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Intermediate Imports and Final Aggregate Demand Components in ASEAN-4: An Empirical Analysis

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ABSTRACT

This study aims to investigate the long run and short run relationship between intermediate imports and domestic final demand among ASEAN-4. By adopting a new measure of final demand (IAD) and disaggregated final demand (IAD) components, the relationship was analyzed using ARDL Bound test, covering the period of 1970-2015. A positive relationship was found between Malaysia's and Singapore's final demand and intermediates imports and also from other ASEAN-4. There are three implications of this finding. Firstly, it is important to analyze the intermediate imports at the disaggregated level to gauge the different magnitude of influence of each final demand component on the intermediate imports. Secondly, the co-integrated relationship between domestic demand of ASEAN-4 and intermediate imports implies the importance of intra-regional trade cooperation and opportunities. Thirdly, relative import price seems to be less significant in determining the import of intermediates.

JEL Classification: F14; F62

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INTRODUCTION

Global value chains (GVCs)[1] is an important feature of the current global economy which is likely to have tremendous impact on the countries that are highly integrated in terms of international trade and global production. The GVCs phenomenon, to a larger extent, has been facilitated by the increasing intermediates trade and the operation of various production stages across country borders. The imports of intermediate goods have been increasing significantly and now it represent more than half of the goods imported by OECD economies and close to three-quarters of the imports of large developing economies, such as China and Brazil (Ali and Dadush, 2011). Despite being a global phenomenon, the value chain is more of regional in characteristics, particularly, if the regional development level is heterogeneous, as in the case of ASEAN-4 (Singapore, Malaysia, Thailand and Indonesia). For example, resources rich Indonesia exports natural resources-based goods, while Malaysia and Thailand specialized in manufacturing goods and Singapore engaged in highly skilled intensive products and services and then these countries exports the final or intermediate goods to a third market. Statistics also show that ASEAN-4 are highly engaged in GVCs activities. From Table 1, ASEAN-4 registered around 43 to 70 in terms of GVC participation index. Among these countries, Singapore display highest GVC participation rates ranging from 60 to 70 during the period 1995 to 2009. This is followed by Malaysia (55 to 65) and Thailand (41 to 52). Meanwhile, resource rich country Indonesia, has relatively lower participation index (34 to 43) over the same period.

Table 1 Global Value Chains Participation Index

	1995	2000	2005	2008	2009
Indonesia	33.5	43.0	49.2	49.2	43.7
Malaysia	55.4	62.6	68.7	67.7	65.6
Singapore	60.5	69.4	74.8	74.3	70.7
Thailand	41.9	49.1	55.9	56.4	52.8
Cambodia	43.7	43.3	42.7	40.9	40.3
Brunei Darussalam	37.7	40.2	45.4	51.8	43.7
India	23.9	31.8	42.8	46.1	42.3

Source: OECD Global Value Chains Indicators Dataset (2013)

In specific, intra intermediates trade among ASEAN-4 was increasing during the period 1995-2015[2], particularly between Singapore-Malaysia and Singapore-Indonesia (refer to Table 2). Singapore is the largest intermediate goods provider and importer to or from Malaysia and Indonesia, in which the bilateral trade constitutes approximately 16 per cent of each total intermediates trade in 2015. On the other hand, Thailand maintained a high portion of intermediates trade with extra-ASEAN partners, such as China and Japan. Nevertheless, a closer intermediates trade relationship was observed between Thailand and Malaysia. The increasing intermediates trade within ASEAN-4 suggests the formation of a regional value chains among these countries.

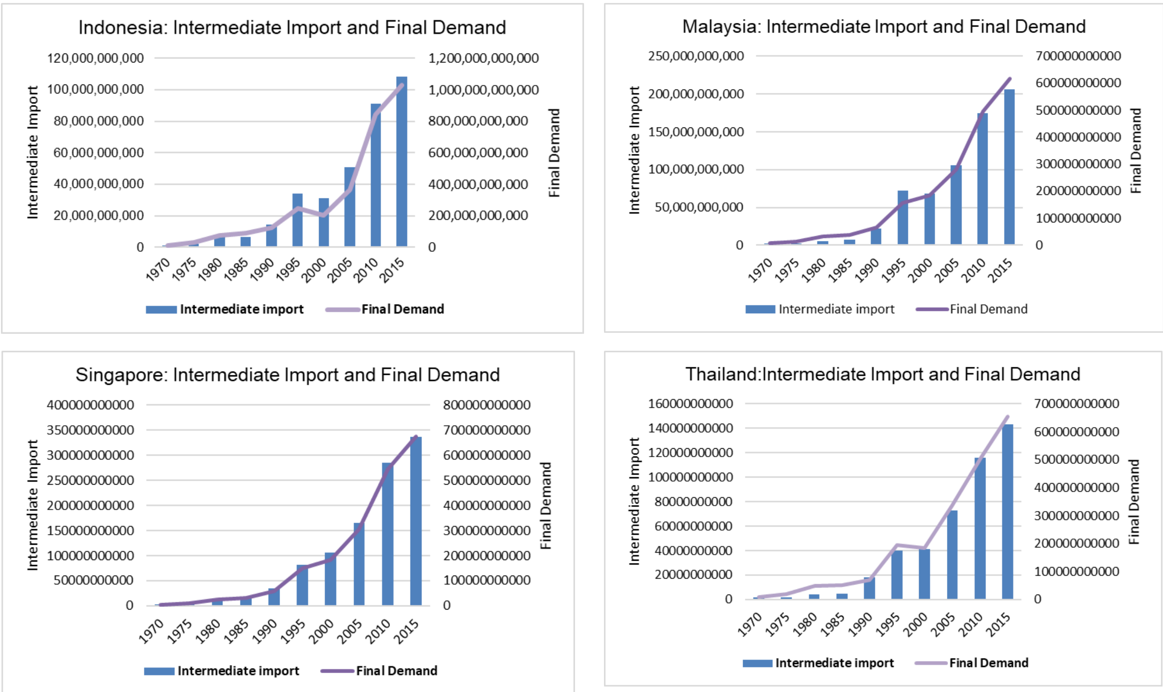
Table 2 Intermediate Trade within ASEAN-4 (% of Total Intermediate Trade)

Malaysia						Thailand					
	1995		2000		2015		1995		2000		2015
Singapore	0.10	Singapore	0.09	Singapore	0.16	Malaysia	0.06	Malaysia	0.06	Malaysia	0.07
Indonesia	0.04	Thailand	0.04	Thailand	0.05	Singapore	0.03	Indonesia	0.02	Singapore	0.04
Thailand	0.04	Indonesia	0.04	Indonesia	0.04	Indonesia	0.01	Singapore	0.02	Indonesia	0.02
Singapore						**Indonesia**					
	1995		2000		2015		1995		2000		2015
Malaysia	0.15	Malaysia	0.15	Malaysia	0.17	Singapore	0.07	Singapore	0.08	Singapore	0.16
Indonesia	0.04	Indonesia	0.06	Indonesia	0.09	Malaysia	0.04	Malaysia	0.06	Thailand	0.03
Thailand	0.03	Thailand	0.03	Thailand	0.03	Thailand	0.02	Thailand	0.03	Malaysia	0.05

Source: Author's own calculation based on EORA Input-output Table

[1]Baldwin (2006) defined GVCs as "sliced and diced" production that separate production into fragments that can be spread around the world. Meanwhile, Grossman and Rossi-Haneberg (2006) defined GVCs as "trade in tasks". Countries tend to trade in tasks than products along a sequence of productive activities from the conception of a product to its manufacturing and commercialization. In other words, each country trade in intermediates goods and specializes in task(s) or "adds value" to a product at each stage of a production chain. This leads to a broader term, that is "global value chain" (GVC) that creates more integrated and specialize trade relationships among countries.
[2] The input-output data from EORA is only available until 2015.

Theoretically, the demand for intermediate goods is a derived demand from final demand. Therefore, a change in final demand is expected to change the demand for intermediate goods proportionally. Figure 1 show that the intermediate imports and final demand of ASEAN-4 are moving in the same direction during 1970-2015. Noticeably, both intermediate imports and final demand are increasing sharply since the mid of 2000s. This could be explained by an increasing GVCs participation among the ASEAN-4 whereby intermediate goods are imported for final demand such as export. Moreover, the slope of final demand is close to the slope of intermediate imports, implying a close relationship between intermediate imports and final demand.



Source: Author's drawing based on EORA Input-output Table

Figure 1 Intermediate Import and Final Demand

Moreover, the separate role and magnitude of individual final demand components on intermediate imports was expected due to the nature of GVCs trade. For example, export and private sector investment are expected to have greater impacts on intermediate imports as intermediate imports are imported for further production (investment) or export. In line with the above research background, this study aims to examine the long run and short run bilateral relationship between intermediate imports and final demand among ASEAN-4. Understanding how final demand affect intermediate imports would allow individual country and firm to respond more effectively to the changes or challenges within the regional value chains. This paper is structured as follows. Section 2.0 presents a brief literature review. Section 3.0 describes the methodological framework and data. Section 4.0 discusses the empirical methodology while section 5.0 describes the empirical result. The final section concludes with some policy recommendations.

A BRIEF LITERATURE REVIEW

The earliest literature on the concept of GVCs can be traced back to work by Rasmussen (1956) and Hirschman (1958) on backward and forward linkages in the late 1950s. According to Rasmussen (as cited in Drejer, 2002), the forward and backward linkages is an estimate of direct and indirect relationship between production, output, and demand. The concept of GVCs in the early 2000s also incorporates several international trade characteristics such as increasing fragmentation of production across countries and specialization in tasks instead of products (De Backer and Miroudot, 2013). Generally, the existence of GVCs is mainly due to the vast international wage differences, the fall in communication and transportation cost as well as free trade agreements (FTAs) (Baldwin, 2012, 2011; Elms and Low, 2013; World Trade Organization [WTO], 2014). Organization for Economic Co-operation and Development (OECD) has recently undertaken both, theoretical and empirical studies to examine the impact of GVCs on variuos macro-economic dimension to draw a more comprehensive picture of the integrated global productions structure using input-output data[3].The input-output model was created based on Leontief (1936) model. The model has been later extended and used in explaining the interaction of production stages across countries. Meanwhile, Rasmussen dispersion indices which is calculated from the Leontief inverse matrix $[I - A]^{-1}$ estimates the direct and indirect increase in the output (intermediates) following an increase in the final demand.

Escaith, Lindenberg and Miroudot (2010) work is the first to link the demand for intermediate inputs with an external shock by adopting a demand-oriented input-output analysis. Using Leontief inverse matrix, the long run and short run trade elasticity was estimated using error correction model (ECM). Escaith et al. (2010) compared the observed changes in the elasticities of the countries which was categorized into sub-groups according to the extent of their participation in the global supply chains. They found no significant trend to confirm the role of GVCs in trade elasticity using panel OLS estimation. Further, vertical specialization variables have been added into the model to confirm the role of GVCs in long term trade elasticity. However, the results vary, and the variables were not consistently significant even though the addition of the variables slightly increased the goodness-of-fit of the model for most of the countries. Meanwhile, Bems et al. (2010) examined U.S. and European Union (EU) demand spillovers and the respond of world trade to GDP during the global recession of 2008 – 2009 using global input-output framework. They modeled the changes in trade elasticity of demand as a function of final and intermediate goods linkages. Each variable in the model is expressed as a weighted average of sector and country-specific demand changes. Since each variable has a unique set of weights, they respond differently to a given vector of demand changes. These weights can be regarded as partial elasticities in which they translate the proportional changes in demand of a sector and destination into proportional changes in production and trade.

As intermediate demand is a derived demand from final demand, the impacts of final demand changes can be transmitted into intermediate imports and this very much depends on the interaction between final demand change and intermediate goods. Few determinants influencing the interaction have been identified such as industries impact, inventory adjustment and credit supply. At world trade level, Bems et al. (2010) found that if expenditure changes are heterogeneous across sectors (such as durable sectors are more elastic to the change in final demand), then global intermediates trade in durable goods could decline more than the changes in the global final demand. Moreover, inventory adjustment also plays an important role in the demand of intermediates in durable industries. Shocks to credit supply would also amplify the impact of demand changes on intermediates trade. Meanwhile, Gangnes and Van Assche (2016) examined the interaction between final demand and intermediates demand through the use of imported intermediate goods in production and participation in GVCs. Their findings suggested that the more imported intermediates used in the production of export, the higher the sensitivity of the export to external or internal income shock. Moreover, the more a country's export relies on foreign market, the higher the sensitivity of its export to foreign income movement.

This sub-section provides review on the selection of variables used in the intermediate imports analysis. Seddighi (1998) and Tang (2003) highlighted that the use of GDP as a proxy of final demand in aggregate import demand function would lead to aggregation bias if the assumption of same import content in disaggregated final demand components has been violated. On the other hand, Bussière et al. (2013) observed a larger fall in the investment during 2008 recession than other AD components due to higher import content. If the observation is correct, the use of a single final demand variable such as GDP might be inaccurate due to aggregation bias. Following this, a new measurement of final demand, an import intensity-adjusted measure of aggregate demand (IAD) has been used in his study. IAD is an import-contents-weighted average of traditional aggregate demand components (investment, private consumption, government spending, and exports) based on constant elasticity of substitution (C.E.S.) demand system. Moreover, the elasticity of import demand to aggregate demand is no longer restricted to one by using IAD. More importantly, IAD is found to be more superior to standard measures in terms of both goodness of fit and stability of parameter estimates.

[3]The OECD-WTO Trade in Value-Added database was release in May 2013.

Considering the mixed findings in the existing literature and lacking of studies on how final demand affect intermediate imports at aggregated and disaggregated level, the present paper examines the relationship between intermediate imports and final demand at aggregated and disaggregated level among ASEAN-4 countries. Since a country's import is another country's export, the findings of this paper are expected to provide an insights on the factors that could affects regional value chain and intermediates trade for the implementation of appropriate trade policy and seeking potential market for intermediates export. In other words, the co-operation in ASEAN-4 can be more complementary than competitive, particularly in current growing dynamic of international trading environment along with the ongoing trade conflict between US-China.

RESEARCH METHODOLOGY

Model Specification

The common import demand equation relates the import demand to domestic real income and relative import prices as below. We apply similar assumption on intermediate imports.

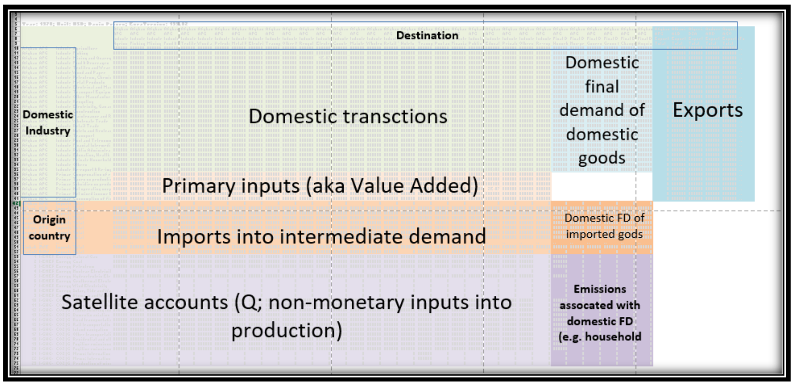
$$Import \ = \ f \ (income, price)$$

The proxy of income is IAD. IAD is an import-contents-weighted average of traditional aggregate demand components (investment, private consumption, government spending, and exports)[4] based on input-output analysis that was introduced by Leontief in 1936. The dispersion index for backward linkages is as shown below:

$$\sum_i U_{ij} = \frac{\frac{1}{n}\sum_i B_{ij}}{\frac{1}{n^2}\sum_{ij} B_{ij}}$$

where n is the number of industries, and $\sum_i B_{ij}$ is the sum of the column elements in the Leontief inverse matrix $B=(I-A)^{-1}$. It can be interpreted as the total increase in output from the entire system of industries needed to cope with an increase in the final demand for the products of industry j by one unit. The industries linkages measured using Rasmussen's indices is sorely depends on demand and supply effects in the economic system. The Rasmussen's indices express how the inputs and outputs of linked-industries changes when there is a change in final demand. Moreover, Johnson and Noguera (2009) developed theoretical and empirical research on the new concept of trade in value added. The new concept of value added exports from an origin country to a destination country is defined as the origin county's value added induced by the destination country's final demand, excluding imports of intermediate goods from the world.

Calculating the Import Content of Aggregate Demand Components (IAD)



Source: EORA MRIO Database (2013)

Figure 2 Input-output table

[4] For the computation of IAD, we follow closely the methodology introduced by Bussière et al. (2013). For details refer to Bussière et al. (2013).

We follow the steps explained in Bussière et al. (2013) in computing the import content of aggregate demand components. From input-output table (Figure 2), the cells in the 'domestic transactions' section (Z^d) contains the amount of domestically produced inputs from sector i (row) needed by sector j (column) for production throughout the year of reference. Meanwhile, the cells in the 'imports into intermediate demand' section (Z^m) contain the amount of imported inputs from country c (row) needed by sector j in country d (column). In the calculations, instead of using Z^d and Z^m, we used slightly modified input matrices, A^d and A^m, where A^d is the S×S matrix of domestic input coefficients and A^m is the S x S matrix of imported input coefficients.

The domestic input coefficients a_{ij}^d contain the amount of domestically produced inputs from sector i needed to produce one unit of output in sector j, and the imported input coefficients a_{cj}^m contain the imported inputs from country c needed to produce one unit of output in sector j, country d. These coefficients can be easily derived by dividing the value of each cell in Z^d and Z^m by the sum of the respective column respectively. Both the 'domestic' and 'import' matrices are used in the construction of the import contents of the four expenditure components. Let us assume that there are S sectors and K final demand components in the economy, and that domestic output from each sector is used both as an intermediate inputs by the other sectors and to satisfy the final demand. The domestic output from sector i needed to satisfy the final demand from the expenditure component k is then given by:

$$x_{i,k} = \sum_{j=1}^{S} a_{i,j}^d x_{j,k} + f_{i,k}^d$$

In matrix format this becomes:

$$X = A^d X + F^d$$

where X is the S ×K matrix of domestic output induced by each spending component k, A^d is the S×S matrix of domestic input coefficients, and F^d is the S×K matrix of final demands of domestic goods and services (such as household consumption, government consumption, exports and gross fixed capital formation). Domestic output can then be expressed as:

$$X = (I-A^d)^{-1} F^d$$

where $(I-A^d)^{-1}$is commonly known as Leontief inverse. Meanwhile, the (M_k^{ind}) is the indirect imports of intermediate induced by the expenditure on domestically produced goods and services for each k as:

$$m_{i,k}^{ind} = \sum_{j=1}^{S} a_{ij}^m x_{j,k}$$

In matrix format:

$$M^{ind} = A^m X,$$
$$\text{Or, } M^{ind} = A^m (1-A^d)^{-1} F^d$$

where M^{ind} is the S x K matrix of indirect imports induced by each spending component k, and A^m is the S x S matrix of imported input coefficients. Total imports can then be expressed as the sum of direct and indirect imports, that is

$$M = M^{ind} + M^{dir} = A^m (1 - A^d)^{-1} F^d + F^m$$

The (M^{dir}) denotes the value of direct imports from each sector for each AD components. Meanwhile, F^m represents the direct imports of goods and services by the final expenditure component. Therefore, $M^{dir} = F^m$. Note that the value of direct import of export is assumed zero as re-exports are excluded from analysis. The weight of total import content of each AD component k is:

$$w_k = \frac{uM_k^{dir} + uM_k^{ind}}{uF_k^d + uF_k^m} = \frac{uA^m(1 - A^d)^{-1}F_k^d + uF_k^m}{uF_k^d + uF_k^m}$$

where the weight (w_k, with k = C, G,I). u is a 1 x S vector with all elements equal to 1 and the subscript k selects the k-th column of each matrix, corresponding to the expenditure components of interest. It is also possible to derive a direct and indirect import content for each expenditure component:

$$w_k^{dir} = \frac{uM_k^{dir}}{uF_k^d + uF_k^m}$$
$$w_k^{ind} = \frac{uM_k^{ind}}{uF_k^d + uF_k^m}$$

where the indirect import content ($\mathrm{w}_\mathrm{k}^{\mathrm{ind}}$) indicates the share of intermediate imported inputs per unit of final demand, and the direct import content ($\mathrm{w}_\mathrm{k}^{\mathrm{dir}}$) reveals the share of imported final goods and services. Note that, the weight is computed based on EORA annual input-output table (IO table). The annual data is only available for the period of 1970-2015 which jusitfy the selection of the period of the present study. We also assumed that there is no changes in the import weights in the four quarters that compose each of the year during the period.

Computing Relative Import Price (rp)

The other explanatory variable is relative import price (rp) which was constructed by dividing the series of import prices for each country with respective domestic GDP deflator (Bussière et al., 2013). We construct import price in domestic currency by multiplying the GDP deflator of import source country with the exchange rate between the import source and domestic countries. Due to insufficient time series bilateral exchange rate data, we compute the two countries exchange rate through the ratio of each country exchange rate to US Dollar. The relative import price is computed as follows:

$$\frac{GDPdeflator_{importing\ country} * \left(\frac{\text{domestic country currency per USD}}{\text{importing country currency per one USD}}\right)}{GDPdeflator_{domestic\ country}}$$

The GDP deflator data was extracted from World Bank's World Development Indicators (2017). Meanwhile, the exchange rate is from Bank for International Settlement (BIS)[5].The coefficients of relative import prices, $\beta_{10}\ and\ \beta_{16}$, are expected to be negative. Furthermore, we observed that there are some negative values for relative import price series. Thus, the common technique to address the negative values were applied (i.e. adding a constant value to the data before transforming to log) to avoid losing the data due to log transformation. The present study concentrates on ASEAN-4 regional value chain. As heterogeneity is expected across the sample countries, we estimated the model bilaterally for the period 1970-2015. Bilateral analysis is expected to generate a better estimation as it allows greater dispersion and volatility across countries.

The Log-Linear Model

Log-linear model is used to avoid some estimation problems such as multicollinearity (Gafar, 1988)[6]. Lags of the dependent and explanatory variables are also included in the model to allow for richer dynamics. Since all variables are expressed in logs, coefficient may be interpreted as elasticity. The log linear model is specified as:

[5] The BIS nominal exchange rate data set contains long time-series on USD exchange rates for currencies of approximately 190 economies at daily, monthly, quarterly, and annual frequencies. These exchange rate series, which draw on central bank data as well as other sources, are used for the calculation of the BIS nominal and real effective exchange rate series and as an input to the BIS International Banking and Financial Statistics (www.bis.org).

[6]In addition, Carone (1996, p. 5) has added that the import demand equation is usually specified in logarithmic form because of its convenience and ease of interpretation.

Aggregated model

$$\ln Mi_{c,d} = \alpha + \beta_2 \ln Mi_{c,d,t-i} + \beta_3 \ln IAD_{c,t} + \beta_{10} \ln rp_{c,t} + \beta_4 \ln IAD_{c,t-i} + \beta_{16} \ln rp_{c,t-i} + \varepsilon_t \quad (1)$$

Disaggregated model

$$\ln Mi_{c,d} = \beta_1 + \beta_2 \ln Mi_{c,d,t-i} + \beta_5 \ln X_{c,t} + \beta_6 \ln FC_{c,t} + \beta_7 \ln HC_{c,t} + \beta_8 \ln GC_{c,t} + \beta_9 \ln INV_{c,t} + \beta_{10} \ln rp_{c,t} + \beta_{11} \ln X_{c,t-i} + \beta_{12} \ln FC_{c,t-i} + \beta_{13} HC_{c,t-i} + \beta_{14} GC_{c,t-i} + \beta_{15} INV_{c,t-i} + \beta_{16} \ln rp_{c,t-i} + \varepsilon_t \quad (2)$$

Where ln implies natural log, $Mi_{c,d}$ is intermediate imports demand of country c from country d, $IAD_{c,t}$ is a weighted vector decomposing aggregate demand: export ($X_{c,t}$), gross fixed capital formation ($FC_{c,t}$), household final consumption ($HC_{c,t}$), government final consumption ($GC_{c,t}$), and changes in inventories ($INV_{c,t)}$ based on the import content intensity from the EORA input-output tables. Data on imported intermediates also come from the same source. The relationships between imported intermediate and final aggregate demand are explained through the coefficients $\beta_3, \beta_{4,}\beta_{5,}\beta_6, \beta_{7,}\beta_{8,}\beta_{9.}$. These coefficients are expected to be positive, as the intermediate goods is assumed to be imported for further production in order to fulfill domestic final demand and export.

The use of disaggregated demand allows the understanding of how individual final demand components are related to intermediate imports. Specifically, more focus is given to $\beta_5\ and\ \beta_6$(coefficients of export (Xc,t) and gross fixed capital formation (FCc,t) following the nature of GVCs which emphasises that intermediates are imported for further production (investment related) or for export. The regression equations does not restrict the import elasticity of aggregate demand to be one, in which aggregate demand takes the form of the IAD aggregator in levels, and a Cobb-Douglas function with time varying weights of household's consumption, government consumption, investment and export (Bussière et al., 2013).

Empirical Methodology: Autoregressive Distributed Lag (ARDL) Bound Test

ARDL Bound test is a common methodology in estimating trade or import elasticity with small sample (Tang, 2003; Wang and Lee, 2012; Gozgor, 2014). The advantages of ARDL approach includes its flexibility in the variables' order of integration besides being relatively more efficient in small and finite sample. Moreover, a dynamic error correction model (ECM) can be derived from ARDL through a simple linear transformation. Firstly, the unit root test was conducted to ensure none of the variables is $I(2)$. Spurious result might be obtained if this assumption is violated. The stationary properties of the variables in the import demand function was tested using Augmented Dickey Fuller (ADF) test, Phillips–Perron (PP) test. The results of unit roots at level and first difference using intercept, intercept, and trend respectively, is reported in Table 3. The results show that none of the series are $I(2)$.

Second, the adopted bounds test is an extension of Pesaran, Shin and Smith (2001) framework. Three test were conducted: (1) the overall F-test on all the coefficients of the lagged variables, (2) a t-test on the coefficient on the lagged level of the dependent variable, and (3) a F-test on all coefficients on the lagged independent variables (Sam et al., 2019). The test statistics of (1) is compared with the critical value from Narayan (2005) (Table of Case II) for a small sample sizes ranging 30-80. The t-test from (2) is compared with the critical value from Pesaran et al. (2001) (Table CI (ii) Case (II)), and the F-test from (3) is compared with the critical value bound from Sam et al. (2019) (Table 2 Case III). If the calculated statistics is greater than both upper ($I(1)$) critical values, then the null hypothesis of no co-integration can be rejected. If the null hypothesis all three tests are rejected, then there is cointegration. If only the null from (1) and (2) are rejected, it implies a case of degenerate lagged independent variable case. If only (1) and (3) are rejected, then it implies a case of degenerate lagged dependent variable case.

Table 3 Unit Root Results

Variable	Malaysia		Indonesia		Singapore		Thailand	
	ADF		ADF		ADF		ADF	
	Intercept	Intercept and trend	Intercept	Intercept and trend	Intercept	Intercept and trend	Intercept	Intercept and trend
Test results for unit root (Level)								
	(t-Stat)	(t-Stat)	(t-Stat)	(t-Stat)	(t-Stat)	(t-Stat)	(t-Stat)	(t-Stat)
LMSMI	-4.96***	-3.32*	-4.28***	-3.06	NA	NA	-3.28**	-1.88
LMTMI	-3.90***	-0.75	-3.45**	-4.72***	-4.42***	-4.42**	NA	NA
LMIMI	-4.60***	-2.39	NA	NA	-1.63	-4.33**	-2.1	-1.48
LMMMI	NA	NA	-4.16***'	-4.76***	-3.08**	-2.02	-2.61	-1.48
LIAD	-1.22	-3.80*	-1.29	-1.59	-0.32	-3.74**	-4.48***	-6.75***
LFCIW	-4.25***	-3.96**	-1.25	-3.53*	-2.81*	-4.12**	-7.16***	-7.16***
LGCW	-0.7	-1.79	-0.74	-3.16	-2.86*	-3.44*	-7.32***	-7.26***
LHCW	-1.19	-3.26*	-1.72	-3.25*	-2.65*	-3.29*	-7.18***	-7.14***
LxW	-2.55	-3.25*	-2.34	-5.31***	-2.63	-2.83	-7.25***	-7.21***
LPMI	-1.33	-1.47	NA	NA	NA	NA	NA	NA
LPMS	-0.47	-3.12	NA	NA	NA	NA	NA	NA
LPMT	-2.76*	-1.65	NA	NA	NA	NA	NA	NA
LPIM	NA	NA	-1.34	-1.47	NA	NA	NA	NA
LPIS	NA	NA	-0.79	-1.47	NA	NA	NA	NA
LPIT	NA	NA	-0.54	-2.34	NA	NA	NA	NA
LPSI	NA	NA	NA	NA	-0.79	-1.47	NA	NA
LPSM	NA	NA	NA	NA	0.36	-2.59	NA	NA
LPST	NA	NA	NA	NA	-1.18	-1.3	NA	NA
LPTI	NA	NA	NA	NA	NA	NA	-0.54	-2.34
LPTM	NA	NA	NA	NA	NA	NA	-2.77*	-1.65
LPTS	NA	NA	NA	NA	NA	NA	-1.18	-1.3
Test results for unit root (first difference)								
LMSMI	-2.64*	-4.99***	-2.55	-3.14	NA	NA	-3.73**	-4.46**
LMTMI	-15.51***	-5.57***	-3.52**	-4.14**	-3.60**	-4.47***	NA	NA
LMIMI	-2.87*	-4.57***	NA	NA	-3.00**	-2.91	-4.21***	-4.64***
LMMMI	NA	NA	-3.20**	-4.12**	-2.95*	-4.98***	-3.73**	-4.47***
LIAD	-5.90***	-4.39**	-3.47**	-3.48*	-10.88***	-12.35***	-6.14***	-6.09***
LFCIW	-5.31***	-4.25**	-3.10**	-3.06	-7.20***	-7.58***	-6.31***	-6.23***
LGCW	-4.28***	-7.16***	-5.85***	-5.80***	-7.47***	-7.38***	-4.91***	-4.84***
LHCW	-7.25***	-5.82***	-6.46***'	-6.39***	-7.13***	-7.05***	-6.30***	-6.22***
LxW	-2.53	-5.23***	-4.09***	-3.86**	-12.08***	12.35***	-4.89***	-4.82***
LPMI	-6.72***	-6.74***	NA	NA	NA	NA	NA	NA
LPMS	-9.33***	-9.21***	NA	NA	NA	NA	NA	NA
LPMT	10.18***	10.82***	NA	NA	NA	NA	NA	NA
LPIM	0	NA	-6.72***	-6.74***	NA	NA	NA	NA
LPIS	NA	NA	-6.57***	-6.50***	NA	NA	NA	NA
LPIT	NA	NA	-6.80***	-6.71***	NA	NA	NA	NA
LPSI	NA	NA	NA	NA	-6.57***	-6.50***	NA	NA
LPSM	NA	NA	NA	NA	-6.47***	-6.51***	NA	NA
LPST	NA	NA	NA	NA	-2.75*	-7.22***	NA	NA
LPTI	NA	NA	NA	NA	NA	NA	-6.80***	-6.71***
LPTM	NA	NA	NA	NA	NA	NA	-10.18***	-10.82***
LPTS	NA	NA	NA	NA	NA	NA	-2.75*	-7.22***

Note: *, **, *** denoted the statistical significant at 1 percent, 5 percent and 10 percent, respectivelyHo: the variable has a unit root with a structural break both in the intercept or trend. Noted that probability values are calculated from a standard t-distribution and do not take into account the breakpoint selection process.

Table 3 Cont.

Variable	Malaysia		Indonesia		Singapore		Thailand	
	PP		PP		PP		PP	
	Intercept	Intercept and trend	Intercept	Intercept and trend	Intercept	Intercept and trend	Intercept	Intercept and trend
Test results for unit root (Level)								
	(t-Stat)	(t-Stat)	(t-Stat)	(t-Stat)	(t-Stat)	(t-Stat)	(t-Stat)	(t-Stat)
LMCMI	-1.62	-1.23	-3.07**	-2.47	-3.52**	-1.96	-1.74	-1.90
LMJMI	-3.23**	-1.20	-5.51***	-3.72**	-7.92***	-4.42***	-4.36***	-4.52***
LMSMI	-3.17**	-1.33	-4.75***	-4.29***	NA	NA	-3.08**	-0.83
LMTMI	-0.66	-3.88**	-3.29**	-2.64	-4.42***	-2.75	NA	NA
LMIMI	-2.35	-1.22	NA	NA	-4.29***	-2.99	-2.16	-0.60
LMMMI	NA	NA	-4.34***	-2.93	-5.84***	-4.10**	-2.93*	-0.44
LIAD	-1.54	-2.50	-3.29**	-3.50*	-4.99***	-5.78***	-4.48***	-6.75***
LFCIW	-4.15***	-3.94**	-1.81	-2.50	-3.46**	-3.85**	-7.16***	-7.16***
LGCW	-0.71	-1.73	-0.78	-2.50	-2.61*	-3.07	-7.32***	-7.26***
LHCW	-1.40	-3.38*	-1.66	-2.67	-2.47	-3.35*	-7.18***	-7.14***
LxW	-2.66*	-3.38*	-2.28	-3.34*	-2.45	-2.67	-7.25***	-7.21***
LPMI	-1.34	-1.48	NA	NA	NA	NA	NA	NA
LPMS	-0.51	-3.05	NA	NA	NA	NA	NA	NA
LPMT	-2.76*	-2.20	NA	NA	NA	NA	NA	NA
LPIM	NA	NA	-1.34	-1.48	NA	NA	NA	NA
LPIS	NA	NA	-0.79	-1.59	NA	NA	NA	NA
LPIT	NA	NA	-0.54	-2.43	NA	NA	NA	NA
LPSI	NA	NA	NA	NA	-0.79	-1.59	NA	NA
LPSM	NA	NA	NA	NA	0.20	-3.59**	NA	NA
LPST	NA	NA	NA	NA	-1.19	-1.07	NA	NA
LPTI	NA	NA	NA	NA	NA	NA	-0.54	-2.34
LPTM	NA	NA	NA	NA	NA	NA	-2.77*	-1.65
LPTS	NA	NA	NA	NA	NA	NA	-1.18	-0.95
Test results for unit root (first difference)								
LMCMI	-3.00**	-3.29*	-3.47*	-4.07**	-3.55**	-4.27***	-3.80***	-4.09**
LMJMI	-2.70*	-3.75**	-3.04**	-4.09**	-2.95**	-4.35***	-3.30**	-4.52***
LMSMI	-2.64*	-3.64**	-2.49	-3.15	NA	NA	-3.73***	-4.49***
LMTMI	-10.93***	-14.00***	-3.55**	-4.18**	-3.61***	-4.50***	NA	NA
LMIMI	-2.89*	-3.40*	NA	NA	-3.40**	-4.35***	-4.21***	-4.64***
LMMMI	NA	NA	-3.26**	-4.19***	-2.80*	-4.01**	-3.73***	-4.47***
LIAD	-4.70***	-4.78***	-10.24***	-10.12***	-19.95***	-34.70***	-9.11***	-9.01***
LFCIW	-5.72***	-5.73***	-6.15***	-6.06***	-10.59***	-12.79***	-6.31***	-6.23***
LGCW	-7.25***	-7.16***	-5.81***	-5.75***	-8.68***	-9.01***	-6.34***	-6.25***
LHCW	-7.23***	-7.13***	-6.98***	-6.87***	-10.93***	-11.71***	-6.30***	-6.22***
LxW	-7.68***	-7.58***	-8.56***	-8.48***	-12.06***	-13.22***	-6.32***	-6.24***
LPMI	-6.73***	-6.75***	NA	NA	NA	NA	NA	NA
LPMS	-10.41***	-10.29***	NA	NA	NA	NA	NA	NA
LPMT	-10.31***	-11.25***	NA	NA	NA	NA	NA	NA
LPIM	0	NA	-6.73***	-6.75***	NA	NA	NA	NA
LPIS	NA	NA	-6.57***	-6.50***	NA	NA	NA	NA
LPIT	NA	NA	-6.80***	-6.71***	NA	NA	NA	NA
LPSI	NA	NA	NA	NA	-6.57***	-6.50***	NA	NA
LPSM	NA	NA	NA	NA	-10.61***	-10.37***	NA	NA
LPST	NA	NA	NA	NA	-7.05***	-7.20***	NA	NA
LPTI	NA	NA	NA	NA	NA	NA	-6.80***	-6.71***
LPTM	NA	NA	NA	NA	NA	NA	-10.18***	10.81***
LPTS	NA	NA	NA	NA	NA	NA	-7.06***	-7.22***

Note: *, **, *** denoted the statistical significant at 1 percent, 5 percent and 10 percent, respectively. Ho: the variable has a unit root with a structural break both in the intercept or trend. Noted that probability values are calculated from a standard t-distribution and do not take into account the breakpoint selection process.

Aggregated Model

$$D\left(\ln\left(Mi_{c,d,t}\right)\right) = \alpha_{01} + \beta_{1i}\ln\left(Mi_{c,d,t}\right) + \beta_{2i}\ln\left(IAD_{c,t-1}\right) + \beta_{3i}\ln\left(rp_{t-1}\right) + \sum_{i=1}^{p}\alpha_{1i}\,D\left(\ln Mi_{c,d,t-i}\right) + \sum_{i=1}^{q}\alpha_{2i}\,D\left(\ln\left(IAD_{c,t-i}\right)\right) + \sum_{i=1}^{q}\alpha_{3i}\,D\left(\ln rp_{t-i}\right) + Dummy + \varepsilon_t \quad (3)$$

Disaggregated Model

$$\begin{aligned} D\left(\ln\left(Mi_{c,d,t}\right)\right) = {} & \alpha_{01} + \beta_{1i}\ln\left(Mi_{c,d,t-1}\right) \\ & + \beta_{2i}\ln\left(X_{c,t-1}\right) + \beta_{3i}\ln\left(FC_{c,t-1}\right) + \beta_{4i}\ln\left(HC_{c,t-1}\right) + \beta_{5i}\ln\left(GC_{c,t-1}\right) + \beta_{6i}\ln\left(INV_{c,t-1}\right) \\ & + \beta_{7i}\ln\left(rp_{c,t-1}\right) + \sum_{i=1}^{p}\alpha_{1i}\,D(\ln Mi_{t-i}) + \sum_{i=1}^{q}\alpha_{2i}\,D\ln(X_{t-i}) \\ & + \sum_{i=1}^{q}\alpha_{3i}\,D\ln(FC_{t-i}) + \sum_{i=1}^{q}\alpha_{4i}\,D\ln(HC_{t-i}) + \sum_{i=1}^{q}\alpha_{5i}\,D\ln(GC_{t-i}) \\ & + \sum_{i=1}^{q}\alpha_{6i}D\ln\left(INV_{c,t-i}\right) + \sum_{i=1}^{q}\alpha_{7i}D\ln\left(rp_{c,t-i}\right) + Dummy + \alpha ECT_{t-1} + \varepsilon_{1t} \end{aligned} \tag{4}$$

All the variables are as previously defined, ln (.) is the logarithm operator, D is the first difference, and ε_t are the error terms. In equation (3) and (4), the term with $\beta_{x,1}$ correspond to the long run relationship while the terms with the summation signs in second part represents the error correction dynamics. Dummy variables such as D2008 (global financial crisis), D1997 (Asian Financial Crisis) and D2010[7] are added in the model for structural breakeven points. Maximum lag of 4 was chosen for the ARDL model (3) and ARDL model (4).

EMPIRICAL RESULTS

The general finding indicates co-integration relationship in unilateral Malaysia-Indonesia (disaggregated), Malaysia-Thailand (disaggregated), Singapore-Malaysia (aggregated) and Singapore-Indonesia (disaggregated) models only. It is noticed that disaggregated model provides more accurate and complete explanation on how the final demand affects the intermediate imports. The empirical results of individual country is discussed in the following section based on Table 4.

Table 4 Result of ARDL Bound Tests and Diagnostic Checking

Equations	**Test statistic & diagnostic checking**
Model with IAD and price as independent variables : C=Malaysia; d=Indonesia, k=2 The ARDL Bound regression: D(LMIMI) = -0.01 + 0.54 D(LMIMI(-1))*** + 0.13 D(LMIMI(-2)) + 0.90 D(LIAD)*** - 0.52 D(LIAD(-1))* -0.50 D(LIAD(-2)) + 0.09 (LPMI) + 0.09 D(LPMI(-1)) +0.37 D(LPMI(-2))* -0.32 D1996**-0.01 D1988 + 0.05 LIAD(-1) -0.03 LPMI(-1) -0.06 LMIMI(-1)*	F-statistic = 4.78* t-statistic (lagged DV) = 3.60* F-statistic (lagged IDV) = 2.05 N = 43 R2 = 0.86 ECMt-1 = -0.06* LM(2) = 0.92 JB = 0.69
Model with disaggregated IAD components and price as independent variables : C=Malaysia; d=Indonesia, k=5 The ARDL Bound regression: D(LMIMI) = 0.91 + 0.30 D(LMIMI(-1))** + 0.02 D(LMIMI(-2)) -0.07 D(LMIMI(-3)) + 1.21 D(LHCW)*** -0.08 D(LHCW(-1)) -0.34 D(LHCW(-2))*** + 0.26 D(LHCW(-3))*** + 1.27 D(LFCIW)*** -0.49 D(LFCIW(-1))** -0.83 D(LFCIW(-2))*** + 1.96 D(LGCW)*** + 0.29 D(LGCW(-1)) +0.83 D(LEXPORTW)*** -0.05 D(LEXPORTW(-1)) -0.22 D(LEXPORTW(-2)) + 0.57 D(LEXPORTW(-3))*** -0.18 D(LPMI) + 0.01 D(LPMI(-1)) + 0.22 D(LPMI(-2))* -0.10 D(LPMI(-3)) -0.47 D1996*** -0.09 D1988 - 0.17 D2011** + 0.06 LHCW(-1) + 0.40 LFCIW(-1)*** + 0.41 LGCW(-1)*** -0.33 LEXPORTW(-1)** -0.14 LPMI(-1)* -0.24 LMIMI(-1)***	F-statistic = 31.23*** t-statistic (lagged DV) = 3.41** F-statistic (lagged IDV) = 5.41* N = 42 R2 = 0.99 ECMt-1 = -0.24*** LM(2) = 0.002 JB = 2.03
Model with IAD and price as independent variables: C=Malaysia; d=Singapore, k=2 The ARDL Bound regression: D(LMSMI) = -1.03 + 0.53 D(LMSMI(-1))*** + 0.90 D(LIAD)*** -0.42 D(LIAD(-1))** + 0.03 D(LIAD(-2)) + 0.48 D(LPMS)** + 0.09 D(LPMS(-1)) -0.28 D(LPMS(-2)) -0.25 D1996** + 0.0001 LIAD(-1) + 0.24 LPMS(-1) -0.06 LMSMI(-1)	F-statistic = 11.59*** t-statistic (lagged DV) = 5.77** F-statistic (lagged IDV) = 3.75 N = 43 R2 = 0.91 ECMt-1 = -0.06** LM(2) = 0.36 JB = 1.09

[7] Effective 1 January 2010, Malaysia, Indonesia, Singapore, Thailand, Brunei Darussalam, and the Philippines have eliminated import duties on 99 per cent of products in the Inclusion List (except for products listed in the Sensitive and Highly Sensitive Lists) under ASEAN Trade in Goods Agreement (ATIGA).

Table 4 Cont.

Equations	Test statistic & diagnostic checking
Model with disaggregated IAD components and price as independent variables : C=Malaysia; d=Singapore, k=5 The ARDL Bound regression: D(LMSMI) = 1.71 + 0.26 D(LMSMI(-1))*** + 0.08 D(LMSMI(-2)) -0.20 D(LMSMI(-3))** + 0.70 D(LHCW)*** + 1.03 D(LFCIW)*** -0.24 D(LFCIW(-1))** -0.34 D(LFCIW(-2))*** -0.36 D(LFCIW(-3))*** + 0.89 D(LGCW)*** + 0.51 D(LEXPORTW)*** + 0.12 D(LEXPORTW(-1))* + 0.23 D(LEXPORTW(-2))*** + 0.62 D(LPMS)*** -0.24 D(LPMS(-1)) -0.71 D(LPMS(-2))*** -0.24 D(LPMS(-3))** -0.08 D2012 -0.15 LHCW(-1)** + 0.44 LFCIW(-1)*** + 0.38 LGCW(-1)* -0.64 LEXPORTW(-1)*** + 0.27 LPMS(-1) -0.18 LMSMI(-1)***	F-statistic = 21.69*** t-statistic (lagged DV) = 3.73** F-statistic (lagged IDV) = 2.51 N = 42 R2 = 0.99 ECMt-1 = -0.18*** LM(2)=0.25 JB = 3.27
Model with IAD and price as independent variables : C=Malaysia; d=Thailand, k=2 The ARDL Bound regression: D(LMTMI) = 0.63 + 0.33 D(LMTMI(-1))** + 0.01 D(LMTMI(-2)) + 0.18 D(LMTMI(-3)) -0.43 D(LMTMI(-4))** + 1.21 D(LIAD)*** -0.56 D(LIAD(-1))** + 0.38 D(LIAD(-2)) -0.28 D(LIAD(-3)) + 0.65 D(LIAD(-4))** -0.20 D(LIAD(-5)) -0.15 D1986 -0.37 D1996*** + 0.01 LIAD(-1) -0.10 LPMT(-1) -0.05 LMTMI(-1)	F-statistic = 3.95* t-statistic (lagged DV) = 2.28 F-statistic (lagged IDV) = 5.1* N = 40 R2 = 0.90 ECMt-1 = -0.07 LM(2) = 0.44 JB = 1.79
Model with disaggregated IAD components and price as independent variables : C=Malaysia; d=Thailand, k=5 The ARDL Bound regression: D(LMTMI) = -4.56** + 0.27 D(LMTMI(-1))** -0.01 D(LMTMI(-2)) + 0.06 D(LMTMI(-3)) + 1.13 D(LHCW)*** + 1.35 D(LFCIW)*** -0.62 D(LFCIW(-1))*** -0.62 D(LFCIW(-2))*** -0.62 D(LFCIW(-3))*** + 1.52 D(LGCW)*** + 0.84 D(LEXPORTW)*** + 0.41 D(LEXPORTW(-1))** + 0.28 D(LEXPORTW(-2))** + 0.26 D(LEXPORTW(-3))** -0.40 D(LPMT) + 0.85 D(LPMT(-1))* + 0.83 D(LPMT(-2))** -0.19 D2011* + 0.34LHCW(-1)** + 1.11LFCIW(-1)*** + 1.26LGCW(-1)*** -0.62 LEXPORTW(-1)*** -1.83 LPMT(-1)*** -0.56 LMTMI(-1)***	F-statistic: 18.83*** t-statistic (lagged DV) = 3.15* F-statistic (lagged IDV) = 6.45*** N = 42 R2 = 0.97 ECMt-1 = -0.56*** LM(2) =0.04 JB =2.00
Model with IAD and price as independent variables : C=Singapore; d=Indonesia, k= 2 The ARDL Bound regression: D(LMIMI) = -1.44 + 0.36 D(LMIMI(-1))** -0.13 D(LMIMI(-2)) + 0.02 D(LMIMI(-3)) -0.02 D(LMIMI(-4)) -0.04 D(LMIMI(-5)) + 0.13 D(LIAD) + 0.36 D(LPSI) + 0.08 D2011 -0.06 D1998 + 0.09 D2008 + 0.30 LIAD(-1)** -0.04 LPSI(-1) -0.26 LMIMI(-1)***	F-statistic: 4.50** t-statistic (lagged DV) = 2.40* F-statistic (lagged IDV) = 0.91 N = 40 R2 = 0.65 ECMt-1 = -0.26*** LM(2) = 0.18 JB = 0.36
Model with disaggregated IAD components and price as independent variables : C=Singapore; d=Indonesia, k=5 The ARDL Bound regression: D(LMIMI) = -1.18 -0.55 D(LMIMI(-1))*** -0.39 D(LMIMI(-2))** -0.30 D(LMIMI(-3))** + 1.00 D(LHCW)*** + 1.28 D(LHCW(-1))*** + 0.60 D(LHCW(-2))** + 1.10 D(LFCIW)*** + 0.71 D(LFCIW(-1))*** + 0.40 D(LFCIW(-2))** + 1.45 D(LGCW)*** -0.49 D(LGCW(-1))* + 1.03 D(LXW)*** + 0.65 D(LXW(-1))*** + 0.38 D(LXW(-2))** -0.05 D(LPSI) -0.26 D(LPSI(-1))* -0.08 D(LPSI(-2)) -0.47 D(LPSI(-3))** + 0.22 D2011** -0.69 LHCW(-1)* + 0.16 LFCIW(-1) + 2.02 LGCW(-1)*** + 0.20 LXW(-1) -0.17 LPSI(-1)** -0.17 LMIMI(-1)	F-statistic = 8.05*** t-statistic (lagged DV) = -4.12** F-statistic (lagged IDV) = 9.36*** N = 41 R2 = 0.96 ECMt-1 = -0.17 LM(2) = 0.27 JB =0.35
Model with IAD and price as independent variables : C=Singapore; d=Malaysia, k= 2 The ARDL Bound regression: D(LMMMI) = 0.1+ 0.54 D(LMMMI(-1))*** -0.19 D(LMMMI(-2)) + 0.02 D(LMMMI(-3)) -0.12 D(LMMMI(-4)) -0.07 D(LMMMI(-5)) + 0.20 D(LIAD)** + 0.77 D(LPSM)** -0.22 D(D1985)* + 0.21 LIAD(-1)** -0.18 LPSM(-1) -0.22 LMMMI(-1)***	F-statistic = 4.75** t-statistic (lagged DV) = 4.08** F-statistic (lagged IDV) = 6.60** N = 40 R2 = 0.76 ECMt-1 = -0.22*** LM(2) = 0.06 JB =1.27
Model with disaggregated IAD components and price as independent variables : C=Singapore; d=Malaysia, k=5 The ARDL Bound regression: D(LMMMI) = -5.52 + 1.22 D(LMMMI(-1)) + 1.32 D(LMMMI(-2))* + 0.28 D(LMMMI(-3)) -0.37 D(LMMMI(-4)) + 1.50 D(LHCW)** -1.68 D(LHCW(-1)) -1.76 D(LHCW(-2))* + 0.12 D(LHCW(-3)) + 1.08 D(LHCW(-4))** + 1.41 D(LFCIW)** -0.91 D(LFCIW(-1)) -1.19 D(LFCIW(-2))* + 0.38 D(LFCIW(-3)) + 1.15 D(LFCIW(-4))** + 1.28 D(LGCW)** + 0.54 D(LGCW(-1)) -0.18 D(LGCW(-2)) + 0.83 D(LGCW(-3)) + 1.21 D(LGCW(-4))** + 1.31 D(LXW)** -0.87 D(LXW(-1)) -1.14 D(LXW(-2))* + 0.33 D(LXW(-3)) + 1.07 D(LXW(-4))** + 0.26 D(LPSM) + 0.50 D(LPSM(-1)) -0.19 D(LPSM(-2)) -0.39 D(LPSM(-3)) -0.08 D(LPSM(-4)) -0.07 D2011 + 2.50 LHCW(-1)* + 1.36 LFCIW(-1) -1.01 LGCW(-1) +1.24 LXW(-1)** -0.97 LPSM(-1) -1.23 LMMMI(-1)**	F-statistic = 9.06*** t-statistic (lagged DV) = 2.84 F-statistic (lagged IDV) = 6.99*** N = 40 R2 = 0.76 ECMt-1 = -0.33*** LM(1) = 0.0005 JB = 2.31
Model with IAD and price as independent variables : C=Singapore; d=Thailand, k= 2 The ARDL Bound regression: D(LMTMI) = 1.30 + 0.20 D(LMTMI(-1)) + 0.21 D(LPST) + 0.76 D(LPST(-1)) + 0.63 D(LPST(-2)) + 1.26 D(LPST(-3)) -0.47 D2009** + 0.07 LIAD(-1) -0.31 LPST(-1) -0.17 LMTMI(-1)***	F-statistic = 4.95** t-statistic (lagged DV) = 1.42 F-statistic (lagged IDV) = 2.13 N = 42 R2 = 0.67 ECMt-1 = -0.22*** LM(2) = 0.51 JB =0.46

Table 4 Cont.

Equations	**Test statistic & diagnostic checking**
Model with disaggregated IAD components and price as independent variables : C=Singapore; d=Thailand, k=5 The ARDL Bound regression: D(LMTMI) = 1.29-0.56 D(LMTMI(-1))** + 1.16 D(LHCW)*** + 1.05 D(LHCW(-1))*** + 0.11 D(LHCW(-2)) -0.50 D(LHCW(-3))*** + 1.17 D(LFCIW)*** + 0.83 D(LFCIW(-1))** + 0.01 D(LFCIW(-2)) -0.44 D(LFCIW(-3))*** + 1.30 D(LGCW)*** + 0.41 D(LGCW(-1)) -0.19 D(LGCW(-2)) -0.34 D(LGCW(-3))* + 1.10 D(LXW)*** + 0.77 D(LXW(-1))** + 0.02 D(LXW(-2)) -0.41 D(LXW(-3))*** + 0.12 D(LPST) + 0.42 D(LPST(-1)) -0.17 D1993** -0.29 LHCW(-1) -0.04 LFCIW(-1) + 0.49 LGCW(-1) -0.02 LXW(-1) -0.49 LPST(-1)** -0.08 LMTMI(-1)	F-statistic = 7.51*** t-statistic (lagged DV) = -2.68 F-statistic (lagged IDV) = 4.55** N = 40 R2 = 0.97 ECMt-1 = -0.08 LM(2) = 0.10 JB =3.05
Model with IAD and price as independent variables: C=Indonesia; d=Malaysia, k=2 The ARDL Bound regression: D(LMMMI) = 2.87***+ 0.04 D(LMMMI(-1)) - 0.07D(LPIM) - 0.48D(LPIM(-1))** – 0.68D(LPIM(-2))*** – 0.52D(LPIM(-3))* – 0.54D(LPIM(-4))** + 0.01D(LIAD) + 0.02D(LIAD(-1))** + 0.02D(LIAD(-2))** – 0.06D1982 - 0.17D1997 - 0.32D2009** + 0.18 LPIM(-1)* - 0.01 LIAD(-1**) - 0.16LMMMI(-1)***	F-statistic = 6.59*** t-statistic (lagged DV) = 0.31 F-statistic (lagged IDV) = 4.47** N = 41 R2 = 0.75 ECMt-1 = -0.16*** LM(2) = 0.03 JB = 0.53
Model with disaggregated IAD components and price as independent variables : C=Indonesia; d=Malaysia, k=5 The ARDL Bound regression: D(LMMMI) = 3.63*** + 0.72 D(LGCW)* +0.07 D(LFCIW)* +0.01 D(LFCIW(-1)) + 0.03 D(LFCIW(-2))*** + 0.08+ D2011 + 0.07 LPIM(-1) -0.02 LHCW(-1) + 0.74LGCW(-1)** + 0.04 LFCIW(-1) + 0.002LXW(-1) – 0.26LMMMI(-1)***	F-statistic = 23.65*** t-statistic (lagged DV) = 1.78 F-statistic (lagged IDV) = 0.43 N =43 R2 = 0.84 ECMt-1 = -0.28*** LM(2) = 0.96 JB = 2.19
Model with IAD and price as independent variables : C=Indonesia; d=Singapore, k=2 The ARDL Bound regression: D(LMSMI) = 2.49*** + 0.39D(LMSMI(-1))*** + 0.01 D(LIAD) - 0.43D(LPIS)** - 0.21 D1985 + 0.001LIAD(-1) + 0.14LPIS(-1)*** - 0.16LMSMI(-1)***	F-statistic =16.31*** t-statistic (lagged DV) = 4.34** F-statistic (lagged IDV) = 3.04 N = 44 R2 = 0.83 ECMt-1 = -0.16*** LM(2) = 0.26 JB = 1.30
Model with disaggregated IAD components and price as independent variables : C=Indonesia; d=Singapore, k=5 The ARDL Bound regression: D(LMSMI) = 0.1D(LMSMI(-1)) + 0.02D(LMSMI(-2)) - 0.25D(LMSMI(-3))** – 0.26D(LPIS) - 0.06D(LPIS(-1)) - 0.06D(LPIS(-2)) – 0.43D(LPIS(-3))** + 0.37D(LCW)*** - 0.03D(LCW(-1)) - 0.11D(LCW(-2)) + 0.18D(LCW(-3))* + 1.01D(LGW)** + 0.33D(LIW)*** - 0.01D(LIW(-1)) - 0.04D(LIW(-2)) + 0.12D(LIW(-3))* + 0.06D(LXW)** -0.03D(LXW(-1)) + 0.02 D2012 + 2.19 + 0.09LPIS(-1) + 0.26LCW(-1) + 0.51LGW(-1) + 0.20LIW(-1) + 0.06LXW(-1) - 0.37LMSMI(-1)***	F-statistic = 4.31** t-statistic (lagged DV) = 0.53 F-statistic (lagged IDV) = 3.69* N = 42 R2 = 0.95 ECMt-1 = -0.37*** LM(1)=0.12 JB = 0.31
Model with IAD and price as independent variables : C=Indonesia; d=Thailand, k=2 The ARDL Bound regression: D(LMTMI) = 0.41 D(LMTMI(-1))*** - 0.67 D(LPIT)** -0.02 D1984 + 2.07 *** - 0.01LIAD(-1) - 0.12 LMTMI(-1)***	F-statistic = 6.28*** t-statistic (lagged DV) = 3.53* F-statistic (lagged IDV) = 0.08 N = 44 R2 = 0.61 ECMt-1 = -0.13*** LM(2) = 0.02 JB =1.23
Model with disaggregated IAD components and price as independent variables : C=Indonesia; d=Thailand, k=5 The ARDL Bound regression: D(LMTMI) = - 0.35 + 0.31 D(LMTMI(-1))* - 0.55 D(LPIT)** + 0.23 D(LPIT(-1)) + 0.52 D(LHCW)*** - 0.08 D(LHCW(-1)) + 0.22 D(LGCW) - 0.82 D(LGCW(-1))* + 0.36 D(LFCIW)** - 0.12 D(LFCIW(-1)) + 0.07 D(LXW)* - 0.03 D(LXW(-1)) - 0.21 D2014 - 0.21 D2009 - 0.01 D1997 + 0.14 LPIT(-1) + 0.24 LHCW(-1) - 0.23 LGCW(-1) + 0.13 LFCIW(-1) + 0.05 LXW(-1) - 0.17 LMTMI(-1)	F-statistic = 1.26 t-statistic (lagged DV) = 1.98 F-statistic (lagged IDV) = 0.89 N = 44 R2 = 0.85 ECMt-1 = -0.17 LM(2) =0.41 JB = 0.20
Model with IAD and price as independent variables : C=Thailand; d=Indonesia, k=2	F-statistic = 4.32 t-statistic (lagged DV) = 3.42 F-statistic (lagged IDV) = 1.29 N = 42 R2 = 0.72 ECMt-1 = -0.13 LM(2) = 0.16 JB = 4.98*

Table 4 Cont.

Equations	Test statistic & diagnostic checking
Model with disaggregated IAD components and price as independent variables : C=Thailand; d=Indonesia, k=5 The ARDL Bound regression: D(LMIMI) = -3.14 + 0.26 D(LMIMI(-1)) + 0.13 D(LMIMI(-2)) -0.25 D(LMIMI(-3)) + 1.48 D(LHCW)*** + 0.06 D(LHCW(-1)) -0.32 D(LHCW(-2)) + 0.33 D(LHCW(-3)) + 1.52 D(LFCIW)*** + 0.04 D(LFCIW(-1)) -0.32 D(LFCIW(-2)) + 0.37 D(LFCIW(-3)) + 0.22 D(LGCW) + 0.93 D(LGCW(-1)) + 1.78 D(LXW)*** -0.22 D(LXW(-1)) -0.34 D(LXW(-2)) + 0.56 D(LXW(-3))* + 0.21 D(LPTI) + 0.05 D2012 + 0.30 LHCW(-1)* + 0.24 LFCIW(-1) -1.30 LGCW(-1)* + 0.35 LXW(-1)* -0.11 LPTI(-1) -0.16 LMIMI(-1)	F-statistic = 3.00 t-statistic (lagged DV) = 1.31 F-statistic (lagged IDV) = 1.12 N = 42 R2 = 0.94 ECMt-1 = - 0.16 LM(2) = 0.68 JB =2.30
Model with IAD and price as independent variables : C=Thailand; d=Malaysia, k=2 The ARDL Bound regression: D(LMMMI) = 2.35** + 0.48 D(LMMMI(-1))*** - 0.30 D(LMMMI(-2))* + 0.04 D(LMMMI(-3)) -0.02 D(LMMMI(-4)) -0.23 D(LMMMI(-5))* + 0.32 D(LPTM) -0.65 D(LPTM(-1)) -0.32 D2009* +0.002 LIAD(-1) -0.61 LPTM(-1) -0.04 LMMMI(-1)**	F-statistic = 3.51 t-statistic (lagged DV) = 3.15 F-statistic (lagged IDV) = 1.47 N = 40 R2 = 0.68 ECMt-1 = - 0.05*** LM(2) = 0.79 JB = 1.35
Model with disaggregated IAD components and price as independent variables : C=Thailand; d=Malaysia, k=5 The ARDL Bound regression: D(LMMMI) = -12.06* + 0.61 D(LMMMI(-1))* + 0.66 D(LMMMI(-2))** + 1.24 D(LPTM)* -1.27 D(LPTM(-1)) -2.28 D(LPTM(-2))** -1.06 D(LPTM(-3))** + 1.15 D(LHCW)*** -1.13 D(LHCW(-1))* -0.86 D(LHCW(-2))** + 1.13 D(LFCIW)*** -1.18 D(LFCIW(-1))* -0.82 D(LFCIW(-2))** + 2.39 D(LGCW)** -2.00 D(LGCW(-1))* -3.12 D(LGCW(-2))** -1.40 D(LGCW(-3))** + 0.66 D(LXW) -0.99 D(LXW(-1))** -0.07 D(LXW(-2)) + 0.32 D(LXW(-3))** -0.35 D1988 -0.15 D2009 -0.08 D1998 + 3.04 LPTM(-1)** + 0.53 LHCW(-1)* + 0.51 LFCIW(-1)* + 2.52 LGCW(-1)** -0.08 LXW(-1) -0.35 LMMMI(-1)**	F-statistic = 2.15 t-statistic (lagged DV) = 1.90 F-statistic (lagged IDV) = 1.81 N = 42 R2 = 0.96 ECMt-1 = -0.35** LM(2) =0.0001 JB = 0.21
Model with IAD and price as independent variables : C=Thailand; d=Singapore, k=2 The ARDL Bound regression: D(LMSMI) = 0.92 + 0.39 D(LMSMI(-1))** + 0.01 D(LIAD) + 0.02 D(LIAD(-1)) -0.95 D(LPTS)* -0.85 D(LPTS(-1)) -0.40 D2009** -0.01 LIAD(-1) -0.01 LPTS(-1) -0.02 LMSMI(-1)	F-statistic = 2.55 t-statistic (lagged DV) = 2.88 F-statistic (lagged IDV) = 1.74 N = 44 R2 = 0.59 ECMt-1 = -0.02 LM(2) = 0.36 JB =0.06
Model with disaggregated IAD components and price as independent variables : C=Thailand; d=Singapore, k=5 The ARDL Bound regression: D(LMSMI) = -0.13 + 0.22 D(LMSMI(-1))** + 0.97D(LHCW)*** + 1.003 D(LFCIW)*** -0.04 D(LFCIW(-1))** + 0.0002 D(LFCIW(-2)) + 0.001 D(LFCIW(-3))*** + 1.50 D(LGCW)** + 0.87 D(LXW)*** -0.21 D(LXW(-1))** + 0.10 D1997 -0.11 D2009 + 0.08 LPTS(-1) + 0.05 LHCW(-1) + 0.06 LFCIW(-1) -0.06 LGCW(-1) +0.11 LXW(-1) -0.07 LMSMI(-1)	F-statistic = 5.84 t-statistic (lagged DV) = 2.18 F-statistic (lagged IDV) = 4.36 N = 42 R2 = 0.93 ECMt-1 = -0.06 LM(2) = 0.98 JB =0.44

Notes: Critical values for the bounds F-test are extracted from Narayan (2005a). ***, ** and * indicate significance levels at the 1%, 5%, and 10%, respectively. $F_{overall}$ denotes the F-statstic for the null hypothesis 1 and the null hypothesis 4. T_{DV} denotes the t-statistic for the null hypothesis 2 and the null hypothesis 5. F_{IDV} denotes the t-statistic for the null hypothesis 3 and the null hypothesis 6. Dummy variable D#### is specified as one at the particular year #### and zero otherwise. For instance, D95 is specified as 1 at year 1995 and 0 for other years. Dummy variable is added based on the plot of model residual. N is the sample size. LM(2) denotes the Prob. Chi-Square of Breusch-Godfrey Lagrange Multiplier test statistic at lag 2, JB indicates Jarque-Bera statistic for normality test. The values in parentheses indicate p values. Dummy variables D#### are defined as one at the specific year #### and zero otherwise.

Empirical Results for Individual Country

a) Malaysia

Co-integrated relationships were only found between disaggregated Malaysia's IAD and intermediate imports from Indonesia and Thailand. This result suggests diversity in Malaysia's trade relationships with ASEAN-3. Specifically, Malaysia's private sector investment has positive impact on intermediate imports from Thailand in both short run and long run. From Table 4, one per cent increase in investment spending would increase the intermediate imports from Thailand by 1.35% and 1.11% in short run and long run, respectively. As expected private sector investment is positively related to intermediate imports in the value chain. Moreover, the coefficient is elastic suggesting a greater change in intermediate imports from Thailand than private sector investment, in both, short run and long run. Meanwhile, the coefficient of export is positive and inelastic in the short run. This implies that a higher export of Malaysia would induce export of intermediates from Thailand to Malaysia (intermediate import) but less than one per cent. However, the coefficient becomes negative in the long run, possibly due to the effectiveness of import substitution policy in Malaysia in the long run. Meanwhile, Malaysia's government spending and household spending also have positive impact on intermediate imports from Thailand. The coefficient of government spending seems to have a greater impact on the intermediate imports implying a significant role of Malaysian government in intermediates trade between Malaysia and Thailand.

Similar result was found in Malaysia-Indonesia model. Table 4 shows that all disaggregated IAD of Malaysia which includes household spending (1.21), private sector spending (1.2), government spending (1.96) and export (0.83) are positively related to intermediate imports from Indonesia in the short run. However, the long run coefficients for all the diasaggregated IAD (household spending (0.06), private sector spending (0.4), government spending (0.41) and export (-0.33)) are inelastic and negative compared to the short run. This implies a relatively stickiness of intermediate imports from Indonesia in the long run. The inconsistent sign of export implies a complementary relationship between intermediates from Indonesia and Malaysia's export in the short run (positive) and a substitutability relationship in the long run (negative).

Moreover, the relative import price is negative and inelastic in the long run in all models for Malaysia suggesting a relatively insignificant role of relative import price in affecting the intermediate imports. For example, one per cent decrease in intermediate price would lead to less than one per cent increase in the intermediate imports. On the other hand, Malaysia's aggregated IAD is found to be positive and significant to the imported intermediate from ASEAN-3. A positive relationship means that an increase in Malaysia's final demand would increase the intermediate imports from ASEAN-3. The error term (ECM_{t-1}) is negative and significant in all models except for Malaysia-Thailand model at aggregated level. All models are normally distributed based on Jarque-Bera statistic. Some models are serially correlated such as Malaysia-Indonesia at disaggregated level due to insufficient number of lags.

b) Singapore

Cointegration were found between Singapore's IAD and intermediate imports from Malaysia, and between Singapore's disaggregated IAD and intermediate imports from Indonesia. Specifically, the final demand of Singapore (LIAD) has relatively consistent positive impact on intermediate imports from Malaysia which is 0.20 in the short run and 0.21 in the long run. This implies a positive relationship between final demand in Singapore and intermediate imports from Malaysia. For disaggregated result, the household spending (2.5) has greatest impact on intermediate imports from Malaysia followed by private sector investment (1.36) and export (1.24). Despite of having no cointegration in the disaggregated models; individual coefficients are significant. Meanwhile, the relative import price is positively related to intermediate imports from Malaysia in the short run (0.77) but negative in the long run (-0.18). This indicates an insignificant role of relative import price in increasing intermediate imports.

On the other hand, positive relationship were found between Singapore's disaggregated IAD and intermediate imports from Indonesia, whereby government spending (1.45), private sector investment (1.10), export (1.03), and household spending (0.997), are all significant in the short run. Moreover, the coefficient of government spending is 2.02 in the long run while export is 0.20. This finding shows that Singapore's government spending has greatest impact on intermediate imports from Indonesia. It also implies that intermediate imports from Indonesia is more related to Singapore's domestic demand than foreign demand (export). Moreover, relative import price is negative and inelastic in the short run (-0.05) and long run (-0.17).

Table 4 also reports that the error term (ECM_{t-1}) is negative and significant in all Singapore's models. The Jarque-Bera statistic suggests that all models are normally distributed. Likewise, serial correlation occurs in Singapore-Malaysia (disaggregated) model due to insufficient number of lags. There is no co-integrating relationship found between Singapore's final demand and intermediate imports from Thailand based on ARDL Bound test.

c) Indonesia

The ARDL Bound test finding reveals that no co-integration between Indonesia final demand and intermediate imports from ASEAN-3. However, some individual coefficients are significant at disaggregated level. For example, Indonesia household spending is significant to the intermediate imports from Singapore (0.37) and Thailand (0.52). Indonesia private sector investment is also significant to the intermediates from Singapore (0.33). The error term (ECM_{t-1}) is negative and significant in all models except Indonesia-Thailand at disaggregated level. The models are free from serial correlation (except Indonesia-Malaysia and Indonesia-

Thailand at aggregated level) according to Breusch– Godfrey, LM test and normally distributed based on the Jarque-Bera test **(**Table 4).

d) Thailand

There is no co-integration found between Thailand's final demand and intermediate imports from ASEAN-3. However, individual coefficient for household spending, private sector investment, government spending, and export are significant in the short run. Specifically, Thailand's export (1.78) has greater impact on intermediate imports from Indonesia in the short run while Thailand government spending has greater impact on intermediate imports from Malaysia in both short run (2.39) and long run (2.52). Moreover, it is found that relative import price has no significant role in determining the intermediate imports in Thailand. The error term (ECM_{t-1}) is negative and significant in all models except for Thailand- Singapore and Thailand-Indonesia (at disaggregated level). The diagnostic check suggests that all models are normally distributed (except Thailand-Indonesia at aggregated level) and no serial correlation (except Thailand-Malaysia at disaggregated level).

CONCLUSION

This study is motivated by the need for an empirical analysis to examine the changes in the regional final demand on intermediate imports among ASEAN-4. The emergence of GVCs has caused a more integrated international trade environment and brought several changes in a country's international trade strategies. GVCs has also triggered the importance of import in intermediate goods which might have implication on the trade performances and economic growth. The present study provides evidence that a change in intermediate imports to Malaysia or Singapore from ASEAN-3 is due to the increase in these two countries' final demand implying occurance of regional value chains relationship. Specifically, the disaggregated final demand results show that export, private sector investment spending, household consumption and government spending have positive impact on the intermediate imports. This finding provides evidence and support for more integrated value chain cooperation among the ASEAN-4 countries.

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