Journal of Economic Integration
Vol. 39, No. 2, June 2024, 483-507
https://doi.org/10.11130/jei.2024017

pISSN: 1225-651X eISSN: 1976-5525

Financial Openness and Trade (Real) Openness: Should We Open Up Both Markets?

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Abstract This study examines the 'interdependence' between financial openness and trade (real) openness, as well as the macroeconomic determinants of such relationship from a general equilibrium perspective (viz. the balance of payments constraint). The macroeconomics factors are national income, exchange rate, and interest rate. The data cover 124 countries over a period spanning between 1970 and 2019. The 'interdependence' between financial and trade openness is captured by a positive Pearson correlation in most of the countries (i.e. between 60% and 79% of the countries). However, a more precise measure of a bidirectional causality between both openness exists in only 35% (44 countries) of 124 countries. The empirical results show that exchange rate explains negatively the estimated correlation coefficients between financial and trade openness, as well as for low income countries. While, the interest rate increases the likelihood of their bidirectional causality results. This study provides policy insights related to both the financial and real markets.

Keywords: causality, financial openness, interdependence, real sector, trade openness

JEL Classifications: E44, F41, G15

Received 5 March 2024, Revised 15 April 2024, Accepted 19 April 2024

I. Introduction

Open economy macroeconomics divides openness into two dimensions: openness in financial markets and in real (goods and services) market.[1)] In general, financial openness involves removing impediments (or less favorable treatment) to cross-border flow of capital and financial services,

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while openness in trade (real market) pertains to removing trade restrictions to the outward or inward orientation of a country. The simultaneous openness hypothesis advocated by Rajan and Zingales (2003) in their seminal paper, emphasizes the importance of concurrently open up both financial and real (trade) markets to encourage domestic firms to access external finance, and accelerate financial development. Accordingly, trade and financial openness are complements, and in the sequencing process of financial liberalization suggests implementing trade openness before financial openness. While, neo-classical theories predict that openness in both financial and trade markets are momentous for channeling economic resources into productive activities across countries. As financial markets open up, real markets experience an increase in production and higher capital mobility, leading to the need for greater trade (real market) openness. Conversely, openness in trade markets breeds competition, and encourages firms to seek cost-effective capital to remain competitive and efficient in production. If domestic capital is costly due to high interest rates, financial markets openness becomes a way to elicit competitive external capital for financing domestic investment activities (Rajan & Zingales, 2003; Ashraf et al., 2021). Indeed, openness in both markets can be influenced by various public finance and political-economic factors (Aizenman, 2008; Aizenman & Noy, 2009).[2)]

In general, the cross-border flow of capital and commercial trade is the outcome of openness in both financial and real markets (Aizenman, 2008; Aizenman & Noy, 2009), signifying an interdependence (more formally, interconnectedness) between financial markets openness and trade (real market) openness. Aizenman and Noy (2009, p.197) strengthens that "... *in an era of rapidly growing trade integration, countries cannot choose financial openness independently of their degree of openness to trade*". Empirical studies like Karimu and Marbuah (2017), Aluko and Ajayi (2018), Zhang et al. (2020), and Ashraf et al. (2021) suggest that financial and trade openness complement each other in relation to financial development. Financial openness can impact trade openness, and *vice versa* via demand side and supply side channels. Bos et al. (2020) emphasize that opening up the trade (real market) stimulates domestic demand for financial flows, and encourages foreign direct investment for export-orientated sectors. Firms access external funds from financial institutions such as banks and stock markets, leading to increased financial flows through financial openness. Financial openness proliferates risk-sharing and creates efficient resource allocation in exportable goods sectors with a comparative advantage, thus improving trading opportunities. Perhaps, the production specialization further perpetuates host countries to embrace

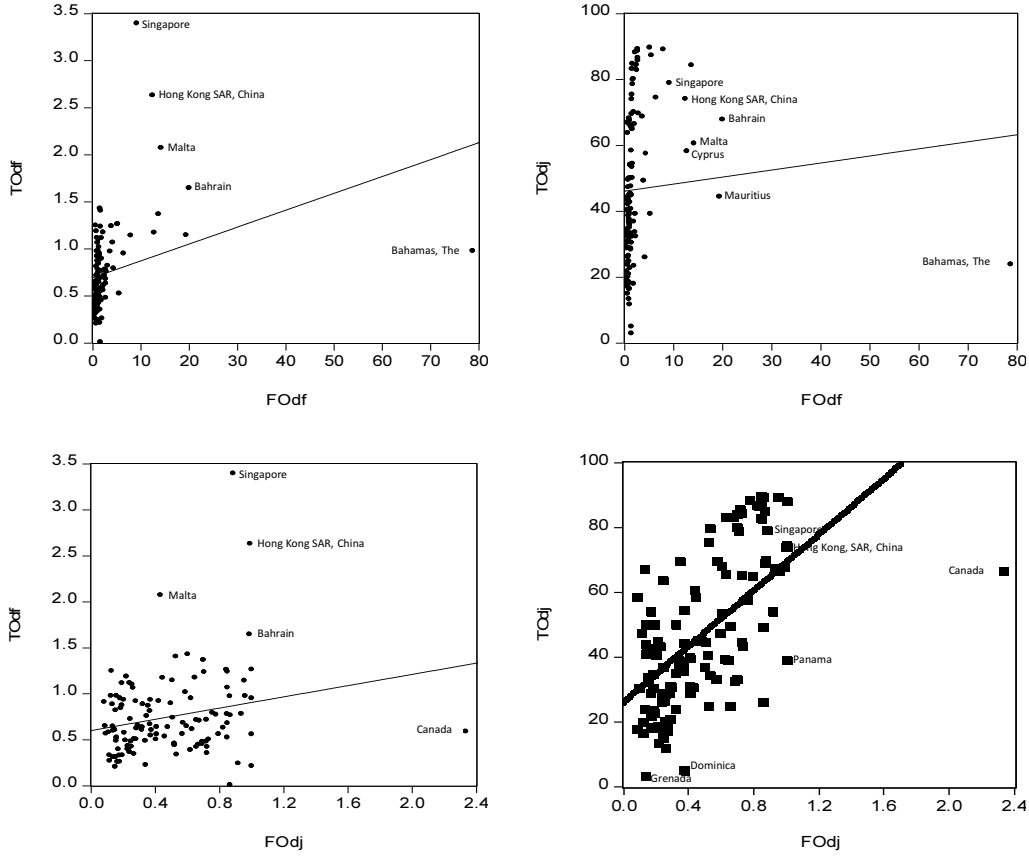
1) This study considers openness to be applied interchangeably to either liberalization, integration, or globalisation in the literature.

2) Aizenman (2008) conjectures financial repression reduces the cost of public debts could impetus capital flights (financial openness) abreast with greater trade openness that provides more opportunities for capital flight through over-invoicing imports and under-invoicing exports. Aizenman and Noy (2009) claim that consumers' welfare-oriented policymakers reduce the likelihood of financial repression whereas extractive type policymakers yield a mixed outcome in capital flight and financial repression.

greater trade openness with their trading partners. Kohli and Wattleworth (2006) further discussed potential channels through which financial and trade openness are mutually interdependent.

Are both financial and trade openness positively correlated? Figure 1 illustrates visually the correlation between of financial and trade openness in 124 sample countries. Both *de facto* and *de jure* measures of trade openness are correlated positively with *de jure* financial openness, with a few extreme outliers. When these outliers are ignored, there is no correlation between both openness resulting in a vertical line skewed to left, indicating low financial openness (i.e., *de factor measures*). After removing the outliers, Figure 2 demonstrates a relatively stronger correlation between financial openness (FO_{df}) and trade openness (TO_{dj}). That is higher financial openness is associated with greater openness in trade. In the second-row panel of Figure 1,

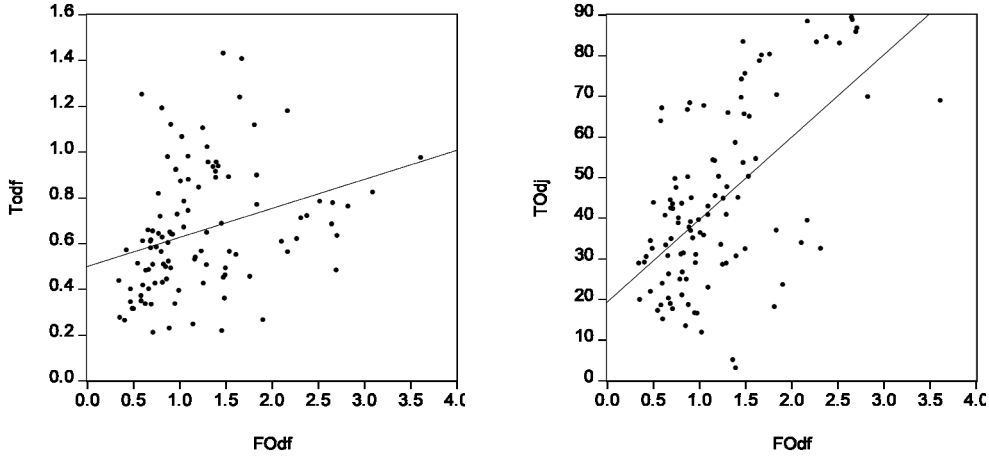
Figure 1. Scatter plots of financial and trade openness in all countries



Notes. Financial openness is measured by the period-average of the sum of assets and liability as a share of GDP, Chinn-Ito KAOPEN index whereas trade openness represents the period-average of total trade (as a percentage of GDP) and KOF Trade Globalization Index, respectively, of individual country. FOdf, FOdj, TOdf, and TOdj indicate *de facto* financial openness, *de jure* financial openness, *de facto* trade openness, and *de jure* trade openness, respectively.

a positive correlation is observed between both *de facto* and *de jure* measures of trade openness, and *de jure* measure of financial openness. *De jure* trade openness shows a higher intensity than *de facto* trade openness. Notably, some countries, such as Hong Kong and Singapore, are more open in both financial and trade markets. While, Bahamas, and Canada tend to be more financially open than in their trade markets. Such variations can be partly explained by that the International Monetary Fund (IMF) allows some member countries impose restrictions on financial flows, Article VIII prohibits all member countries from imposing restrictions on payments and transfers for current international transactions.

Figure 2. Scatter plots of financial and trade openness in all countries without outliers



The observed positive correlation between financial and trade openness raises a concern of whether both are mutually reinforcing. However, correlation has little to say about interdependence (or interconnectedness) than of their causation. Indeed, "*...In observational data, correlations are almost certainly not reflecting a causal relationship because the variables were endogenously chosen by people who were making decisions, they thought were best*." (Cunningham, 2021, p.18). That is, a positive correlation indicates that when one increases, the other tends to increase as well, and *vice versa*, while the latter is one-time series causes another (i.e., which came first, the chicken or the egg). To note that the cause happens *prior* to its effect (Granger, 1969). Therefore, simultaneous changes in financial and trade openness may merely depict a positive correlation, but they do not necessarily mean financial and trade openness are interdependent in the sense of a bidirectional Granger causality, that is a more precise measure. This study is motivated by this concern.

According to Kohli and Wattleworth (2006, pp. 38-39), financial and trade openness are mutually reinforcing due to foreign investment, reductions in the cost of capital, demand-side

effects, and supply-side effects. Aizenman (2008) claims that financial repression (i.e., a set of government regulations, laws and other non-market restrictions prevent the financial intermediaries to function at their full capacity) provides the impetus for capital flight (financial openness) in developing countries. Indeed, trade openness can facilitate illicit capital flight through trade mis-invoicing that is a money laundering mechanism. However, Aizenman's (2008, p.381) analysis isolated the impact of greater trade openness on financial openness, and overlooked the possibility of reverse feedbacks in which greater financial openness impacts trade openness. In what follows, Aizenman and Noy (2009) propose a theoretical framework illustrating two-way feedback between financial and trade openness to examine the endogenous determination of financial and trade (commercial) openness empirically. Their study suggests that increase in trade (commercial) openness is associated with an increase in *de facto* financial openness. And, an increase in *de facto* financial openness has favourable effects on future trade openness. Meanwhile, the direction of causality from financial openness to trade openness decomposes about 53% of its overall linear feedback, while 34% is from trade openness to financial openness.

Goh et al. (2019) consider the "*interconnectedness'* between both *de jure* (KAOPEN) and *de facto* (FDI flows) financial openness, and trade openness (*de facto*). They found a bidirectional causality between *de facto* financial openness and trade openness, but it is not the case for the *de jure* measure of financial openness. Such bidirectional causality is observed for different income levels, except for lower-middle income countries, where causality is from trade openness to financial openness. Nevertheless, they do not consider further the determination of such "*interconnectedness*" between financial and trade openness, systematically and empirically. From another perspective, Davis and Wincoop (2018) reveal that increased financial openness can reinforce the correlation between inflows and outflows of capital. On the other hand, greater trade openness tells different story since it reduces such correlation. Other studies have investigated the effect of openness of financial and trade markets with other macroeconomic variables such as financial development (Baltagi et al., 2009; Hanh, 2010; Zhang et al., 2015; Karimu & Marbuah, 2017; Ashraf, 2018), economic growth (Bayar, 2016; Lim & McNelis, 2016; Adeel-Farooq et al., 2017; Gabriel & David, 2021), industrial specialization (Bos et al., 2020), bank loan pricing (Ashraf et al., 2021), and real exchange rate volatility (César & Megumi, 2018).[3)]

The financial and trade openness interdependence is crucial, particularly to test the so-called simultaneous openness hypothesis, and liberalization initiatives. Previous studies have considered to investigate the causality between both (financial and trade) openness, and macroeconomic factors (Goh et al., 2019), and the effect of trade openness on financial openness (Aizenman & Noy, 2009). However, they do not systematically look at the "*interdependentness*" between financial and trade openness, especially the macroeconomic determinants of such interdependent. As inspired by Albanesi (2007) and Davis and Wincoop (2018), this study aims to examine

3) A summary of 16 past related studies is available from the corresponding author upon request.

the 'interdependence' (or interconnectedness) between financial openness and trade (real market) openness, along with its macroeconomic variables using global data of 124 countries for the period between 1970 and 2019. This study uses the balance of payments (BoP) constraint approach from a general equilibrium perspective, to identify systematically three macroeconomic variables, namely income, exchange rate, and interest rate.

This study contributes to the existing literature by mainly discovering a positive correlation coefficient between financial and trade openness in between 60% and 79% of the 124 sample countries based on both *de jure* and/or *de facto* measures of financial and trade openness, respectively. It is crucial to note that the tandem move of global financial and trade flows may or may not depict the correlation either positive or negative between financial and trade openness in specific countries. This study complements the works by Aizenman (2008), and Aizenman and Noy (2009) on the interdependence of financial and real markets with a bidirectional Granger non-causality between financial and trade openness in 44 countries (or 35% of the sample countries). Also, different income groups such as high, upper-middle, lower-middle-, and low-income groups, yield different findings for both correlation and causality findings. Lastly, the macroeconomic determination of financial and trade openness interdependence that the exchange rate explaining the positive correlation coefficient between financial and trade openness, while interest rate has a favour implication on the likelihood of bidirectional causality. Income, on the other hand, is found to be insignificant.

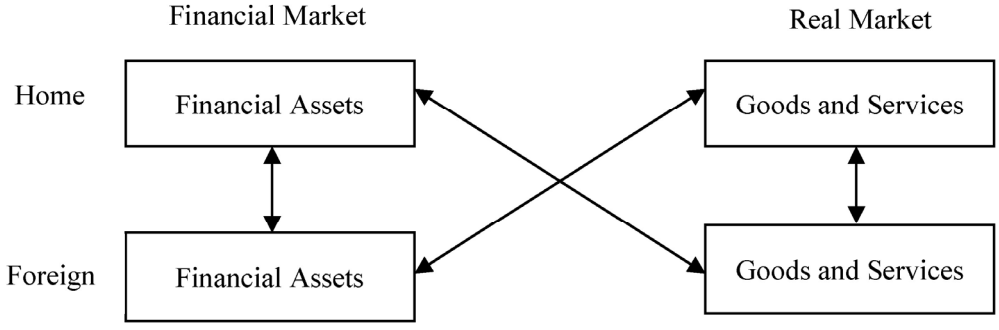
The organization of this study is as follows. Section 2 presents the conceptual framework, variables, and data, including also both computed test statistics of correlation and Granger non-causality tests between financial and trade markets openness. The empirical results are reported and their findings discussed in Section 3. Finally, Section 4 concludes this study.

II. Conceptual Framework, Data, and Methods of Analysis

An open economy framework as shown in Figure 3, Krugman et al. (2012) outline three types of market transactions involving between the real market (goods and services) and financial market (financial assets) by home and foreign participants (countries). Within each market, two exchanges involve transactions between home and foreign participants for similar either goods and services, or financial assets. Financial assets exchange for financial assets between home and foreign participants, while goods and services buy goods and services. The third market transaction is the exchange between goods and services, and financial assets by home and foreign participants. Such [real] cross-markets transaction informs the interdependence between financial market, and real market. The inter-temporal model by Obstfeld and Rogoff (1995) further explains that at any period, a country engages in inter-temporal trade by exchanging assets for

goods and services. In the relation of BoP, when a country opens up (liberalizes) her financial markets, the country's current account (trade) deficits can be financed by capital inflows via selling financial assets and/or - borrowing from abroad. Symmetrically, a country's current account (trade) surpluses can be allocated to finance the financial account deficits. In view of such financial and real markets interdependence, opening up both the financial and trade markets simultaneously is *necessary condition* in order to facilitate Krugman et al.'s (2012) third type market transition; that is the free flow (exchange) between goods and services, and financial assets by home and foreign participants. Such cross-broader transactions are restricted if one market is relatively isolated, or in a state of autarky compared to the other market.

Figure 3. Conceptual relationships between financial market and real market of home and foreign participants (countries)



(Source) Adapted from the framework of "Three Types of International Transaction," Krugman et al. (Figure 21-1, 2012, p. 588)

In addition, the macroeconomic variables explaining the interdependence between financial and trade (real market) openness can be identified (derived) from Fausten's (1989/1990) seminal work on the financial account and current account interdependence, which is built of BoP framework.[4] Considering the BoP constraint from a general equilibrium perspective which is an accounting identity informs that the sum of current account (CA) balance, financial account (FA) balance (which might include capital account, KA if available), changes in international reserves (ΔIR), and balancing item (ΔBI, or net errors and omissions) must equal to zero: $BoP=CA+FA+\Delta IR+\Delta BI=0$. The BoP constraint does capture systematically the interdependence between trade (current account) and financial markets (financial account) as well as the

4) Tang and Fausten (2012) examine empirically the interdependence between the current and financial cross-border transaction flows and provide reasonably robust empirical evidence of current and capital account interdependence for five developing countries (Argentina, Mexico, Indonesia, South Korea, Thailand); and four developed countries (the U.S., the U.K., Germany and Japan). Tang (2015) proposes an alternative analytical framework for twin deficits hypothesis from the general equilibrium perspective and applies for the U.S. data. Another study by Tang (2018) considers the financial sector on the real sector; that is aggregate import demand function.

macroeconomic variables explaining their behaviour. It is conventionally to assume that ΔIR is negligible or constant, and ΔBI is zero by assuming that all cross-broader transactions are accurately and completely recorded in the double-entry book keeping of BoP. Re-writing the BoP constraint equation, yielding $CA + FA = 0$ or $CA = -FA$. This 'simplified' version informs that both current account and financial account of BoP are interdependence. As shown, a dollar of deficit in financial account (market), is to be financed by a dollar of current account (real market) surplus, and *vice versa.*

However, such equation does not capture the macroeconomic variables determining the behaviour of CA and FA without considering their respective behaviour relations, i.e. $CA(.)$ and $FA(.)$. In such, the BoP constraint can be rewritten as $CA(.) = -FA(.)$. Following Brooks and Fausten (1998), in a conventional view that the behaviour of CA is determined by domestic income (y), exchange rate (e)[5], and income from the rest of the world (y^*). Higher domestic income, and exchange rate (i.e. depreciation of home currency) induce expenditure on foreign-produced goods and services, leading to deterioration in the current account position. On the other hand, higher foreign national income (y^*), is expected to increase exports of domestically produced goods and services due to higher foreign purchasing power. By the same token, the FA behaviour is determined by the domestic interest rate (r) and interest rate of the rest of the world (r^*). A high domestic interest rate offering higher returns on domestic asset holdings, attracts foreign capital inflows, strengthening the financial account position. Conversely, foreign interest rate changes may trigger capital outflows leading to a weakening of the financial accounts. By embedding these macroeconomic variables into the behavioural relations $CA(.)$ and $FA(.)$ yields the equation (1):

$$CA(y^{(-)},\ e^{(-)},\ y^{*(+)}) = -FA(r^{(+)},\ r^{*(-)}) \tag{1}$$

The superscripts represent their expected signs. Such interactions between financial and real markets intuitively requires openness in both markets. In other words, transactions in both CA and FA are fully facilitated by their respective degree of openness. Trade liberalisation promotes cross-broader transactions of goods and services with exchanges of financial assets, and *vice versa.* Hence, the macroeconomic variables those determining CA and FA behaviours also affect their openness with a baseline assumption that *openness comes before transactions.* This *necessary condition* considers both behavioural relations $CA(.)$ and $FA(.)$ are in the state being dependent upon one another. Hence, the macroeconomic variables from both CA and FA behavioural relations also determine their *interdependentness.*

The data consider 124 countries for the period spanning between 1970 and 2019. Appendix

5) That is the number of units of domestic currency required to purchase one unit of a foreign currency.

I is a list of countries grouped by their income levels, namely high-income (43 countries), upper-middle-income (36 countries), lower-middle-income (29 countries), and low-income (16 countries) based on their classification by the World Bank. Two measures of financial openness are employed for comprehensiveness viz. *de facto* (quantity-based) and *de jure* (rule-based). *De facto* financial openness measures the effectiveness or enforcement of financial markets related regulations and is used by Prasad et al. (2003), Aizenman (2008), and Hanh (2010). It is the sum of total assets and liabilities as a share of GDP and is available from Lane and Milesi-Ferretti (2018). While, *de jure* measure (KAOPEN index) is binary dummy variable of codifying the tabulation of restrictions on cross-border financial transactions reported in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).* The initial KAOPEN index data are normalized with values ranging between 0 and 1 for comparison purpose where a value approaching 1 indicates perfect (full) openness in the financial markets, and *vice versa*. This study also considers both *de facto* and *de jure* trade openness measures. The *de facto* measure of trade openness (TO_{df}) is conventionally employed in the past studies, that is the sum of exports and imports as a percentage of GDP. Indeed, the *de jure* trade openness (TO_{dj}) is a composite index that measures globalization along the economic, social and political dimension for almost every country in the world on a scale of 1 (least) to 100 (most globalized). It is available from the KOF Globalization Index database (Dreher, 2006; Gygli et al., 2019)

Table 1 describes the variables employed in this study as from equation (1). In addition to both financial and trade openness variables, there are three explanatory variables namely, income, exchange rate, and interest rate. These explanatory variables are essential in explaining the interdependence between financial and trade openness as proxied by a positive correlation, and a bidirectional causality between financial and trade openness.[6] In this empirical setup, foreign income (y^*) and foreign interest rate (r^*) as illustrated in equation (1) are excluded due to their exogenous nature i.e., one data series for all the countries. It is estimable for time series model, but not applicable for cross sectional analysis as in this study that 124 observations [countries] with individual values for financial and trade openness interdependence, and macroeconomic variables. While foreign income and foreign interest rate values remain constant for all countries. Table 2 provides a summary statistics of the variables offering a better understanding of the data central tendency, distributions and variations.

6) Past studies related to financial markets openness utilise the KAOPEN index (Chinn and Ito, 2006), a *de jure* measure of financial openness since it addresses the shortfalls *de jure* measures (Quinn, 1997, 2003; Johnston & Tamirisa, 1998; Miniane, 2004). Similarly, along with the realized trade flows i.e. *de facto* measure of trade openness, the *de jure* measure of trade openness is used in extant literature to capture government regulations and restrictions on a country's international trade flows. Most of these *de jure* trade openness indexes are developed based on the reports submitted to the International Monetary Fund (IMF), and World Bank, World Development Indicator (WDI).

Table 1. *The Variables*

Variable	Description	Source
Financial Openness:		
FOdf	A *de facto* measure that is the sum of total assets and liabilities as a share of GDP.	Lane and Milesi-Ferretti (2018).
FOdj	A *de jure measure by KAOPEN* index (Chinn and Ito, 2006) based on 4 assigned binary indicators - restriction of current account, restriction on capital account, repatriation and surrenders of trading proceeds and absence or presence of multiple exchange rates - using the first principal component analysis (PCA).	Chinn and Ito (2006).
Trade openness:		
TOdf	The sum of exports and imports of goods and services measured as a share of GDP, which is a *de facto measure.*	World Development Indicator, World Bank
TOdj	Trade Globalization (the KOF Globalization Index) captures trade regulations, trade taxes, tariff and trade agreements, a *de jure measure.*	Gygli et al. (2019).
Income, y	Real GDP per capita of each country i.e., nominal GDP per capita divided by GDP deflator.	World Development Indicator, World Bank
Exchange rate, e	Real effective exchange rate for which the nominal effective exchange rate (i.e. a measure of the value of a currency against a weighted average of several foreign currencies) is divided by a price deflator or index of costs. [a]	World Development Indicator, World Bank
Interest rate, r	Domestic interest rate proxies by lending interest rate after adjusted for inflation.	World Development Indicator, World Bank

Notes. *df* and *dj* denote *de facto*, and *de jure*, respectively. [a] It is noteworthy that real effective exchange rate can comprehensively measure the overall value of home currency against foreign currencies since an open economy prone to involve in cross-border financial transactions and multilateral trade. See Bahmani-Oskooee (2010) and Goswami (2011) for more discussion on the real effective exchange rate.

Table 2. *Descriptive Statistics*

	FOdf	*FOdj*	*TOdf*	*TOdj*	lny_i	lne_i	r_i
Mean	2.873	0.475	0.747	46.754	1.462	0.116	5.518
Median	1.197	0.391	0.640	42.294	0.618	0.060	4.446
Maximum	78.743	2.334	3.397	89.718	25.070	1.182	41.064
Minimum	0.352	0.082	0.011	2.960	-3.027	-0.285	-21.195
Std. Dev.	7.643	0.327	0.445	22.683	4.478	0.249	6.896
Observations	124	124	124	123	124	75	96

Notes. The descriptive statistics are based on the period-average of each variable. y_i, and e_i are transformed into natural logarithm to the base 10, *ln* to address the skewness of large values.

As noted before, two measures are employed in order to measure the financial and trade openness interdependence. First, Pearson correlation coefficient informs the correlation between financial and trade openness, in which a positive correlation indicates that higher financial openness, higher trade openness, and *vice versa*. The method is briefly outlined in Appendix II.A, Table 3 summarizes the correlation coefficient estimates. A positive correlation is commonly

found between 60.5% and 79% of all countries from the four combinations of financial and trade openness. This observation holds consistently across different income levels.[7)]

Table 3. *Pearson Correlations between Financial and Trade Openness (in percentage, %)*

	FOdf_TOdf		FOdj_TOdf		FOdf_TOdj		FOdj_TOdj	
	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative
All countries	77.419	20.968	68.548	25.807	79.032	19.355	60.484	33.065
Income levels:								
High	30.645	4.032	27.419	3.226	31.452	3.226	24.194	6.452
Upper-middle	22.581	5.645	16.129	12.097	22.581	5.645	19.355	8.871
Lower-middle	16.129	6.452	19.355	4.032	16.936	5.645	12.097	10.484
Low	8.065	4.839	6.452	6.452	8.065	4.839	5.645	7.258

Notes. The percentage is calculated based on 124 sample countries, even though correlation coefficients of some countries cannot be generated due to the unavailability of data.

The cross-section OLS regression is expressed as regression equation (2):

$$\widehat{FOTO\_CORi} = c_i + \beta_1 lny_i + \beta_2 lne_i + \beta_3 r_i \quad (2)$$

where $FOTO\_COR_i$ represents the estimated correlation coefficient between financial and trade openness in country i, with a total of 124 countries to be considered in the analysis. The independent variables, lny_i, lne_i and r_i denote home income (real GDP per capita), exchange rate (real effective exchange rate) and interest rate (real domestic interest rate), respectively, in country i. Based on the conceptual illustration before, β_1 and β_2 are expected to be negative, while β_3 is expected to be positive. Such methodology is initially inspired by Albanesi (2007) who examines the impact of distribution conflict on the positive correlation between inflation and income inequality; and the work by Davis and Wincoop (2018) which examine the effects of globalization on the correlation between capital inflows and outflows.

The second approach of measuring financial and trade openness interdependence is their bidirectional causality. Aizenman and Noy (2009), and Goh et al. (2019) have acknowledged bidirectional causality between both financial and trade openness in capturing their relationship. This study employs the) Granger non-causality tests extended by Toda and Yamamoto (1995) as their methodology briefly outlined in Appendix II.B. Table 4 presents a summary of the findings regarding their directions of causality, including both bidirectional and unidirectional causality, and categorized by income levels.[8)] It is observed that a bidirectional causality is

7) The individual country's estimated correlation coefficients are not reported here but available upon request from the corresponding author.

8) The computed statistics of the T-Y Granger non-causality tests are not reported here, but available from the

found in 44 countries (or 35%) out of 124 countries, while unidirectional causality is observed in 57 countries (or 46%), either from financial openness to trade openness, or *vice versa.* Similar patterns are observed across different income levels, with most countries showing unidirectional causality. However, for low-income group, there are 7 countries with bidirectional causality, and 6 countries with unidirectional causality.

Table 4. *Causality Patterns of Toda-Yamamoto's (1995) Granger Non-causality Tests*

	Bidirectional	Unidirectional
All countries	35.484% (44/124)	45.968% (57/124)
High income countries	12.903% (16/124)	16.129% (20/124)
	Austria, Barbados, Chile, Cyprus, Hong Kong SAR, China, Iceland, Kuwait, Malta, New Zealand, Norway, Romania, Seychelles, Slovak Republic, Spain, Sweden, and Uruguay.	FO->TO: 16 countries Australia, Bahamas, Bahrain, Belgium, Canada, Finland, Germany, Korea, Rep., Mauritius, Netherlands, Saudi Arabia, Singapore, Slovenia, Switzerland, United Kingdom, and United States TO->FO: 4 countries Denmark, France, Greece, , and Italy.
Upper-middle income countries	11.29% (14/124)	14.516% (18/124)
	Armenia, Brazil, China, Costa Rica, Dominica, Ecuador, Grenada, Guatemala, Iran Islamic Rep., Jordan, Lebanon, Libya, Paraguay, and Thailand.	FO->TO: 9 countries Argentina, Azerbaijan, Botswana, Bulgaria, Indonesia, Paraguay, South Africa, Turkey, and Venezuela. TO->FO: 9 countries Albania, Belize, Colombia, Fiji, Jamaica, Malaysia, Peru, Russian Federation, and Tonga.
Lower-middle income countries	5.645% (7/124)	10.484% (13/124)
	Cameroon, India, Kiribati, Lao PDR, Nepal, Nicaragua, and the Philippines.	FO->TO: 7 countries Bangladesh, Cabo Verde, Egypt Arab Rep., Nigeria, Tunisia, Ukraine, and Vietnam. TO->FO: 6 countries Algeria, Benin, El Salvador, Honduras, Kenya, , and Solomon Islands.
Low-income countries	5.645% (7/124)	4.839% (6/124)
	Burundi, Chad, Guinea, Madagascar, Mali, Sierra Leone, and Togo.	FO->TO: 2 countries Central African Republic, and, Sudan. TO->FO: 4 countries Burkina Faso, Gambia, Malawi, and Rwanda

Notes. The unidirectional and bidirectional causality are compiled regardless of the *de jure* or *de facto* financial openness measures used in the Toda-Yamamoto Granger non-causality test for all sample countries.

Based on the preceding causality findings, this study utilizes the binary logistic (logit) model to examine the influence of the identified macroeconomic variables on the finding of bidirectional causality that is, the likelihood of financial and trade openness interdependence. Appendix II.C briefly describes the methodology of logit model. The logit model to be empirically estimated

corresponding author upon request.

from 124 observations (countries) i is expressed as equation (3).

$$ln \frac{FOTO\_Dummyi}{1 - FOTO\_Dummyi} = \alpha_i + \beta_1 lny_i + \beta_2 lne_i + \beta_3 r_i + \mu_i \quad (3)$$

where $FOTO\_Dummy_i$ is a value of one if bidirectional causality exists between financial and trade openness, and zero otherwise. And μ_i represents the residuals. The slope coefficient (β_1, β_2 and β_3) indicate the change in the log-odds of $ln \frac{FOTO\_Dummyi}{1 - FOTO\_Dummyi}$ for each one-unit change in the macroeconomic indicator - *lny*, *lne*, or *r*. These coefficients are expected to be greater than zero. If these coefficients are positive, it suggests that the likelihood of successful bidirectional causality (i.e., *FOTO_Dummy* = 1) increases when the macroeconomic indicator(s) increase by one-unit. A positive coefficient for the macroeconomic indicator(s), when logged (i.e., *e*, *y*), is associated with an increase in the log-odds of the dependent binary variable taking the value of one (correlation exits). For instance, a positive coefficient could indicate the higher exchange rate is associated with the occurrence of the bidirectional causality.

III. Empirical Results

In this section, the estimates of equation (2) are tabulated in Table 5 for four combinations of openness variables. It looks at the impact of the macroeconomic variables on the estimated correlation between financial and trade openness. The results show that exchange rate (in this case, local currency required to exchange for one unit of foreign currency) is statistically significant at the 5% level with the expected negative sign. The estimated coefficients are ranging between -0.6 and -0.9 as for cases (1) - (4), except for case (2). This suggests that a depreciation of the exchange rate reduces the interdependence between financial and trade openness. This finding aligns with theoretical perspectives, as the exchange rate replicates the cost of asset stock and commodity flows. For example, when domestic currency depreciates, it becomes relatively more expensive to dispose of foreign asset claims needed to finance planned expenditures or holding real assets. Dou (2016) explains that exchange rate reform is crucial for achieving greater financial openness and benefiting from trade in financial services liberalization in the long-run. Other macroeconomic variables, income and interest rate are found to be statistically insignificant even at 10% level indicating that the data does not fully support the derived equation (2) of the BoP constraint from general equilibrium perspective.

Table 5. *OLS Estimates, Dependent Variable: FOTO_COR$_i$*

All countries	(1) *FOdf_TOdf*	(2) *FOdj_TOdf*	(3) *FOdf_TOdj*	(4) *FOdj_TOdj*
lny_i	0.010 (0.410)	0.016 (0.327)	-0.005 (0.722)	0.012(0.495)
lne_i	**-0.626 (0.007)*****	-0.338 (0.230)	**-0.900 (0.000)*****	**-0.697 (0.022)****
r_i	-0.006 (0.658)	-0.004 (0.681)	-0.007 (0.454)	0.004 (0.725)
Constant	0.523 (0.000)***	0.258 (0.008)***	0.587 (0.000)***	0.269 (0.009)***
Adjusted R^2	0.094	-0.009	0.200	0.077
F-statistic (p-value)	2.904 (0.043)	0.846 (0.476)	5.586 (0.002)	2.452 (0.074)
J-B normality	Normal	Normal	Normal	Normal
Breusch-Godfrey LM	1.396 (0.243)	0.625 (0.540)	0.641 (0.531)	0.630 (0.537)
Breusch-Pagan-Godfrey	0.569 (0.638)	0.354 (0.786)	0.621 (0.605)	1.232 (0.308)
Ramsey RESET	0.163 (0.688)	0.624 (0.434)	0.952 (0.334)	0.625 (0.433)
Variance Inflation Factors	Not correlated	Not correlated	Not correlated	Not correlated
No. of observations	56	53	56	53

Notes. The values of residual diagnostic test results are the F-statistic, and parentheses are p-values. ***, **, and * denote 1 percent, 5 percent, and 10 percent significance levels, respectively. Value in parentheses is p-values.

Table 6 presents the estimated equation (2) for four different income levels viz. for high, upper-middle, lower-middle, and low income countries. The results indicate that the exchange rate is statistically significant, and has a negative sign, -1 for low-income countries. However, for other income groups, none of the proposed macroeconomic variables (i.e. income and interest rate) are statistically significant at 10% level. Dennis (2001) delivers that exchange rate is a crucial macroeconomic variable for small open economies since it rigorously influences the cost of imports. Depreciation in the domestic currency precipitates higher prices of imported goods (i.e. more money flowing out), but it also stimulates demand for domestically produced goods, that is exports - more goods and services flowing out. The reported estimates of equations (1) - (4) (both in Tables 5 and 6) are relatively reasonable with a set of residual diagnostic tests like Breusch-Godfrey serial correlation LM test, Breusch-Pagan-Godfrey of heteroskedasticity test, and Jarque-Bera normality test confirm these. While, Ramsey RESET tests and variance inflation factors affirm that the estimates are free from misspecification errors and multicollinearity.

Table 6. *OLS Eby income Levels, Dependent Variable: FOTO_COR$_i$*

High	(1) *FOdf_TOdf*	(2) *FOdj_TOdf*	(3) *FOdf_TOdj*	(4) *FOdj_TOdj*
lny_i	-0.008 (0.874)	0.003 (0.959)	0.040 (0.529)	0.049 (0.388)
lne_i	-0.025 (0.966)	-0.819 (0.249)	-0.580 (0.448)	0.236 (0.734)
r_i	-0.001 (0.979)	0.007 (0.812)	-0.041 (0.202)	-0.046 (0.119)
Constant	0.823 (0.766)	4.207 (0.217)	3.134 (0.391)	0.680 (0.838)
Adjusted R^2	-0.156	-0.074	0.036	-0.007
F-statistic (p-value)	0.012 (0.998)	0.565 (0.646)	1.277 (0.311)	0.957 (0.437)
J-B normality	Non-normal	Normal	Normal	Normal
Breusch-Godfrey LM	0.795 (0.468)	0.254 (0.622)	0.274 (0.764)	0.756 (0.488)
Breusch-Pagan-Godfrey	0.171 (0.914)	0.216 (0.884)	0.132 (0.940)	0.314 (0.815)
Ramsey RESET	0.347(0.563)	0.009 (0.927)	3.467 (0.079)	0.228 (0.640)
Variance Inflation Factors	Not correlated	Not correlated	Not correlated	Not correlated
No. of observations	23	20	23	20
Upper-middle				
lny_i	0.027 (0.265)	0.019 (0.547)	-0.017 (0.488)	-0.011 (0.712)
lne_i	-0.034 (0.960)	0.594 (0.490)	-0.767 (0.270)	-1.380 (0.108)
r_i	-0.004 (0.788)	0.012 (0.492)	-0.002 (0.895)	0.010 (0.576)
Constant	0.402 (0.900)	-2.959 (0.472)	4.246 (0.205)	6.626 (0.106)
Adjusted R^2	-0.052	-0.051	-0.093	0.092
F-statistic (p-value)	0.721 (0.556)	0.725 (0.554)	0.516 (0.678)	1.573 (0.240)
J-B normality	Normal	Normal	Normal	Normal
Breusch-Godfrey LM	2.226 (0.151)	0.773 (0.484)	1.264 (0.318)	0.961(0.345)
Breusch-Pagan-Godfrey	1.314 (0.266)	1.920 (0.173)	0.205 (0.891)	0.668 (0.586)
Ramsey RESET	0.491 (0.496)	0.269 (0.613)	0.569 (0.464)	1.276 (0.279)
Variance Inflation Factors	Not correlated	Not correlated	Not correlated	Not correlated
No. of observations	18	18	18	18
Lower-middle				
lny_i	-0.006 (0.753)	-0.002 (0.928)	-0.005 (0.853)	-0.014 (0.595)
lne_i	0.069 (0.905)	-0.508 (0.466)	-0.553 (0.523)	1.294 (0.146)
r_i	-0.012 (0.543)	0.013 (0.595)	0.001 (0.981)	0.023 (0.409)
Constant	-0.042 (0.988)	2.708 (0.415)	3.025 (0.464)	-6.159 (0.145)
Adjusted R^2	-0.358	-0.376	-0.369	0.236
F-statistic (p-value)	0.298 (0.826)	0.271 (0.844)	0.281 (0.838)	1.822 (0.260)
J-B normality	Normal	Normal	Normal	Normal
Breusch-Godfrey LM	6.359 (0.065)	0.205 (0.825)	0.115 (0.896)	0.040 (0.852)
Breusch-Pagan-Godfrey	0.789 (0.550)	5.134 (0.055)	0.569 (0.659)	0.498 (0.700)
Ramsey RESET	3.062 (0.155)	0.225 (0.660)	0.141 (0.726)	0.915 (0.393)
Variance Inflation Factors	Not correlated	Not correlated	Not correlated	Not correlated
No. of observations	9	9	9	9

Table 6. *Continued*

Low				
lny_i	0.016 (0.825)	0.040 (0.800)	0.010 (0.837)	0.035 (0.722)
lne_i	0.148 (0.794)	0.283 (0.822)	**-0.972 (0.098)***	-0.272 (0.728)
r_i	-0.038 (0.233)	-0.051 (0.412)	0.002 (0.911)	0.019 (0.606)
Constant	-0.629 (0.687)	-1.426 (0.812)	4.885 (0.090)*	0.704 (0.849)
Adjusted R^2	0.058	-0.451	0.608	-0.972
F-statistic (*p*-value)	1.103 (0.508)	0.482 (0.728)	3.588 (0.226)	0.179 (0.903)
J-B normality	Normal	Normal	Normal	Normal
Breusch-Godfrey LM	0.832(0.529)	7660.819 (0.007)***	0.945 (0.509)	0.220 (0.721)
Breusch-Pagan-Godfrey	32.954 (0.030)	6.878 (0.137)	1.644 (0.400)	1.869 (0.367)
Ramsey RESET	27.560 (0.120)	0.708 (0.555)	2.395 (0.365)	0.153 (0.763)
Variance Inflation Factors	Not correlated	Not correlated	Not correlated	Not correlated
No. of observations	6	6	6	6

Table 7 tabulates the estimated binary logistic (logit) models of equation (3) about the influence of three macroeconomic variables on the likelihood of financial and trade openness interdependence. In the second column, it is observed that all three macroeconomic variables (i.e. income, exchange rate, and interest rate) are statistically insignificant at 10% level in impacting the likelihood of a bidirectional causality between financial and trade openness. Aizenman (2008) argues that financial repression, which lowers real interest rates (that is an implicit tax on domestic savings) facilities capital flight (financial openness) alongside greater trade openness. Both international capital and trade flows must take into account the cost of international transaction, partly determined by exchange rate. Hence, in the third column, only the estimates of exchange rate and interest rate are presented. Interestingly, the interest rate is statistically significant at 10% level, indicating its role in increasing the likelihood of financial and trade openness interdependence. This finding is aligned with Aizenmen's (2008) prognostication. For the different income groups, none of the macroeconomic variables including exchange rate, and interest rate, are statistically significant at 10% level. This observation holds true when considering all three macroeconomic variables simultaneously. However, it is essential to interpret these statistics with caution, as some income groups have an extremely small sample size, ranging between 9 and 17 observations. To address the lack of observations for low income countries (only 5), the estimates combine both lower-middle and low income countries. The results remain unchanged, with none of the macroeconomic variables including income, being statistically significant at 10% level. Yan and Yang (2008) mention that "*...when there is complete sterilization, foreign reserves will increase, and the current account will not be affected. Hence, no relationship can be detected between capital inflows and current account*." (p.440). This insight suggests that country-specific characteristics and domestic policy responses to capital and trade flows can play a crucial role

in nullifying the interdependence between financial and trade openness, as well as their association with the macroeconomic variables. Therefore, the impact of the macroeconomic variables in this study may not be generalizable unless country-specific characteristics are taken into account.

Table 7. *Binary Logistic (logit) Estimates of FOTO (Dependent variable, FOTO_Dummy)*

	Equation:		Income levels:			
	(1)	(2)	High	Upper-middle	Lower-middle	Lower-middle + Lower
lny_i	0.073 (0.425)					
lne_i	-0.293 (0.871)	-0.040 (0.981)	-3.573 (0.405)	5.047 (0.278)	-0.443 (0.919)	0.211 (0.213)
r_i	0.076 (0.272)	**0.100** **(0.099)***	0.192 (0.261)	0.137 (0.301)	0.140 (0.327)	0.1 (0.427)
Constant	-1.118 (0.034)**	-1.121 (0.036)**	-1.412 (0.120)	-1.452 (0.284)	-1.933 (0.186)	-1.596 (0.213)
McFadden R^2	0.081	0.069	0.104	0.118	0.131	0.067
S.E of Regression	0.484	0.483	0.496	0.527	0.485	0.506
No. of observations	42	42	17	14	9	11

Notes. The value of *FOTO_Dummy* is 1 if the bidirectional causality exists between financial and trade openness, and 0 otherwise regardless of either *de jure* or *de facto* financial openness measures. Value in parentheses is *p*-value. ** and * denote 5 percent and 10 percent significance levels, respectively. For low income countries, only 5 observations available after excluded countries with non-asymptotic distribution.

Alternatively, this study also considers additional *de facto* measures of financial openness, that is net inflows and outflows of foreign direct investment (FDI) as ratio to GDP for comprehensives. The results are documented in Appendix III. This measure has been used in prior studies (Zhang et al., 2015; Goh et al., 2019; Gabriel and David, 2021) to capture financial openness. For the baseline measure of financial and trade openness interdependence i.e. correlation coefficients, none of the three macroeconomic variables are statistically significant at the 10% level. This finding remains consistent across different income levels estimates. However, for the second measure of interdependence, it is interesting to find that exchange rate is statistically significant and has a negative impact on the likelihood of bidirectional causality between financial and trade openness. None of the macroeconomic variables are statistically significant for high income countries. Indeed, other income levels countries are incomputable their logit estimates given technical complicates such as insufficient number of observations.

IV. Concluding Remarks

This study estimates the interdependence between financial openness and trade (real market) openness across 124 countries for the period between 1970 and 2019. In most countries, there is a positive Pearson correlation between both openness by either *de jure* or *de factor* indicators, that is about between 60% and 79% of the countries. Alternatively, only 35% (44 countries) of the 124 countries exhibit a bidirectional causality between financial and trade openness. They are mostly from high- and upper-middle income countries. While, 46% (57 countries) of the countries show unidirectional causality either from financial openness to trade openness, or *vice versa.* Lastly, this study finds that exchange rate has a negative influence on the correlation coefficient between financial and trade openness, especially in the low income countries. For the second interdependence measure, higher interest rates increase the likelihood of bidirectional causality between financial and trade openness. This study further highlights that exchange rate is *necessary*, while interest rate is *sufficient* macroeconomic variables to ensure the interdependent between financial and trade openness.

Some broad policy implications are proposed here in that are to further liberalizing (opening up) both financial and trade (real) markets. Through the exchange rate policy, controlling information and market interventions to devalue the local currency can help simultaneous openness of both markets, fostering financial and economic development. Policymakers, in particular central bankers can utilize the interest rate channel to strengthen the interdependence between financial and trade openness. It also suggests the respective measures directed at diluting regulatory control over the institutional structures, instruments and activities of agents in different segments of the financial markets. For the trade related real market, it is to reduce and/or eliminate tariffs, quotas non-tariff barriers and strengthening non-tariff measures, or implementing them simultaneously can be beneficial. Indeed, country-specific policies should be formulated and implemented accordingly in accord to their income levels.

This exploration work remains imperfect. Of what has been done, the recent available database of Wang-Jahan capital account openness index (*de jure* based) can be employed for further study for comprehensives. It offers 6 aggregate openness indexes, and 12 types of assets categories for 168 countries (including 60 low-income developing countries) for the period 1996-2013.[9] Secondly, this study considers two measures - positive correlation coefficient, and

9) Available at https://www.imf.org/external/datamapper/datasets/CL It covers 6 indicators for aggregate openness - overall openness index (all asset categories), openness of capital inflows index, openness of capital outflows index, financial market openness index (equity, bond, money market, collective investment, and derivates), non-resident openness index, and resident openness index. Also, available the openness indexes by 12 asset categories, namely, equity openness index, bond openness index, money market openness index, collective investment openness index, derivative investment openness index, commercial credit openness index, guarantee openness, direct investment openness index, direct investment liquidation openness index, real estate capital transaction openness index, and personal capital transaction openness index. It also covers 6 indicators for aggregate openness - overall openness

bidirectional causality in order to capture the financial and trade openness interdependence. Indeed, other approaches can be used to more precisely indicate the degree (value) of financial and trade openness interdependence (or over time). For example, a normalized value between two values (balances) of financial and trade openness, systematically. Lastly, further study can consider a set of control variables which has been ignored in this study; also, to capture the conditional (threshold) effects the underlying (or other) variables. For instance, intuitional quality is commonly considered in development economics, but not a fashion in open economy macroeconomics. In short, further study is crucial to deliver a better understanding of the nature of "*interdependentness*" between financial and trade openness.

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index (all asset categories), openness of capital inflows index, openness of capital outflows index, financial market openness index (equity, bond, money market, collective investment, and derivates), non-resident openness index, and resident openness index.

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Appendix I.

Table A1. *List of 124 Countries*

Income levels:	Countries:
High (43 countries)	Australia, Austria, Bahamas, Bahrain, Barbados, Belgium, Canada, Chile, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong SAR, China, Iceland, Ireland, Israel, Italy, Japan, Korea, Rep., Kuwait, Malta, Mauritius, Netherlands, New Zealand, Norway, Oman, Panama, Portugal, Romania, Saudi Arabia, Seychelles, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States, and Uruguay.
Upper-middle (36 countries)	Albania, Argentina, Armenia, Azerbaijan, Belarus, Belize, Botswana, Brazil, Bulgaria, China, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, Fiji, Gabon, Grenada, Guatemala, Indonesia, Iran, Islamic Rep., Jamaica, Jordan, Lebanon, Libya, Malaysia, Mexico, Namibia, Paraguay, Peru, Russian Federation, South Africa, Thailand, Tonga, Turkey, and Venezuela .
Lower-middle (29 countries)	Algeria, Bangladesh, Benin, Bolivia, Cabo Verde, Cameroon, Congo, Rep., Côte d'Ivoire, Egypt Arab Rep., El Salvador, Ghana, Honduras, India, Kenya, Kiribati, Lao PDR, Morocco, Nepal, Nicaragua, Nigeria, Pakistan, Philippines, Senegal, Solomon Islands, Sri Lanka, Tunisia, Ukraine, Vietnam, and Zimbabwe.
Low (16 countries)	Burkina Faso, Burundi, Central African Republic, Chad, Gambia, Guinea, Guinea-Bissau, Madagascar, Malawi, Mali, Niger, Rwanda, Sierra Leone, Sudan, Togo, and Uganda.

Appendix II. Technical Notes

A. Pearson correlation

Pearson correlation measures the proportionate change of one series associated to a change in other series. The estimated correlation coefficient illustrates the strength of either a positive or negative correlation between two variables. The Pearson correlation coefficient between financial openness *(FO)* and trade openness *(TO)* can be computed by the formula below:

$$\rho(FO, TO) = \frac{\hat{\sigma}(TO,\ FO)}{(\hat{\sigma}(TO, TO).\ \hat{\sigma}(FO, FO))^{\frac{1}{2}}}$$

The correlation coefficient, ρ, may take on the value from -1 to + 1. Indication of between financial and trade openness interdependence occurs when the estimated correlation has a value approaches ±1. A correlation coefficient approaching zero (in absolute terms) signifies no correlation between *FO* and *TO*.

B. Toda-Yamamoto (1995)'s granger non-causality tests

Toda-Yamamoto Granger non-causality procedure complements to the traditional Granger non-causality tests (Granger, 1969) as it accommodates the underlying time-series data with varying order of integration i.e., $I(0)$, $I(1)$ or $I(2)$ and applicable to either cointegrated or non-cointegrated of two or more time-series data. A bivariate augmented VAR ($m + d_{max}$) framework of between FO and TO can be written as follows:

$$FO_t = \propto_0 + \sum_{i=1}^{m} \partial_{1i} FO_{t-i} + \sum_{i=m+1}^{m+d_{\max}} \partial_{2i} FO_{t-i} + \sum_{i=1}^{m} \theta_{1i} TO_{t-i} + \sum_{i=m+1}^{m+d_{\max}} \theta_{2i} TO_{t-i} + v_{1t} \quad \text{(A.1)}$$

$$TO_t = \eta_0 + \sum_{i=1}^{m} \phi_{1i} TO_{t-i} + \sum_{i=m+1}^{m+d_{\max}} \phi_{2i} TO_{t-i} + \sum_{i=1}^{m} \vartheta_{1i} FO_{t-i} + \sum_{i=m+1}^{m+d_{\max}} \vartheta_{2i} FO_{t-i} + v_{2t} \quad \text{(A.2)}$$

where FO_t is financial openness and TO_t is trade openness. $\propto$, ∂ 's, θ's, β, ϕ's, and ϑ's are coefficient of the equations, m is the optimal lag length and d_{max} denotes the maximum order of integration suspected to occur in the system. $v_{1t} \sim N(0, \sum v_{1t})$ and $v_{2t} \sim N(0, \sum v_{2t})$ are residuals of the models, and $\sum v_{1t}$ and $\sum v_{2t}$ are covariance matrices of v_{1t} and v_{2t}, respectively. The results of the augmented Dickey-Fuller (ADF) unit root tests are not reported here, but available from the corresponding author upon request. The d_{max} and m are determined by their degree of integration, I(d) by the ADF tests, and Akaike information criterion (AIC) criterion, respectively. The null hypothesis is "*X does not Granger-cause Y*", in a common fashion based on a standard asymptotic distribution of the Wald statistic. For example, TO_t is said to do Granger-cause FO_t if θ_{1i} or θ_{2i} is non-zero in equation (A.2), and the null hypothesis can be rejected by F-statistics at a conventional significant level. On the other hand, FO_t does Granger-cause TO_t if ϕ_{1i} or ϕ_{2i} is non-zero in Equation (A.3).

C. Binary logistic regression

The binary logistic (logit) regression approach is advantageous in the analysis with a dichotomous dependent variable that possesses only two possible observed results such as 0 and 1. Logit regression function is used to estimate the probabilities that the value of 1 or $Y= 1$ is given by the equation as follows: $Prob\ (Y_i = 1 \mid X_i, \beta) = F\ (\beta X_i) = e^{Xi'\beta} / 1+ e^{Xi'\beta}$, where $F\ (\beta X_i)$ is the cumulative logistic distribution, β denotes the vector of coefficients, X represents vector of the independent variables. Based on the above equation, the logit model estimates

the probability of bidirectional causation between financial and trade openness by maximizing the likelihood function developed as in the Equation (A.4) under the methodology section.

Appendix III. Alternative *de facto* Financial Openness, Net Inflows and Outflows of Foreign Direct Investment

Two alternative *de facto measures* financial openness are labelled as *FO1* and *FO2. FO1* is the net inflows of foreign direct investment (new investment inflows less disinvestment) in the reporting economy from foreign investors and is divided by GDP. Meanwhile, *FO2* is net outflows of investment from the reporting economy to the rest of the world and is divided by GDP. The estimates of the three macroeconomic are reported as followings for OLS and logit estimators, respectively. The income levels estimates for *FOTO_COR* are not reported here since none of their estimates of income, exchange rate, interest rate are statistically significant at 10% level.

Table A2. *Dependent Variable, FOTO_COR$_i$, based on the Estimated Pearson Correlation*

	FO1_TO	*FO2_TO*
lny_i	0.010 (0.362)	0.012 (0.336)
lne_i	0.298 (0.128)	-0.150 (0.498)
r_i	0.002 (0.792)	-0.005 (0.547)
Constant	0.185 (0.005)***	0.206 (0.006)***
Adjusted R^2	0.015	-0.030
Durbin-Watson stat	2.097	2.156
F-statistic(p-value)	1.285 (0.289)	0.471 (0.704)
J-B normality	Normal	Normal
Breusch-Godfrey LM	0.285 (0.754)	0.548 (0.582)
Breusch-Pagan-Godfrey	1.088 (0.362)	2.379 (0.080)
Ramsey RESET	0.786 (0.380)	0.925 (0.341)
No. of Observations	56	56

Notes. *** and * denote 1 percent and 10 percent significance levels, respectively. Value in parentheses is *p*-value.

Table A3. *Dependent Variable, FOTO_Dummy, in which 1 for a Didirectional Granger Non-causality, 0 elsewhere, by Income Groups*

	All	High
lny_i	0.069 (0.783)	-0.167 (0.887)
lne_i	**-1.385 (0.086)***	-7.317 (0.400)
r_i	-0.123 (0.415)	-0.407 (0.679)
Constant	-3.134 (0.048)**	-1.417 (0.705)
McFadden R^2	0.366	0.191
S.E of Regression	0.222	0.265
Total observations	37	17

Notes. ** and * denote 5 percent and 10 percent significance levels, respectively. Value in parentheses is *p*-value. Another income levels i.e. upper-middle, lower-middle, and low income are incomputable given some technical complications such as perfectly predicts binary response failure, dependent variable has no variance, and insufficient number of observations.