*COVID | | | | | | 1.390 | | |
| | | | | | | (0.451) | | |
| BI*COVID | | | | | | | 0.775 | |
| | | | | | | | (0.512) | |
| TI*COVID | | | | | | | | -0.457 |
| | | | | | | | | (0.664) |
| Constant | 3.462* | -2.537 | 2.941 | 5.614** | 4.812** | -0.389 | 1.071 | 9.083*** |
| | (0.094) | (0.448) | (0.276) | (0.030) | (0.026) | (0.913) | (0.706) | (0.001) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ***, ** and * refer to significance level at 1%, 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table 9: BCS of Viet Nam with Selected ASEAN Countries

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|-----------|---------|---------|---------|-----------|
| GVC (-1) | -1.142 | | | | -1.309 | | | |
| | (0.325) | | | | (0.272) | | | |
| FI (-1) | | 0.750 | | | | 1.705* | | |
| | | (0.255) | | | | (0.051) | | |
| BI (-1) | | | 1.010 | | | | 1.064 | |
| | | | (0.157) | | | | (0.194) | |
| TI (-1) | | | | -3.737*** | | | | -3.920*** |
| | | | | (0.001) | | | | (0.000) |
| COVID | | | | | 0.601 | -0.993 | 1.128 | 0.415 |
| | | | | | (0.639) | (0.839) | (0.641) | (0.784) |
| GVC*COVID | | | | | 0.323 | | | |
| | | | | | (0.751) | | | |
| FI*COVID | | | | | | -0.447 | | |
| | | | | | | (0.739) | | |
| BI*COVID | | | | | | | 0.487 | |
| | | | | | | | (0.620) | |
| TI*COVID | | | | | | | | 0.062 |
| | | | | | | | | (0.943) |
| Constant | -1.124 | 2.860 | 2.942 | -6.218*** | -1.364 | 6.017** | 3.089 | -6.582*** |
| | (0.442) | (0.202) | (0.114) | (0.001) | (0.366) | (0.040) | (0.152) | (0.001) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ***, ** and * refer to significance level at 1%, 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms. Source: Authors.

3.1. Industry-level Analysis

We conduct an industry-level analysis for deeper insights. We focus primarily on three broad industry domains: manufacturing, services, and high-technology intensive industries. The results are provided in Appendix A. The results of GVC integration in manufacturing industries and the related BCS across ASEAN nations are shown in Tables A1–A9. Tables A10–A18 give the results of GVC integration in service sectors and the related BCS across ASEAN nations, whereas Tables A19–A27 present the results of GVC integration in high-technology intensive industries and the associated BCS amongst ASEAN countries. The outcomes are summarised as follows. First, we see that, as with the overall findings, there is mixed evidence on the association of GVC integration and BCS across nations and industry groups. Several ASEAN countries have seen improved synchrony, whilst others have not. Second, the outcomes of GVC and BCS differ depending on the type of GVC integration, such as forward integration, backward integration, or two-sided integration across industry groups. Finally, in some countries, COVID-19 improved the favourable connection of GVCs with output correlations, whereas in others,

desynchronisation tendencies are observed.

3.2. Robustness

We consider an alternative proxy for BCS to ensure the validity of our findings. The findings using Equation (2) are presented in Table A28–Table A36 (Appendix A). We discover that the results corroborate the previous findings for all countries, indicating the robustness of our findings.

4. Conclusions

This study investigates the role of GVC integration in driving BCS in nine selected ASEAN countries from 2007 to 2020. First, we computed the instantaneous quasicorrelation of output growth amongst ASEAN countries. Second, we quantified the GVC integration and various types of GVC integration, such as forward integration, backward integration, and two-sided integration amongst ASEAN countries. Third, using the panel fixed effects approach, we examined the association between GVCs and BCS. We also included a dummy variable to control for the COVID-19 pandemic. Fourth, for greater insights, we considered an industry-level analysis. We grouped industries under three major groupings of manufacturing, services, and high-technology intensive industries. Finally, for the robustness of our findings, we considered an alternative proxy for BCS.

The findings are as follows: First, plotting the instantaneous quasicorrelation of ASEAN output growth validates early indications of output synchronisation amongst ASEAN nations. Second, according to GVC measurements, Singapore has the greatest proportion of GVC as a percentage of total output. Third, the panel fixed effects approach results provide mixed evidence of output synchronisation and desynchronisation related to GVC integration. The addition of the Covid dummy enhanced the statistical significance of GVC in influencing BCS. Fourthly, the industry analysis reveals a mixed picture of output synchronisation and desynchronisation amongst ASEAN nations. Finally, the results corroborate the previous findings for all the countries, indicating the robustness of our findings.

The findings have important policy implications: First, policymakers must understand the shock transmission associated with GVC integration. Second, it is critical to note that output synchronisation and desynchronisation do not follow a consistent pattern across ASEAN countries. Finally, synchronisation varies depending on the type of GVC integration and industry.

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Appendix A

Table A1: BCS of Brunei with Selected ASEAN Countries (Manufacturing industries)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| MAN_GVC (-1) | 0.881* | | | | 1.004** | | | |
| | (0.053) | | | | (0.046) | | | |
| MAN_FI (-1) | | 0.565* | | | | 0.753** | | |
| | | (0.073) | | | | (0.046) | | |
| MAN_BI (-1) | | | 0.116 | | | | 0.151 | |
| | | | (0.772) | | | | (0.720) | |
| MAN_TI (-1) | | | | 0.725* | | | | 0.857* |
| | | | | (0.079) | | | | (0.067) |
| COVID | | | | | -0.615 | -3.287 | 0.038 | -0.640 |
| | | | | | (0.517) | (0.305) | (0.975) | (0.536) |
| MAN_GVC*COVID | | | | | -0.291 | | | |
| | | | | | (0.466) | | | |
| MAN_FI*COVID | | | | | | -0.758 | | |
| | | | | | | (0.280) | | |
| MAN_BI*COVID | | | | | | | 0.048 | |
| | | | | | | | (0.881) | |
| MAN_TI*COVID | | | | | | | | -0.259 |
| | | | | | | | | (0.467) |
| Constant | 2.492** | 2.966** | 1.013 | 2.488** | 2.750** | 3.735** | 1.164 | 2.821** |
| | (0.013) | (0.027) | (0.508) | (0.024) | (0.012) | (0.018) | (0.470) | (0.022) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. MAN_GVC= global value chain integration in manufacturing industries; MAN_FI= forward integration in manufacturing industries; MAN_BI= backward integration in manufacturing industries; MAN_TI = two-sided integration in manufacturing industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ** and * refer to significance level at 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms. Source: Authors.

**Table A2: BCS of Cambodia with Selected ASEAN Countries
(Manufacturing industries)**

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| MAN_GVC (-1) | 0.309 | | | | 1.036 | | | |
| | (0.661) | | | | (0.125) | | | |
| MAN_FI (-1) | | -0.159 | | | | 0.767* | | |
| | | (0.723) | | | | (0.095) | | |
| MAN_BI (-1) | | | 0.724 | | | | 0.319 | |
| | | | (0.169) | | | | (0.552) | |
| MAN_TI (-1) | | | | -0.187 | | | | 1.015 |
| | | | | (0.761) | | | | (0.109) |
| COVID | | | | | 0.317 | -0.811 | -0.471 | 0.896 |
| | | | | | (0.792) | (0.774) | (0.786) | (0.464) |
| MAN_GVC*COVID | | | | | -0.467 | | | |
| | | | | | (0.371) | | | |
| MAN_FI*COVID | | | | | | -0.485 | | |
| | | | | | | (0.410) | | |
| MAN_BI*COVID | | | | | | | -0.499 | |
| | | | | | | | (0.316) | |
| MAN_TI*COVID | | | | | | | | -0.206 |
| | | | | | | | | (0.621) |
| Constant | 1.151 | -0.235 | 3.029 | -0.021 | 2.533* | 3.729* | 1.431 | 2.996* |
| | (0.452) | (0.908) | (0.103) | (0.990) | (0.083) | (0.070) | (0.453) | (0.076) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. MAN_GVC= global value chain integration in manufacturing industries; MAN_FI= forward integration in manufacturing industries; MAN_BI= backward integration in manufacturing industries; MAN_TI = two-sided integration in manufacturing industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. * refers to significance level at 10%. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table A3: BCS of Indonesia with Selected ASEAN Countries (Manufacturing industries)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|-----------|---------|---------|
| MAN_GVC (-1) | 0.338 | | | | 1.718** | | | |
| | (0.595) | | | | (0.038) | | | |
| MAN_FI (-1) | | 0.261 | | | | 2.246*** | | |
| | | (0.642) | | | | (0.008) | | |
| MAN_BI (-1) | | | -0.200 | | | | 0.113 | |
| | | | (0.785) | | | | (0.893) | |
| MAN_TI (-1) | | | | 0.354 | | | | 1.734** |
| | | | | (0.541) | | | | (0.022) |
| COVID | | | | | -0.682 | -1.102 | 1.041 | -0.863 |
| | | | | | (0.769) | (0.900) | (0.750) | (0.721) |
| MAN_GVC*COVID | | | | | -0.586 | | | |
| | | | | | (0.474) | | | |
| MAN_FI*COVID | | | | | | -0.516 | | |
| | | | | | | (0.773) | | |
| MAN_BI*COVID | | | | | | | 0.120 | |
| | | | | | | | (0.876) | |
| MAN_TI*COVID | | | | | | | | -0.575 |
| | | | | | | | | (0.427) |
| Constant | 1.436 | 1.733 | -0.295 | 1.643 | 4.946** | 10.594*** | 0.938 | 5.780** |
| | (0.395) | (0.500) | (0.923) | (0.363) | (0.022) | (0.006) | (0.787) | (0.013) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. MAN_GVC= global value chain integration in manufacturing industries; MAN_FI= forward integration in manufacturing industries; MAN_BI= backward integration in manufacturing industries; MAN_TI = two-sided integration in manufacturing industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. *** and ** refer to significance level at 1% and 5% respectively. P-values are provided in parentheses. All the variables are taken in logarithms. Source: Authors.

**Table A4: BCS of Lao PDR with Selected ASEAN Countries
(Manufacturing industries)**

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| MAN_GVC (-1) | 0.429 | | | | 0.703 | | | |
| | (0.384) | | | | (0.180) | | | |
| MAN_FI (-1) | | 0.177 | | | | 0.530 | | |
| | | (0.653) | | | | (0.210) | | |
| MAN_BI (-1) | | | 0.482 | | | | 0.297 | |
| | | | (0.334) | | | | (0.552) | |
| MAN_TI (-1) | | | | 0.150 | | | | 0.523 |
| | | | | (0.745) | | | | (0.297) |
| COVID | | | | | 0.882 | -3.021 | 2.268* | 0.550 |
| | | | | | (0.396) | (0.240) | (0.084) | (0.617) |
| MAN_GVC*COVID | | | | | 0.122 | | | |
| | | | | | (0.775) | | | |
| MAN_FI*COVID | | | | | | -0.771 | | |
| | | | | | | (0.153) | | |
| MAN_BI*COVID | | | | | | | 0.490 | |
| | | | | | | | (0.154) | |
| MAN_TI*COVID | | | | | | | | -0.016 |
| | | | | | | | | (0.966) |
| Constant | 1.290 | 1.126 | 2.149 | 0.740 | 1.816 | 2.621 | 1.389 | 1.667 |
| | (0.243) | (0.524) | (0.254) | (0.555) | (0.118) | (0.165) | (0.463) | (0.217) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. MAN_GVC= global value chain integration in manufacturing industries; MAN_FI= forward integration in manufacturing industries; MAN_BI= backward integration in manufacturing industries; MAN_TI = two-sided integration in manufacturing industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. * refers to significance level at 10%. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table A5: BCS of Malaysia with Selected ASEAN Countries (Manufacturing industries)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|----------|---------|---------|----------|----------|-----------|---------|----------|
| MAN_GVC (-1) | 1.995*** | | | | 2.959*** | | | |
| | (0.001) | | | | (0.000) | | | |
| MAN_FI (-1) | | 1.664** | | | | 3.790*** | | |
| | | (0.020) | | | | (0.000) | | |
| MAN_BI (-1) | | | 1.191 | | | | 1.543* | |
| | | | (0.107) | | | | (0.060) | |
| MAN_TI (-1) | | | | 1.812*** | | | | 2.618*** |
| | | | | (0.001) | | | | (0.000) |
| COVID | | | | | -1.316 | -5.518 | -2.004 | -1.344 |
| | | | | | (0.429) | (0.349) | (0.453) | (0.486) |
| MAN_GVC*COVID | | | | | -1.070 | | | |
| | | | | | (0.220) | | | |
| MAN_FI*COVID | | | | | | -1.531 | | |
| | | | | | | (0.266) | | |
| MAN_BI*COVID | | | | | | | -0.620 | |
| | | | | | | | (0.411) | |
| MAN_TI*COVID | | | | | | | | -0.923 |
| | | | | | | | | (0.280) |
| Constant | 4.030*** | 7.385** | 4.742* | 4.287*** | 5.587*** | 15.911*** | 5.940** | 5.826*** |
| | (0.000) | (0.011) | (0.066) | (0.000) | (0.000) | (0.000) | (0.037) | (0.000) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. MAN_GVC= global value chain integration in manufacturing industries; MAN_FI= forward integration in manufacturing industries; MAN_BI= backward integration in manufacturing industries; MAN_TI = two-sided integration in manufacturing industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ***, ** and * refer to significance level at 1%, 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

**Table A6: BCS of Philippines with Selected ASEAN Countries
(Manufacturing industries)**

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|----------|----------|---------|----------|
| MAN_GVC (-1) | 0.905* | | | | 1.961*** | | | |
| | (0.084) | | | | (0.001) | | | |
| MAN_FI (-1) | | 0.519 | | | | 1.828*** | | |
| | | (0.222) | | | | (0.000) | | |
| MAN_BI (-1) | | | 0.904 | | | | 0.941 | |
| | | | (0.138) | | | | (0.122) | |
| MAN_TI (-1) | | | | 0.745 | | | | 1.851*** |
| | | | | (0.113) | | | | (0.000) |
| COVID | | | | | 0.219 | -0.290 | 0.517 | 0.166 |
| | | | | | (0.889) | (0.947) | (0.828) | (0.924) |
| MAN_GVC*COVID | | | | | -0.462 | | | |
| | | | | | (0.460) | | | |
| MAN_FI*COVID | | | | | | -0.396 | | |
| | | | | | | (0.657) | | |
| MAN_BI*COVID | | | | | | | -0.095 | |
| | | | | | | | (0.876) | |
| MAN_TI*COVID | | | | | | | | -0.440 |
| | | | | | | | | (0.453) |
| Constant | 2.682** | 2.967 | 4.092* | 2.607** | 4.912*** | 8.694*** | 4.110* | 5.375*** |
| | (0.027) | (0.127) | (0.083) | (0.041) | (0.000) | (0.000) | (0.081) | (0.000) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. MAN_GVC= global value chain integration in manufacturing industries; MAN_FI= forward integration in manufacturing industries; MAN_BI= backward integration in manufacturing industries; MAN_TI = two-sided integration in manufacturing industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ***, ** and * refer to significance level at 1%, 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms. Source: Authors.

Table A7: BCS of Singapore with Selected ASEAN Countries (Manufacturing Industries)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| MAN_GVC (-1) | -0.330 | | | | 1.226 | | | |
| | (0.589) | | | | (0.102) | | | |
| MAN_FI (-1) | | -0.375 | | | | 1.788* | | |
| | | (0.647) | | | | (0.091) | | |
| MAN_BI (-1) | | | -0.766 | | | | 0.022 | |
| | | | (0.162) | | | | (0.970) | |
| MAN_TI (-1) | | | | -0.096 | | | | 1.556** |
| | | | | (0.864) | | | | (0.027) |
| COVID | | | | | -1.076 | 2.955 | -4.922* | -0.353 |
| | | | | | (0.583) | (0.648) | (0.080) | (0.877) |
| MAN_GVC*COVID | | | | | -1.138 | | | |
| | | | | | (0.255) | | | |
| MAN_FI*COVID | | | | | | 0.405 | | |
| | | | | | | (0.790) | | |
| MAN_BI*COVID | | | | | | | - | |
| | | | | | | | 1.716** | |
| | | | | | | | (0.043) | |
| MAN_TI*COVID | | | | | | | | -0.697 |
| | | | | | | | | (0.464) |
| Constant | -0.047 | -1.012 | -1.902 | 0.315 | 2.454* | 7.649* | 0.472 | 3.630** |
| | (0.964) | (0.762) | (0.271) | (0.791) | (0.052) | (0.074) | (0.795) | (0.014) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. MAN_GVC= global value chain integration in manufacturing industries; MAN_FI= forward integration in manufacturing industries; MAN_BI= backward integration in manufacturing industries; MAN_TI = two-sided integration in manufacturing industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ** and * refer to significance level at 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms. Source: Authors.

Table A8: BCS of Thailand with Selected ASEAN Countries (Manufacturing industries)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|-------------|---------|---------|-------------|--------------|---------------|---------|--------------|
| MAN_GVC (-1) | 2.233* * | | | | 3.574** * | | | |
| | (0.037) | | | | (0.002) | | | |
| MAN_FI (-1) | | 0.465 | | | | 2.744** | | |
| | | (0.596) | | | | (0.010) | | |
| MAN_BI (-1) | | | 0.963 | | | | 0.608 | |
| | | | (0.151) | | | | (0.387) | |
| MAN_TI (-1) | | | | 2.081* * | | | | 4.252** * |
| | | | | (0.042) | | | | (0.000) |
| COVID | | | | | -0.816 | -10.639 | 0.495 | -0.771 |
| | | | | | (0.731) | (0.208) | (0.887) | (0.777) |
| MAN_GVC*COVID | | | | | -0.931 | | | |
| | | | | | (0.433) | | | |
| MAN_FI*COVID | | | | | | -2.636 | | |
| | | | | | | (0.160) | | |
| MAN_BI*COVID | | | | | | | -0.035 | |
| | | | | | | | (0.972) | |
| MAN_TI*COVID | | | | | | | | -0.884 |
| | | | | | | | | (0.442) |
| Constant | 4.762* * | 2.505 | 3.955 | 5.150* * | 7.182** * | 12.211** * | 2.586 | 9.827** * |
| | (0.021) | (0.511) | (0.103) | (0.025) | (0.001) | (0.008) | (0.310) | (0.000) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. MAN_GVC= global value chain integration in manufacturing industries; MAN_FI= forward integration in manufacturing industries; MAN_BI= backward integration in manufacturing industries; MAN_TI = two-sided integration in manufacturing industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. *** and ** refer to significance level at 1% and 5% respectively. P-values are provided in parentheses. All the variables are taken in logarithms. Source: Authors.

Table A9: BCS of Viet Nam with Selected ASEAN Countries (Manufacturing industries)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|----------|---------|---------|---------|-----------|
| MAN_GVC (-1) | -1.212 | | | | -1.449 | | | |
| | (0.169) | | | | (0.116) | | | |
| MAN_FI (-1) | | -0.217 | | | | -0.036 | | |
| | | (0.737) | | | | (0.963) | | |
| MAN_BI (-1) | | | 0.659 | | | | 0.739 | |
| | | | (0.198) | | | | (0.231) | |
| MAN_TI (-1) | | | | - | | | | -3.266*** |
| | | | | 3.224*** | | | | |
| | | | | (0.000) | | | | (0.000) |
| COVID | | | | | 0.852 | -1.331 | 1.163 | 0.614 |
| | | | | | (0.606) | (0.847) | (0.630) | (0.758) |
| MAN_GVC*COVID | | | | | 0.354 | | | |
| | | | | | (0.722) | | | |
| MAN_FI*COVID | | | | | | -0.325 | | |
| | | | | | | (0.832) | | |
| MAN_BI*COVID | | | | | | | 0.461 | |
| | | | | | | | (0.602) | |
| MAN_TI*COVID | | | | | | | | 0.187 |
| | | | | | | | | (0.839) |
| Constant | -1.756 | -0.623 | 2.267 | - | -2.200 | 0.136 | 2.518 | -6.777*** |
| | (0.244) | (0.823) | (0.137) | 6.654*** | (0.166) | (0.968) | (0.177) | (0.000) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. MAN_GVC= global value chain integration in manufacturing industries; MAN_FI= forward integration in manufacturing industries; MAN_BI= backward integration in manufacturing industries; MAN_TI = two-sided integration in manufacturing industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. *** refers to significance level at 1%. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table A10: BCS of Brunei with Selected ASEAN Countries (Service industries)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| SER_GVC (-1) | -0.989 | | | | -1.465 | | | |
| | (0.269) | | | | (0.133) | | | |
| SER_FI (-1) | | -0.470 | | | | -0.608 | | |
| | | (0.502) | | | | (0.398) | | |
| SER_BI (-1) | | | -0.544 | | | | -1.134 | |
| | | | (0.394) | | | | (0.144) | |
| SER_TI (-1) | | | | -0.777 | | | | -1.107 |
| | | | | (0.316) | | | | (0.186) |
| COVID | | | | | 1.250 | 1.569 | 3.136 | 1.060 |
| | | | | | (0.284) | (0.438) | (0.181) | (0.370) |
| SER_GVC*COVID | | | | | 0.475 | | | |
| | | | | | (0.226) | | | |
| SER_FI*COVID | | | | | | 0.390 | | |
| | | | | | | (0.391) | | |
| SER_BI*COVID | | | | | | | 0.738 | |
| | | | | | | | (0.165) | |
| SER_TI*COVID | | | | | | | | 0.335 |
| | | | | | | | | (0.303) |
| Constant | -2.297 | -1.482 | -1.819 | -2.195 | -3.658 | -2.061 | -4.397 | -3.349 |
| | (0.376) | (0.628) | (0.517) | (0.426) | (0.195) | (0.511) | (0.197) | (0.260) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. SER_GVC= global value chain integration in service industries; SER_FI= forward integration in service industries; SER_BI= backward integration in service industries; SER_TI = two-sided integration in service industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

**Table A11: BCS of Cambodia with Selected ASEAN Countries
(Service Industries)**

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| SER_GVC (-1) | 1.408 | | | | 0.878 | | | |
| | (0.208) | | | | (0.426) | | | |
| SER_FI (-1) | | 0.674 | | | | 1.026 | | |
| | | (0.456) | | | | (0.222) | | |
| SER_BI (-1) | | | 1.367* | | | | 0.895 | |
| | | | (0.088) | | | | (0.312) | |
| SER_TI (-1) | | | | 0.905 | | | | 0.293 |
| | | | | (0.384) | | | | (0.773) |
| COVID | | | | | 1.844 | 3.957 | 1.750 | 1.917 |
| | | | | | (0.176) | (0.106) | (0.517) | (0.170) |
| SER_GVC*COVID | | | | | 0.210 | | | |
| | | | | | (0.649) | | | |
| SER_FI*COVID | | | | | | 0.606 | | |
| | | | | | | (0.274) | | |
| SER_BI*COVID | | | | | | | 0.122 | |
| | | | | | | | (0.843) | |
| SER_TI*COVID | | | | | | | | 0.189 |
| | | | | | | | | (0.624) |
| Constant | 4.530 | 3.404 | 6.461* | 3.676 | 2.828 | 4.744 | 4.222 | 1.335 |
| | (0.160) | (0.386) | (0.065) | (0.317) | (0.373) | (0.193) | (0.277) | (0.710) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. SER_GVC= global value chain integration in service industries; SER_FI= forward integration in service industries; SER_BI= backward integration in service industries; SER_TI = two-sided integration in service industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. * refers to significance level at 10%. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table A12: BCS of Indonesia with Selected ASEAN Countries (Service Industries)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|----------|---------|
| SER_GVC (-1) | -0.419 | | | | -0.460 | | | |
| | (0.715) | | | | (0.718) | | | |
| SER_FI (-1) | | 0.658 | | | | 0.839 | | |
| | | (0.542) | | | | (0.434) | | |
| SER_BI (-1) | | | -1.027 | | | | -1.922* | |
| | | | (0.200) | | | | (0.081) | |
| SER_TI (-1) | | | | -0.260 | | | | -0.496 |
| | | | | (0.814) | | | | (0.674) |
| COVID | | | | | 3.095 | 5.127 | 12.345** | 2.751 |
| | | | | | (0.174) | (0.239) | (0.013) | (0.207) |
| SER_GVC*COVID | | | | | 0.736 | | | |
| | | | | | (0.252) | | | |
| SER_FI*COVID | | | | | | 0.936 | | |
| | | | | | | (0.290) | | |
| SER_BI*COVID | | | | | | | 2.421** | |
| | | | | | | | (0.016) | |
| SER_TI*COVID | | | | | | | | 0.532 |
| | | | | | | | | (0.299) |
| Constant | -0.923 | 3.757 | -4.467 | -0.552 | -1.134 | 4.569 | -8.845* | -1.620 |
| | (0.818) | (0.476) | (0.253) | (0.905) | (0.798) | (0.383) | (0.097) | (0.744) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. SER_GVC= global value chain integration in service industries; SER_FI= forward integration in service industries; SER_BI= backward integration in service industries; SER_TI = two-sided integration in service industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ** and * refer to significance level at 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table A13: BCS of Lao PDR with Selected ASEAN Countries (Service industries)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| SER_GVC (-1) | 0.248 | | | | 0.310 | | | |
| | (0.800) | | | | (0.767) | | | |
| SER_FI (-1) | | 1.101 | | | | 1.340* | | |
| | | (0.152) | | | | (0.084) | | |
| SER_BI (-1) | | | -0.002 | | | | -0.314 | |
| | | | (0.997) | | | | (0.704) | |
| SER_TI (-1) | | | | -0.244 | | | | -0.284 |
| | | | | (0.767) | | | | (0.743) |
| COVID | | | | | 0.649 | 0.770 | 2.551 | 0.852 |
| | | | | | (0.609) | (0.723) | (0.311) | (0.507) |
| SER_GVC*COVID | | | | | 0.058 | | | |
| | | | | | (0.892) | | | |
| SER_FI*COVID | | | | | | 0.049 | | |
| | | | | | | (0.920) | | |
| SER_BI*COVID | | | | | | | 0.473 | |
| | | | | | | | (0.406) | |
| SER_TI*COVID | | | | | | | | 0.106 |
| | | | | | | | | (0.761) |
| Constant | 1.056 | 5.140 | 0.322 | -0.544 | 1.166 | 6.105* | -1.111 | -0.754 |
| | (0.711) | (0.126) | (0.918) | (0.854) | (0.702) | (0.071) | (0.759) | (0.809) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. SER_GVC= global value chain integration in service industries; SER_FI= forward integration in service industries; SER_BI= backward integration in service industries; SER_TI = two-sided integration in service industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. * refers to significance level at 10%. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table A14: BCS of Malaysia with Selected ASEAN Countries (Service industries)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|----------|---------|---------|---------|----------|
| SER_GVC (-1) | 1.534 | | | | 1.939 | | | |
| | (0.151) | | | | (0.139) | | | |
| SER_FI (-1) | | -1.013 | | | | -1.233 | | |
| | | (0.336) | | | | (0.301) | | |
| SER_BI (-1) | | | -0.437 | | | | -1.879 | |
| | | | (0.701) | | | | (0.184) | |
| SER_TI (-1) | | | | 2.008** | | | | 2.685*** |
| | | | | (0.013) | | | | (0.005) |
| COVID | | | | | 0.298 | 2.823 | 7.668* | -0.552 |
| | | | | | (0.872) | (0.447) | (0.083) | (0.759) |
| SER_GVC*COVID | | | | | 0.011 | | | |
| | | | | | (0.987) | | | |
| SER_FI*COVID | | | | | | 0.702 | | |
| | | | | | | (0.437) | | |
| SER_BI*COVID | | | | | | | 1.754* | |
| | | | | | | | (0.085) | |
| SER_TI*COVID | | | | | | | | -0.290 |
| | | | | | | | | (0.593) |
| Constant | 4.666 | -3.482 | -1.301 | 7.126*** | 5.705* | -4.357 | -7.559 | 9.269*** |
| | (0.101) | (0.411) | (0.792) | (0.007) | (0.100) | (0.361) | (0.217) | (0.003) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. SER_GVC= global value chain integration in service industries; SER_FI= forward integration in service industries; SER_BI= backward integration in service industries; SER_TI = two-sided integration in service industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ***, ** and * refer to significance level at 1%, 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms. Source: Authors.

Table A15: BCS of Philippines with Selected ASEAN Countries (Service Industries)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|----------|---------|
| SER_GVC (-1) | 0.411 | | | | 0.129 | | | |
| | (0.727) | | | | (0.914) | | | |
| SER_FI (-1) | | -0.053 | | | | 0.227 | | |
| | | (0.958) | | | | (0.814) | | |
| SER_BI (-1) | | | 0.005 | | | | -1.057 | |
| | | | (0.996) | | | | (0.366) | |
| SER_TI (-1) | | | | 0.620 | | | | 0.255 |
| | | | | (0.549) | | | | (0.805) |
| COVID | | | | | 3.275* | 6.207* | 10.002** | 2.872* |
| | | | | | (0.067) | (0.093) | (0.010) | (0.099) |
| SER_GVC*COVID | | | | | 0.776 | | | |
| | | | | | (0.174) | | | |
| SER_FI*COVID | | | | | | 1.242 | | |
| | | | | | | (0.148) | | |
| SER_BI*COVID | | | | | | | 1.940** | |
| | | | | | | | (0.019) | |
| SER_TI*COVID | | | | | | | | 0.524 |
| | | | | | | | | (0.243) |
| Constant | 1.862 | 0.378 | 0.625 | 2.960 | 0.872 | 1.441 | -4.466 | 1.448 |
| | (0.606) | (0.929) | (0.896) | (0.452) | (0.811) | (0.725) | (0.414) | (0.714) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. SER_GVC= global value chain integration in service industries; SER_FI= forward integration in service industries; SER_BI= backward integration in service industries; SER_TI = two-sided integration in service industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ** and * refer to significance level at 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table A16: BCS of Singapore with Selected ASEAN Countries (Service industries)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|----------|---------|---------|----------|
| SER_GVC (-1) | 0.155 | | | | -2.692** | | | |
| | (0.876) | | | | (0.031) | | | |
| SER_FI (-1) | | -1.326 | | | | -0.842 | | |
| | | (0.253) | | | | (0.463) | | |
| SER_BI (-1) | | | 0.591 | | | | -0.917 | |
| | | | (0.354) | | | | (0.239) | |
| SER_TI (-1) | | | | 0.156 | | | | -2.825** |
| | | | | (0.858) | | | | (0.015) |
| COVID | | | | | 1.606 | 3.471 | 6.363* | 1.156 |
| | | | | | (0.290) | (0.338) | (0.083) | (0.493) |
| SER_GVC*COVID | | | | | 0.175 | | | |
| | | | | | (0.838) | | | |
| SER_FI*COVID | | | | | | 0.755 | | |
| | | | | | | (0.454) | | |
| SER_BI*COVID | | | | | | | 1.445 | |
| | | | | | | | (0.139) | |
| SER_TI*COVID | | | | | | | | -0.150 |
| | | | | | | | | (0.852) |
| Constant | 0.804 | -4.185 | 2.828 | 0.864 | -4.628** | -2.576 | -3.214 | -5.948** |
| | (0.661) | (0.309) | (0.257) | (0.656) | (0.047) | (0.526) | (0.296) | (0.023) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. SER_GVC= global value chain integration in service industries; SER_FI= forward integration in service industries; SER_BI= backward integration in service industries; SER_TI = two-sided integration in service industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ** and * refer to significance level at 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

**Table A17: BCS of Thailand with Selected ASEAN Countries
(Service Industries)**

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|-------------------|---------------------|-------------------|-------------------|--------------------|---------------------|----------------------|-------------------|
| SER_GVC (-1) | -1.063 (0.285) | | | | -1.862* (0.070) | | | |
| SER_FI (-1) | | -1.258** (0.046) | | | | -1.370** (0.026) | | |
| SER_BI (-1) | | | -0.394 (0.627) | | | | -1.688* (0.053) | |
| SER_TI (-1) | | | | -0.264 (0.820) | | | | -1.198 (0.335) |
| COVID | | | | | 4.582** (0.038) | 7.857* (0.077) | 13.165*** (0.004) | 3.751 (0.105) |
| SER_GVC*COVID | | | | | 1.346* (0.077) | | | |
| SER_FI*COVID | | | | | | 1.680 (0.106) | | |
| SER_BI*COVID | | | | | | | 2.803*** (0.007) | |
| SER_TI*COVID | | | | | | | | 0.872 (0.184) |
| Constant | -2.569 (0.368) | -4.877* (0.069) | -1.274 (0.725) | -0.435 (0.914) | -4.970* (0.092) | -5.459** (0.037) | -7.156* (0.067) | -3.800 (0.382) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. SER_GVC= global value chain integration in service industries; SER_FI= forward integration in service industries; SER_BI= backward integration in service industries; SER_TI = two-sided integration in service industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ***, ** and * refer to significance level at 1%, 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

**Table A18: BCS of Viet Nam with Selected ASEAN Countries
(Service Industries)**

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|-----------|---------|---------|---------|------------|
| SER_GVC (-1) | -1.893 | | | | -1.899 | | | |
| | (0.109) | | | | (0.118) | | | |
| SER_FI (-1) | | 0.982 | | | | 1.401* | | |
| | | (0.194) | | | | (0.096) | | |
| SER_BI (-1) | | | 0.175 | | | | 0.432 | |
| | | | (0.853) | | | | (0.723) | |
| SER_TI (-1) | | | | -2.827*** | | | | -3.085*** |
| | | | | (0.001) | | | | (0.000) |
| COVID | | | | | 0.573 | -0.018 | 0.748 | 0.661 |
| | | | | | (0.743) | (0.996) | (0.854) | (0.693) |
| SER_GVC*COVID | | | | | 0.159 | | | |
| | | | | | (0.781) | | | |
| SER_FI*COVID | | | | | | -0.085 | | |
| | | | | | | (0.900) | | |
| SER_BI*COVID | | | | | | | 0.118 | |
| | | | | | | | (0.897) | |
| SER_TI*COVID | | | | | | | | 0.077 |
| | | | | | | | | (0.869) |
| Constant | -5.366 | 4.751 | 1.093 | -9.949*** | -5.398 | 6.590* | 2.207 | -10.939*** |
| | (0.129) | (0.165) | (0.795) | (0.001) | (0.137) | (0.082) | (0.683) | (0.000) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. SER_GVC= global value chain integration in service industries; SER_FI= forward integration in service industries; SER_BI= backward integration in service industries; SER_TI = two-sided integration in service industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. *** and * refer to significance level at 1% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms. Source: Authors.

**Table A19: BCS of Brunei with Selected ASEAN Countries
(High-technology Intensive Industries)**

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| HT_GVC (-1) | 0.628* | | | | 0.736* | | | |
| | (0.065) | | | | (0.054) | | | |
| HT_FI (-1) | | 0.496* | | | | 0.606* | | |
| | | (0.076) | | | | (0.063) | | |
| HT_BI (-1) | | | 0.433 | | | | 0.513* | |
| | | | (0.123) | | | | (0.081) | |
| HT_TI (-1) | | | | 0.519 | | | | 0.625* |
| | | | | (0.116) | | | | (0.096) |
| COVID | | | | | -0.657 | -2.030 | 0.595 | -0.758 |
| | | | | | (0.503) | (0.483) | (0.649) | (0.470) |
| HT_GVC*COVID | | | | | -0.264 | | | |
| | | | | | (0.443) | | | |
| HT_FI*COVID | | | | | | -0.447 | | |
| | | | | | | (0.452) | | |
| HT_BI*COVID | | | | | | | 0.177 | |
| | | | | | | | (0.531) | |
| HT_TI*COVID | | | | | | | | -0.288 |
| | | | | | | | | (0.430) |
| Constant | 2.193** | 2.803** | 2.616* | 2.117** | 2.459** | 3.277** | 3.024** | 2.422** |
| | (0.014) | (0.027) | (0.050) | (0.033) | (0.012) | (0.024) | (0.031) | (0.030) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. HT_GVC= global value chain integration in high-technology intensive industries; HT_FI= forward integration in high-technology intensive industries; HT_BI= backward integration in high-technology intensive industries; HT_TI= two-sided integration in high-technology intensive industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ** and * refer to significance level at 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms. Source: Authors.

**Table A20: BCS of Cambodia with Selected ASEAN Countries
(High-technology Intensive Industries)**

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| HT_GVC (-1) | 0.063 | | | | 0.676 | | | |
| | (0.899) | | | | (0.161) | | | |
| HT_FI (-1) | | -0.144 | | | | 0.300 | | |
| | | (0.709) | | | | (0.437) | | |
| HT_BI (-1) | | | 0.574 | | | | 0.399 | |
| | | | (0.151) | | | | (0.294) | |
| HT_TI (-1) | | | | -0.194 | | | | 0.510 |
| | | | | (0.686) | | | | (0.288) |
| COVID | | | | | 1.272 | 0.516 | 1.790 | 0.832 |
| | | | | | (0.156) | (0.775) | (0.209) | (0.501) |
| HT_GVC*COVID | | | | | -0.040 | | | |
| | | | | | (0.884) | | | |
| HT_FI*COVID | | | | | | -0.157 | | |
| | | | | | | (0.637) | | |
| HT_BI*COVID | | | | | | | 0.121 | |
| | | | | | | | (0.686) | |
| HT_TI*COVID | | | | | | | | -0.191 |
| | | | | | | | | (0.651) |
| Constant | 0.666 | -0.247 | 3.210* | -0.162 | 2.255 | 1.808 | 2.205 | 1.975 |
| | (0.648) | (0.900) | (0.092) | (0.919) | (0.108) | (0.352) | (0.226) | (0.212) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. HT_GVC= global value chain integration in high-technology intensive industries; HT_FI= forward integration in high-technology intensive industries; HT_BI= backward integration in high-technology intensive industries; HT_TI = two-sided integration in high-technology intensive industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. * refers to significance level at 10%. P-values are provided in parentheses. All the variables are taken in logarithms. Source: Authors.

**Table A21: BCS of Indonesia with Selected ASEAN Countries
(High-technology Intensive Industries)**

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|----------|----------|---------|----------|
| HT_GVC (-1) | 0.593 | | | | 1.752** | | | |
| | (0.292) | | | | (0.012) | | | |
| HT_FI (-1) | | 0.454 | | | | 1.905*** | | |
| | | (0.383) | | | | (0.006) | | |
| HT_BI (-1) | | | 0.349 | | | | 1.020* | |
| | | | (0.419) | | | | (0.055) | |
| HT_TI (-1) | | | | 0.654 | | | | 1.763** |
| | | | | (0.262) | | | | (0.012) |
| COVID | | | | | -0.134 | 0.124 | 0.666 | -1.071 |
| | | | | | (0.951) | (0.985) | (0.807) | (0.657) |
| HT_GVC*COVID | | | | | -0.350 | | | |
| | | | | | (0.590) | | | |
| HT_FI*COVID | | | | | | -0.214 | | |
| | | | | | | (0.864) | | |
| HT_BI*COVID | | | | | | | -0.044 | |
| | | | | | | | (0.934) | |
| HT_TI*COVID | | | | | | | | -0.610 |
| | | | | | | | | (0.397) |
| Constant | 2.402 | 2.815 | 2.248 | 2.864 | 5.887*** | 9.911*** | 5.396** | 6.652*** |
| | (0.175) | (0.280) | (0.288) | (0.168) | (0.006) | (0.004) | (0.036) | (0.007) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. HT_GVC= global value chain integration in high-technology intensive industries; HT_FI= forward integration in high-technology intensive industries; HT_BI= backward integration in high-technology intensive industries; HT_TI = two-sided integration in high-technology intensive industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ***, ** and * refer to significance level at 1%, 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

**Table A22: BCS of Lao PDR with Selected ASEAN Countries
(High-technology Intensive Industries)**

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| HT_GVC (-1) | 0.315 | | | | 0.560 | | | |
| | (0.475) | | | | (0.219) | | | |
| HT_FI (-1) | | 0.104 | | | | 0.167 | | |
| | | (0.762) | | | | (0.645) | | |
| HT_BI (-1) | | | 0.556 | | | | 0.505 | |
| | | | (0.125) | | | | (0.166) | |
| HT_TI (-1) | | | | 0.094 | | | | 0.368 |
| | | | | (0.828) | | | | (0.427) |
| COVID | | | | | -0.041 | -1.876 | 0.402 | 0.507 |
| | | | | | (0.961) | (0.252) | (0.754) | (0.647) |
| HT_GVC*COVID | | | | | -0.204 | | | |
| | | | | | (0.424) | | | |
| HT_FI*COVID | | | | | | -0.457 | | |
| | | | | | | (0.134) | | |
| HT_BI*COVID | | | | | | | -0.008 | |
| | | | | | | | (0.977) | |
| HT_TI*COVID | | | | | | | | -0.015 |
| | | | | | | | | (0.968) |
| Constant | 1.238 | 0.853 | 2.964* | 0.640 | 1.861 | 1.098 | 2.661 | 1.459 |
| | (0.331) | (0.621) | (0.085) | (0.652) | (0.154) | (0.545) | (0.125) | (0.333) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. HT_GVC= global value chain integration in high-technology intensive industries; HT_FI= forward integration in high-technology intensive industries; HT_BI= backward integration in high-technology intensive industries; HT_TI = two-sided integration in high-technology intensive industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. * refers to significance level at 10%. P-values are provided in parentheses. All the variables are taken in logarithms. Source: Authors.

**Table A23: BCS of Malaysia with Selected ASEAN Countries
(High-technology Intensive Industries)**

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|----------|----------|----------|----------|----------|-----------|----------|----------|
| HT_GVC (-1) | 2.412*** | | | | 3.492*** | | | |
| | (0.001) | | | | (0.000) | | | |
| HT_FI (-1) | | 1.814*** | | | | 3.499*** | | |
| | | (0.005) | | | | (0.000) | | |
| HT_BI (-1) | | | 1.480** | | | | 1.983*** | |
| | | | (0.014) | | | | (0.004) | |
| HT_TI (-1) | | | | 2.420*** | | | | 3.323*** |
| | | | | (0.000) | | | | (0.000) |
| COVID | | | | | -0.765 | -2.324 | -0.334 | -1.633 |
| | | | | | (0.683) | (0.639) | (0.910) | (0.398) |
| HT_GVC*COVID | | | | | -0.672 | | | |
| | | | | | (0.419) | | | |
| HT_FI*COVID | | | | | | -0.731 | | |
| | | | | | | (0.500) | | |
| HT_BI*COVID | | | | | | | -0.200 | |
| | | | | | | | (0.786) | |
| HT_TI*COVID | | | | | | | | -1.021 |
| | | | | | | | | (0.233) |
| Constant | 5.632*** | 8.502*** | 6.327*** | 6.422*** | 7.780*** | 15.707*** | 8.209*** | 8.500*** |
| | (0.000) | (0.002) | (0.007) | (0.000) | (0.000) | (0.000) | (0.002) | (0.000) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. HT_GVC= global value chain integration in high-technology intensive industries; HT_FI= forward integration in high-technology intensive industries; HT_BI= backward integration in high-technology intensive industries; HT_TI = two-sided integration in high-technology intensive industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. *** and ** refer to significance level at 1% and 5% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

**Table A24: BCS of Philippines with Selected ASEAN Countries
(High-technology Intensive Industries)**

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|--------------------|-------------------|-------------------|--------------------|---------------------|---------------------|--------------------|---------------------|
| HT_GVC (-1) | 0.966** (0.050) | | | | 1.889*** (0.000) | | | |
| HT_FI (-1) | | 0.592 (0.126) | | | | 1.616*** (0.000) | | |
| HT_BI (-1) | | | 0.884* (0.090) | | | | 0.911* (0.073) | |
| HT_TI (-1) | | | | 0.842* (0.063) | | | | 1.815*** (0.000) |
| COVID | | | | | 0.913 (0.596) | 0.842 (0.833) | 2.437 (0.365) | 0.046 (0.979) |
| HT_GVC*COVID | | | | | -0.166 (0.784) | | | |
| HT_FI*COVID | | | | | | -0.140 (0.856) | | |
| HT_BI*COVID | | | | | | | 0.350 (0.565) | |
| HT_TI*COVID | | | | | | | | -0.468 (0.424) |
| Constant | 3.126** (0.016) | 3.479* (0.065) | 4.472* (0.051) | 3.087** (0.022) | 5.342*** (0.000) | 8.229*** (0.000) | 4.459** (0.045) | 5.754*** (0.000) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. HT_GVC= global value chain integration in high-technology intensive industries; HT_FI= forward integration in high-technology intensive industries; HT_BI= backward integration in high-technology intensive industries; HT_TI = two-sided integration in high-technology intensive industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ***, ** and * refer to significance level at 1%, 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

**Table A25: BCS of Singapore with Selected ASEAN Countries
(High-technology Intensive Industries)**

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| HT_GVC (-1) | -0.324 | | | | 1.174 | | | |
| | (0.601) | | | | (0.121) | | | |
| HT_FI (-1) | | -0.349 | | | | 1.707 | | |
| | | (0.681) | | | | (0.106) | | |
| HT_BI (-1) | | | -0.733 | | | | -0.079 | |
| | | | (0.139) | | | | (0.882) | |
| HT_TI (-1) | | | | -0.041 | | | | 1.626** |
| | | | | (0.945) | | | | (0.026) |
| COVID | | | | | -0.386 | 2.758 | -5.452* | -0.275 |
| | | | | | (0.857) | (0.604) | (0.092) | (0.904) |
| HT_GVC*COVID | | | | | -0.718 | | | |
| | | | | | (0.471) | | | |
| HT_FI*COVID | | | | | | 0.360 | | |
| | | | | | | (0.766) | | |
| HT_BI*COVID | | | | | | | -1.742* | |
| | | | | | | | (0.055) | |
| HT_TI*COVID | | | | | | | | -0.657 |
| | | | | | | | | (0.489) |
| Constant | -0.091 | -0.959 | -1.939 | 0.426 | 2.564* | 7.584* | 0.140 | 4.036** |
| | (0.938) | (0.790) | (0.243) | (0.752) | (0.067) | (0.088) | (0.937) | (0.014) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. HT_GVC= global value chain integration in high-technology intensive industries; HT_FI= forward integration in high-technology intensive industries; HT_BI= backward integration in high-technology intensive industries; HT_TI= two-sided integration in high-technology intensive industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ** and * refer to significance level at 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms. Source: Authors.

**Table A26: BCS of Thailand with Selected ASEAN Countries
(High-technology Intensive Industries)**

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|----------|---------|---------|----------|----------|-----------|---------|-----------|
| HT_GVC (-1) | 2.378** | | | | 3.585*** | | | |
| | (0.014) | | | | (0.000) | | | |
| HT_FI (-1) | | 0.655 | | | | 2.065*** | | |
| | | (0.353) | | | | (0.010) | | |
| HT_BI (-1) | | | 0.924 | | | | 0.819 | |
| | | | (0.140) | | | | (0.186) | |
| HT_TI (-1) | | | | 2.486*** | | | | 4.051*** |
| | | | | (0.010) | | | | (0.000) |
| COVID | | | | | -0.029 | -7.828 | 2.017 | -0.537 |
| | | | | | (0.991) | (0.244) | (0.625) | (0.841) |
| HT_GVC*COVID | | | | | -0.493 | | | |
| | | | | | (0.664) | | | |
| HT_FI*COVID | | | | | | -1.833 | | |
| | | | | | | (0.182) | | |
| HT_BI*COVID | | | | | | | 0.339 | |
| | | | | | | | (0.743) | |
| HT_TI*COVID | | | | | | | | -0.742 |
| | | | | | | | | (0.512) |
| Constant | 5.679*** | 3.568 | 4.191* | 6.610*** | 8.157*** | 10.046*** | 3.677 | 10.292*** |
| | (0.008) | (0.283) | (0.096) | (0.005) | (0.000) | (0.007) | (0.141) | (0.000) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. HT_GVC= global value chain integration in high-technology intensive industries; HT_FI= forward integration in high-technology intensive industries; HT_BI= backward integration in high-technology intensive industries; HT_TI = two-sided integration in high-technology intensive industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ***, ** and * refer to significance level at 1%, 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

**Table A27: BCS of Viet Nam with Selected ASEAN Countries
(High-technology Intensive Industries)**

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|-------------------|-------------------|---------------------|---------------------|-------------------|-------------------|---------------------|---------------------|
| HT_GVC (-1) | -0.390 (0.648) | | | | -0.479 (0.584) | | | |
| HT_FI (-1) | | -0.681 (0.258) | | | | -0.645 (0.317) | | |
| HT_BI (-1) | | | 1.267*** (0.004) | | | | 1.282*** (0.004) | |
| HT_TI (-1) | | | | -1.848** (0.033) | | | | -2.033** (0.022) |
| COVID | | | | | 0.237 (0.912) | -1.897 (0.735) | 1.200 (0.705) | 0.724 (0.729) |
| HT_GVC*COVID | | | | | 0.027 (0.977) | | | |
| HT_FI*COVID | | | | | | -0.398 (0.729) | | |
| HT_BI*COVID | | | | | | | 0.318 (0.696) | |
| HT_TI*COVID | | | | | | | | 0.203 (0.833) |
| Constant | -0.585 (0.766) | -2.916 (0.307) | 5.389*** (0.002) | -4.539** (0.045) | -0.815 (0.687) | -2.751 (0.366) | 5.454*** (0.003) | -5.066** (0.031) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: Quasi correlation of output is the dependent variable. HT_GVC= global value chain integration in high-technology intensive industries; HT_FI= forward integration in high-technology intensive industries; HT_BI= backward integration in high-technology intensive industries; HT_TI = two-sided integration in high-technology intensive industries; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. *** and ** refer to significance level at 1% and 5% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

**Table A28: BCS of Brunei with Selected ASEAN Countries
(Robustness)**

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|--------|---------|--------|--------|--------|--------|
| GVC (-1) | 0.12* | | | | 0.08 | | | |
| | (0.06) | | | | (0.27) | | | |
| FI (-1) | | 0.10** | | | | 0.06 | | |
| | | (0.02) | | | | (0.24) | | |
| BI (-1) | | | -0.02 | | | | -0.00 | |
| | | | (0.66) | | | | (0.97) | |
| TI (-1) | | | | 0.11* | | | | 0.07 |
| | | | | (0.06) | | | | (0.29) |
| COVID | | | | | -0.06 | -0.03 | -0.03 | -0.06 |
| | | | | | (0.41) | (0.89) | (0.84) | (0.47) |
| GVC*COVID | | | | | -0.01 | | | |
| | | | | | (0.91) | | | |
| FI*COVID | | | | | | 0.01 | | |
| | | | | | | (0.91) | | |
| BI*COVID | | | | | | | 0.01 | |
| | | | | | | | (0.80) | |
| TI*COVID | | | | | | | | -0.00 |
| | | | | | | | | (0.92) |
| Constant | 0.29*** | 0.41*** | 0.04 | 0.34*** | 0.23** | 0.29* | 0.11 | 0.26* |
| | (0.00) | (0.00) | (0.79) | (0.01) | (0.03) | (0.05) | (0.51) | (0.05) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: OCORR2 is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ***, ** and * refer to the significance level at 1%, 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table A29: BCS of Cambodia with Selected ASEAN Countries (Robustness)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| GVC (-1) | 0.01 | | | | -0.02 | | | |
| | (0.95) | | | | (0.74) | | | |
| FI (-1) | | 0.02 | | | | 0.01 | | |
| | | (0.45) | | | | (0.67) | | |
| BI (-1) | | | -0.04 | | | | -0.04 | |
| | | | (0.29) | | | | (0.33) | |
| TI (-1) | | | | 0.01 | | | | -0.02 |
| | | | | (0.92) | | | | (0.61) |
| COVID | | | | | 0.01 | -0.10 | 0.07 | 0.01 |
| | | | | | (0.93) | (0.49) | (0.46) | (0.88) |
| GVC*COVID | | | | | 0.02 | | | |
| | | | | | (0.51) | | | |
| FI*COVID | | | | | | -0.02 | | |
| | | | | | | (0.61) | | |
| BI*COVID | | | | | | | 0.03 | |
| | | | | | | | (0.31) | |
| TI*COVID | | | | | | | | 0.02 |
| | | | | | | | | (0.50) |
| Constant | 0.07 | 0.15 | -0.04 | 0.08 | 0.05 | 0.12 | -0.04 | 0.02 |
| | (0.29) | (0.15) | (0.71) | (0.39) | (0.49) | (0.26) | (0.73) | (0.81) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: OCORR2 is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table A30: BCS of Indonesia with Selected ASEAN Countries (Robustness)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|--------|---------|--------|---------|--------|--------|
| GVC (-1) | 0.10** | | | | 0.09* | | | |
| | (0.01) | | | | (0.10) | | | |
| FI (-1) | | 0.08*** | | | | 0.09** | | |
| | | (0.00) | | | | (0.03) | | |
| BI (-1) | | | 0.08* | | | | 0.05 | |
| | | | (0.05) | | | | (0.41) | |
| TI (-1) | | | | 0.09** | | | | 0.07 |
| | | | | (0.02) | | | | (0.16) |
| COVID | | | | | 0.00 | -0.19 | 0.07 | 0.00 |
| | | | | | (0.99) | (0.61) | (0.73) | (0.98) |
| GVC*COVID | | | | | 0.00 | | | |
| | | | | | (0.95) | | | |
| FI*COVID | | | | | | -0.05 | | |
| | | | | | | (0.60) | | |
| BI*COVID | | | | | | | 0.02 | |
| | | | | | | | (0.67) | |
| TI*COVID | | | | | | | | 0.00 |
| | | | | | | | | (0.90) |
| Constant | 0.26*** | 0.36*** | 0.35** | 0.30*** | 0.25** | 0.40*** | 0.23 | 0.26** |
| | (0.00) | (0.00) | (0.02) | (0.00) | (0.02) | (0.01) | (0.23) | (0.05) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: OCORR2 is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ***, ** and * refer to the significance level at 1%, 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table A31: BCS of Lao PDR with Selected ASEAN Countries (Robustness)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|--------|--------|---------|---------|--------|--------|---------|
| GVC (-1) | 0.12** | | | | 0.14*** | | | |
| | (0.01) | | | | (0.01) | | | |
| FI (-1) | | 0.06* | | | | 0.06* | | |
| | | (0.08) | | | | (0.09) | | |
| BI (-1) | | | 0.01 | | | | 0.02 | |
| | | | (0.84) | | | | (0.70) | |
| TI (-1) | | | | 0.13*** | | | | 0.15*** |
| | | | | (0.01) | | | | (0.00) |
| COVID | | | | | -0.05 | -0.00 | -0.05 | -0.05 |
| | | | | | (0.36) | (0.97) | (0.64) | (0.46) |
| GVC*COVID | | | | | -0.04 | | | |
| | | | | | (0.31) | | | |
| FI*COVID | | | | | | -0.00 | | |
| | | | | | | (0.97) | | |
| BI*COVID | | | | | | | -0.01 | |
| | | | | | | | (0.69) | |
| TI*COVID | | | | | | | | -0.03 |
| | | | | | | | | (0.35) |
| Constant | 0.28*** | 0.29** | 0.12 | 0.36*** | 0.30*** | 0.29** | 0.14 | 0.40*** |
| | (0.00) | (0.01) | (0.37) | (0.00) | (0.00) | (0.02) | (0.31) | (0.00) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: OCORR2 is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ***, ** and * refer to the significance level at 1%, 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table A32: BCS of Malaysia with Selected ASEAN Countries (Robustness)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|--------|---------|---------|--------|--------|---------|
| GVC (-1) | 0.11** | | | | 0.08 | | | |
| | (0.01) | | | | (0.10) | | | |
| FI (-1) | | 0.11** | | | | 0.09 | | |
| | | (0.01) | | | | (0.13) | | |
| BI (-1) | | | 0.11* | | | | 0.07 | |
| | | | (0.08) | | | | (0.33) | |
| TI (-1) | | | | 0.09** | | | | 0.07 |
| | | | | (0.01) | | | | (0.11) |
| COVID | | | | | 0.03 | 0.03 | 0.03 | 0.04 |
| | | | | | (0.72) | (0.91) | (0.88) | (0.64) |
| GVC*COVID | | | | | 0.03 | | | |
| | | | | | (0.59) | | | |
| FI*COVID | | | | | | 0.01 | | |
| | | | | | | (0.89) | | |
| BI*COVID | | | | | | | 0.02 | |
| | | | | | | | (0.76) | |
| TI*COVID | | | | | | | | 0.03 |
| | | | | | | | | (0.51) |
| Constant | 0.21*** | 0.39*** | 0.41** | 0.22*** | 0.18*** | 0.35* | 0.29 | 0.19*** |
| | (0.00) | (0.00) | (0.03) | (0.00) | (0.01) | (0.05) | (0.19) | (0.01) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: OCORR2 is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ***, ** and * refer to the significance level at 1%, 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table A33: BCS of Philippines with Selected ASEAN Countries (Robustness)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|---------|--------|---------|---------|---------|--------|--------|
| GVC (-1) | 0.08** | | | | 0.06 | | | |
| | (0.02) | | | | (0.10) | | | |
| FI (-1) | | 0.09*** | | | | 0.09** | | |
| | | (0.00) | | | | (0.02) | | |
| BI (-1) | | | 0.03 | | | | 0.01 | |
| | | | (0.49) | | | | (0.83) | |
| TI (-1) | | | | 0.07** | | | | 0.05* |
| | | | | (0.02) | | | | (0.10) |
| COVID | | | | | 0.04 | -0.00 | 0.15 | 0.04 |
| | | | | | (0.48) | (0.99) | (0.21) | (0.49) |
| GVC*COVID | | | | | 0.03 | | | |
| | | | | | (0.37) | | | |
| FI*COVID | | | | | | -0.00 | | |
| | | | | | | (0.99) | | |
| BI*COVID | | | | | | | 0.05 | |
| | | | | | | | (0.15) | |
| TI*COVID | | | | | | | | 0.02 |
| | | | | | | | | (0.40) |
| Constant | 0.20*** | 0.36*** | 0.15 | 0.21*** | 0.17*** | 0.36*** | 0.09 | 0.18** |
| | (0.00) | (0.00) | (0.24) | (0.00) | (0.01) | (0.00) | (0.48) | (0.01) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: OCORR2 is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ***, ** and * refer to the significance level at 1%, 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table A34: BCS of Singapore with Selected ASEAN Countries (Robustness)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|---------|--------|---------|---------|---------|--------|--------|---------|
| GVC (-1) | 0.18** | | | | 0.21** | | | |
| | (0.03) | | | | (0.02) | | | |
| FI (-1) | | -0.02 | | | | -0.02 | | |
| | | (0.74) | | | | (0.79) | | |
| BI (-1) | | | 0.10** | | | | 0.10** | |
| | | | (0.03) | | | | (0.04) | |
| TI (-1) | | | | 0.23** | | | | 0.25** |
| | | | | (0.02) | | | | (0.01) |
| COVID | | | | | -0.01 | -0.15 | 0.05 | -0.01 |
| | | | | | (0.90) | (0.55) | (0.76) | (0.85) |
| GVC*COVID | | | | | -0.02 | | | |
| | | | | | (0.74) | | | |
| FI*COVID | | | | | | -0.05 | | |
| | | | | | | (0.56) | | |
| BI*COVID | | | | | | | 0.02 | |
| | | | | | | | (0.78) | |
| TI*COVID | | | | | | | | -0.02 |
| | | | | | | | | (0.74) |
| Constant | 0.25*** | 0.01 | 0.34*** | 0.38*** | 0.28*** | 0.01 | 0.34** | 0.42*** |
| | (0.00) | (0.95) | (0.01) | (0.00) | (0.00) | (0.95) | (0.01) | (0.00) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: OCORR2 is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. *** and ** refer to the significance level at 1% and 5% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table A35: BCS of Thailand with Selected ASEAN Countries (Robustness)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|--------|----------|--------|--------|--------|----------|--------|--------|
| GVC (-1) | -0.07 | | | | -0.10 | | | |
| | (0.38) | | | | (0.25) | | | |
| FI (-1) | | -0.19*** | | | | -0.24*** | | |
| | | (0.00) | | | | (0.00) | | |
| BI (-1) | | | -0.06 | | | | -0.05 | |
| | | | (0.28) | | | | (0.38) | |
| TI (-1) | | | | 0.01 | | | | -0.01 |
| | | | | (0.86) | | | | (0.89) |
| COVID | | | | | 0.00 | 0.21 | -0.01 | -0.02 |
| | | | | | (0.99) | (0.56) | (0.95) | (0.85) |
| GVC*COVID | | | | | 0.02 | | | |
| | | | | | (0.84) | | | |
| FI*COVID | | | | | | 0.07 | | |
| | | | | | | (0.48) | | |
| BI*COVID | | | | | | | -0.00 | |
| | | | | | | | (0.99) | |
| TI*COVID | | | | | | | | -0.00 |
| | | | | | | | | (0.95) |
| Constant | -0.03 | -0.56*** | -0.10 | 0.10 | -0.07 | -0.74*** | -0.07 | 0.05 |
| | (0.79) | (0.00) | (0.54) | (0.51) | (0.58) | (0.00) | (0.67) | (0.76) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: OCORR2 is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. *** refers to the significance level at 1%. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table A36: BCS of Viet Nam with Selected ASEAN Countries (Robustness)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---------------------|--------|--------|--------|---------|--------|--------|--------|---------|
| GVC (-1) | -0.13 | | | | -0.13 | | | |
| | (0.15) | | | | (0.16) | | | |
| FI (-1) | | 0.03 | | | | 0.05 | | |
| | | (0.57) | | | | (0.51) | | |
| BI (-1) | | | -0.03 | | | | -0.04 | |
| | | | (0.54) | | | | (0.52) | |
| TI (-1) | | | | -0.21** | | | | -0.22** |
| | | | | (0.02) | | | | (0.02) |
| COVID | | | | | -0.01 | 0.12 | -0.06 | -0.01 |
| | | | | | (0.95) | (0.75) | (0.74) | (0.91) |
| GVC*COVID | | | | | -0.01 | | | |
| | | | | | (0.91) | | | |
| FI*COVID | | | | | | 0.03 | | |
| | | | | | | (0.78) | | |
| BI*COVID | | | | | | | -0.03 | |
| | | | | | | | (0.71) | |
| TI*COVID | | | | | | | | -0.01 |
| | | | | | | | | (0.86) |
| Constant | -0.06 | 0.20 | 0.01 | -0.27* | -0.07 | 0.26 | -0.01 | -0.28* |
| | (0.58) | (0.26) | (0.95) | (0.08) | (0.56) | (0.28) | (0.95) | (0.08) |
| Observations | 112 | 112 | 112 | 112 | 112 | 112 | 112 | 112 |
| Number of Countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

Notes: OCORR2 is the dependent variable. GVC= global value chain integration; FI=forward integration in GVC; BI= backward integration in GVC; TI= two-sided integration in GVC; COVID= a dummy variable with the value 1 for the years 2020 and 2021, otherwise zero. ** and * refer to the significance level at 5% and 10% respectively. P-values are provided in parentheses. All the variables are taken in logarithms.

Source: Authors.

Table A37: List of Industries and Groupings

| No | Industry name | Industry groupings | |
|----|--|--------------------|-----------------|
| 1 | Food, beverages, and tobacco | Manufacturing | |
| 2 | Textiles and textile products | Manufacturing | |
| 3 | Leather, leather products, and footwear | Manufacturing | |
| 4 | Wood and products of wood and cork | Manufacturing | |
| 5 | Pulp, paper, paper products, printing, and publishing | Manufacturing | |
| 6 | Coke, refined petroleum, and nuclear fuel | Manufacturing | High Technology |
| 7 | Chemicals and chemical products | Manufacturing | High Technology |
| 8 | Rubber and plastics | Manufacturing | |
| 9 | Other nonmetallic minerals | Manufacturing | High Technology |
| 10 | Basic metals and fabricated metal | Manufacturing | High Technology |
| 11 | Machinery, nec | Manufacturing | High Technology |
| 12 | Electrical and optical equipment | Manufacturing | High Technology |
| 13 | Transport equipment | Manufacturing | High Technology |
| 14 | Manufacturing, nec; recycling | Manufacturing | |
| 15 | Sale, maintenance, and repair of motor vehicles and motorcycles; retail sale of fuel | Services | |
| 16 | Wholesale trade and commission trade, except of motor vehicles and motorcycles | Services | |
| 17 | Retail trade, except of motor vehicles and motorcycles; repair of household goods | Services | |
| 18 | Hotels and restaurants | Services | |
| 19 | Inland transport | Services | |
| 20 | Water transport | Services | |
| 21 | Air transport | Services | |
| 22 | Other supporting and auxiliary transport activities; activities of travel agencies | Services | |
| 23 | Post and telecommunications | Services | |
| 24 | Financial intermediation | Services | |
| 25 | Real estate activities | Services | |
| 26 | Renting of M&Eq and other business activities | Services | |
| 27 | Public administration and defence; compulsory social security | Services | |
| 28 | Education | Services | |
| 29 | Health and social work | Services | |
| 30 | Other community, social, and personal services | Services | |
| 31 | Private households with employed persons | Services | |

Source: Authors.

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