Dynamic Interactions between Trade Globalization and Financial Globalization: A Heterogeneous Panel VAR Approach

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Abstract

The postwar period has seen a rapid growth of both trade and financial globalization. However, trade globalization has slowed down noticeably since the global financial crisis (GFC) and may slow down even further in the aftermath of COVID-19. An interesting and significant issue is whether trade deglobalization may lead to financial deglobalization. This paper analyzes the dynamic interactions between trade integration and financial integration by employing the panel VAR models that allow full heterogeneity among individual countries. We find that trade integration has huge and persistent positive effects on financial integration. This result is robust to various specifications of the model. We find that financial integration also tends to have a positive effect on trade integration. Our results suggest that the ongoing trade deglobalization may adversely affect financial globalization in the future.

Keywords: Trade integration, Financial integration, Panel VAR, Heterogeneity

JEL Classifications: F15, F36

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1. Introduction

The postwar period has seen a rapid growth of both trade and financial globalization. However, the seemingly unstoppable momentum of trade globalization slowed down noticeably after the global financial crisis (GFC). Moreover, the Covid-19 highlighted the vulnerability of long and distant global supply chains to shocks as well as the risk of over-dependence on imports of vital goods such as medical supplies and equipment. As a result, the pandemic is likely to accelerate post-GFC trade deglobalization trends further. However, it is unclear how the ongoing trade deglobalization will affect financial globalization. The central objective of our paper is to analyzes how trade (de) globalization affects financial (de) globalization and, more generally, the interactions between the two types of globalization.

Several past studies empirically examined how international trade integration affects international financial integration. Lane and Milesi-Ferretti (2003) showed that trade integration promotes international financial integration, measured by the sum of foreign assets and liabilities per GDP.[1] They provided some reasons for a positive relationship between the two types of integration. First, trade involves corresponding financial transactions. Second, trade and financial positions are mutually determined, given the importance of intra-firm intermediate trade. Finally, trade openness motivates cross-border financial transactions, reducing home bias in financial asset holdings.

Chambet and Gibson (2008) decomposed trade openness into natural and residual components, both of which contribute to financial integration, specifically stock market integration, in emerging markets. Aizenman (2008) also identified a hidden link, the public finance channel, through which *de facto* trade openness promotes *de facto* financial openness.[2] In terms of bilateral integration, Forbes and Chinn (2004) suggested that bilateral trade is an important determinant of cross-country linkages in the financial market. Similarly, Ananchotikul et al. (2015) found bilateral trade integration is one of the positive drivers of financial integration in Asia.

Other papers, however, argued that international trade integration does not necessarily lead to international financial integration. Using bilateral trade integration measures, Vithessonthi and Kumarasinghe (2016) found that international trade integration is not related to stock market integration, whereas financial development has a positive effect on stock market integration in Asia.

These studies mostly analyzed the effects of trade integration on financial integration, but financial integration can also affect trade integration. Therefore, it is important to consider the feedback between the two types of integration. However, relatively few past studies investigated the feedback relation by explicitly considering the interactions between the two types of integration. Some exceptions are as follows. Aizenman and Noy (2006, 2009) applied the causality test and Geweke decomposition test to assess the relationship between the two types of integration. Aviat and Coeurdacier (2007) investigated causality between bilateral

[1] Chinn and Ito (2006) measured financial openness based on the capital account restrictions and found that trade openness is a prerequisite for financial openness. However, the reverse causality from financial openness to trade openness was not confirmed.

[2] Aizenman (2008) suggested that greater trade openness increases the effective cost of enforcing financial repression, reducing the usefulness of financial repression as an implicit tax. In this context, financial reforms can be a by-product of trade openness.

trade integration and bilateral asset holdings using simultaneous gravity equations and found that bilateral trade and bilateral asset holdings have positive causality in both directions.

In this paper, we investigate the relationship between trade and financial integration. In the preliminary analysis, we analyze the predictive relationship between these two types of globalization by applying the Granger causality test as in some past studies. That is, we investigate whether trade (de) globalization Granger-causes financial (de) globalization, and vice versa. However, drawing a clear conclusion is not easy because the results are quite different across countries. This motivates the main analysis of this paper, which can take account of heterogeneity across countries but draw a clear conclusion.

In the main part of our empirical analysis, we analyze the dynamic relationship between trade globalization and financial globalization by constructing heterogeneous panel structural VAR models. VAR models consider the dynamic interactions between two variables of interest and are able to show the dynamic effects of one integration on the other over time. We also allow heterogeneity among different countries because the relation between two types of integration can differ across countries, as suggested by the preliminary analysis. Using the heterogeneous panel structural VAR model, we would like to draw a general conclusion on the relationship between two types of integration by fully exploiting the information from panel data but allowing full heterogeneity in the relationship across countries.

Section 2 shows the measures of trade and financial integration and the results of the Granger-causality test. Section 3 explains the empirical framework. Section 4 reports and discusses the empirical results. Section 5 concludes our paper.

2. Data and Preliminary Analysis

In this section, we show our measures of trade and financial integration and report the results of Granger causality test between the two variables.

2.1. Measures of Trade and Financial Integration

International trade integration (TRADE) is measured as the sum of exports and imports of goods and services relative to GDP. International financial integration (FIN) is measured as the sum of foreign assets and liabilities relative to GDP, following past studies such as Lane and Milesi-Ferretti (2003).[3] That is,

$$TRADE = (Exports + Imports)/GDP$$
$$FIN = (Foreign\ assets + Foreign\ liabilities)/GDP$$

Quarterly data for Q1 1987 – Q4 2019 for 39 developed and developing countries are used in our empirical analysis. The sample countries included in the analysis are listed in Table 1. The main sources of data are the International Financial Statistics (IFS), the Balance of Payment and the International Investment Position (BOP/IIP) of the IMF, and the Global Economic Monitor of the World Bank. We also use data from national sources and the CEIC database. Details on data sources are provided in Appendix 1.

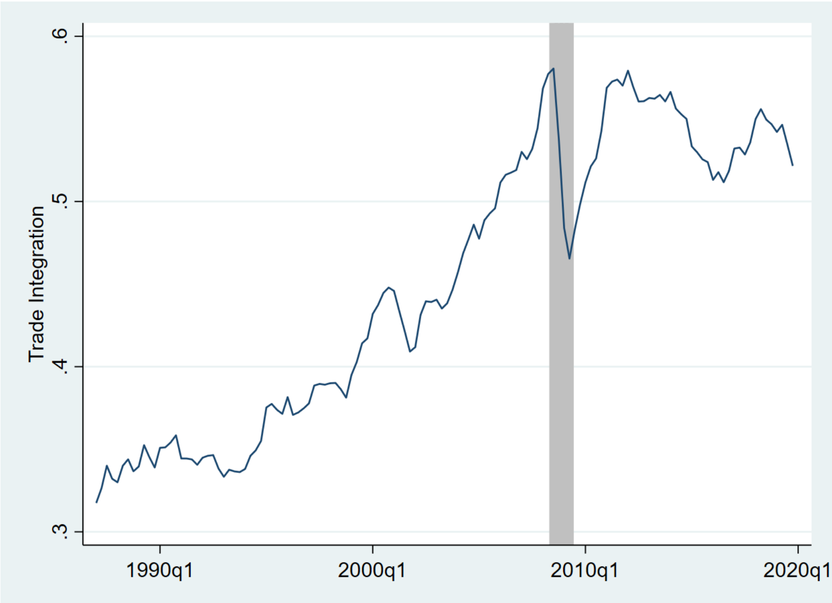
[3] We use annual rates of GDP, exports, and imports.

Figures 1 and 2 show the trends in trade and financial integration, respectively, of the whole sample countries. The measures are constructed as the weighted average of the individual country measures, weighted by the relative shares of GDP in aggregate GDP of all countries in the sample (in US dollar). Both integration measures have increased rapidly over time until the global financial crisis (GFC). Both trade and financial integration has nearly doubled over two decades. During the GFC, trade integration fell rapidly, reflecting the sharp shrinkage of global trade. On the other hand, financial integration did not fall much since the fall in GDP tends to as large as the fall in financial assets and liabilities during the GFC.

For both trade and financial integration, the rate of increase tends to slow down since the GFC. While financial integration stays relatively stable after the GFC, trade integration tends to decrease. These trends throw up some interesting issues regarding the interaction between trade and financial integration. For example, is the recent decline in trade integration going to have a negative effect on financial integration? Were there any interactions between trade and financial integration before the GFC when trade and financial integration increased rapidly? Does trade integration have a positive effect on financial integration? Conversely, does financial integration have a positive influence on trade integration?

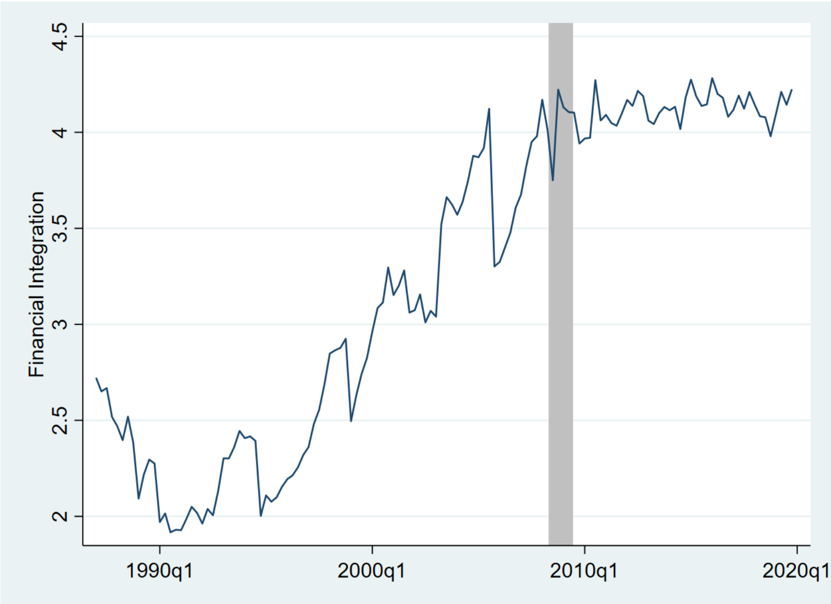
Table 1 summarizes the sample period averages of trade and financial integration measures for each country. The most financially open countries are advanced European economies such as the Netherlands, Switzerland, and Belgium, with values of 18.48, 10.56, and 9.37, respectively. On the other hand, developing countries tend to show limited financial integration. India, Guatemala, and Turkey have values of 0.63, 0.79, and 0.94, respectively. The measure of trade integration is the highest for Belgium (1.57), Hungary (1.40), and Netherlands (1.4) and the lowest for the U.S. (0.24), Brazil (0.25), and Columbia (0.35).

Figure 1 Trend in Global Trade Integration



Note: The weighted average of trade integration. The shaded area indicates the Global Financial Crisis periods.

Figure 2 Trend in Global Financial Integration



Note: The weighted average of financial integration. The shaded area indicates the Global Financial Crisis periods.

Table 1 Trade and Financial Integration

	Trade Integration	Financial Integration		Trade Integration	Financial Integration
United Kingdom	0.520	7.215	Hungary	1.404	3.533
Australia	0.397	2.037	India	0.482	0.632
Austria	1.166	4.489	Israel	0.662	1.507
Belgium	1.570	9.373	Italy	0.528	2.570
Bolivia	0.667	1.255	Kazakhstan	0.802	1.616
Brazil	0.248	0.939	Korea Rep.	0.761	1.054
Bulgaria	1.235	2.176	Netherlands	1.397	18.482
Canada	0.662	2.579	New Zealand	0.585	2.296
Chile	0.640	2.513	Peru	0.407	1.146
Colombia	0.347	0.993	Poland	0.884	1.376
Costa Rica	0.725	1.219	Portugal	0.721	4.231
Czech Republic	1.282	1.837	Romania	0.736	1.036
Denmark	1.002	4.923	Slovenia	1.348	2.044
Finland	0.686	3.704	Spain	0.588	3.279
France	0.581	5.003	Sweden	0.827	4.858
Georgia	0.872	1.530	Switzerland	1.096	10.557
Germany	0.815	4.326	Turkey	0.523	0.939
Greece	0.579	3.170	Ukraine	1.016	1.771
Guatemala	0.560	0.790	United States	0.243	2.949
Honduras	0.835	1.244	Average	0.764	3.263

Note: The table lists the sample countries and reports the average of trade and financial integration over the sample periods for each country.

2.2. Granger Causality Test

Before estimating the VAR model, we test the Granger-causality between trade and financial integration measures of each country to gain some insights into the relationship between trade and financial integration in both directions at the individual country level.

First, we perform a unit root test for each country to check whether both measures are stationary.[4] Since trade and financial integration tend to show a time trend, we included a trend term in each regression, and the lag length is selected based on the Akaike information criteria (AIC). Table 2 reports the results. The null hypothesis of unit root is rejected for TRADE in most countries. It is rejected at a 10% level in all but five countries and a 5% level in all but 10 countries. The null hypothesis of a unit root in the measure of FIN is rejected in a majority of countries but still not rejected in quite a few countries. It is rejected at a 10% level in 24 out of 39 countries and at a 5% level in 20 out of 39 countries. The null hypothesis of the unit root is rejected in most but not all countries.

Based on the unit root test results, we first consider the case where TRADE and FIN are stationary, and then we consider the case where TRADE and FIN have a unit root when we perform the Granger-Causality test. Table 3 reports the results. Columns (1) and (2) show the results when TRADE and FIN are assumed stationary. Columns (3) and (4) show the results when TRADE and FIN are assumed to have a unit root, and the first differenced measures are used in the test. Columns (1) and (3) show the results for the Granger causality test from TRADE to FIN, while (2) and (4) show the results for the Granger causality test from FIN to TRADE.

The null hypothesis that TRADE does not Granger-cause FIN is not rejected in a majority of countries. Out of 39 countries, it is rejected in 11 and 12 countries at a 10% level in Columns (1) and (3), respectively. It is rejected at a 5% level in only 8 and 9 countries, respectively, in Columns (1) and (3). The test for Granger-causality from FIN to TRADE shows a mixed result. Out of 39 countries, it is rejected in 22 and 18 countries at a 10% level, respectively, in Columns (2) and (4), and 19 and 12 countries at a 5% level.

To summarize, the results suggest that trade integration Granger-cause financial integration in a majority of countries, but the hypothesis is rejected in some countries. Moreover, the Granger-causality from financial to trade integration is less certain. Interestingly, the results vary across countries, showing a clear heterogeneity across countries in terms of the interactions between trade and financial integration. This result supports the modeling approach that explicitly considers full heterogeneity across countries, as discussed in Section 3.1.

[4] We also performed the panel unit root tests. The results are reported in Appendix 2.

Table 2 Unit Root Test

Country Name	TRADE	FIN
United Kingdom	-4.1805***	-1.3794
Australia	-3.9999***	-3.3585***
Austria	-2.854***	-0.4496
Belgium	-4.0419***	-2.3821**
Bolivia	-0.983	-3.3922***
Brazil	-1.9707**	-1.9067*
Bulgaria	-3.7218***	-1.9532**
Canada	-1.3072	-1.1284
Chile	-0.9298	-3.4335***
Colombia	-3.0775***	-1.3081
Costa Rica	-2.5534**	-1.9417*
Czech Republic	-1.8883*	-3.3892***
Denmark	-2.6498***	-2.4422**
Finland	-2.6423***	-2.8003***
France	-3.3793***	-1.6653*
Georgia	-4.2267***	-2.0573**
Germany	-2.1012**	-2.2353**
Greece	-1.7952*	-1.4472
Guatemala	-2.068**	-2.8379***
Honduras	-3.5907***	-2.7745***
Hungary	-2.0566**	-0.8745
India	-0.9079	-2.7958***
Israel	-1.9511**	-1.4219
Italy	-3.4483***	-2.9756***
Kazakhstan	-1.8229*	-2.5119**
Korea Rep.	-1.8196*	-3.0906***
Netherlands	-3.8159***	-1.0927
New Zealand	-4.4316***	-3.7149***
Peru	-1.2644	-1.4207
Poland	-3.477***	0.4297
Portugal	-2.094**	-0.5993
Romania	-2.9798***	-0.5468
Slovenia	-2.6656***	-0.6693
Spain	-3.3409***	-1.5359
Sweden	-2.4163**	-1.0029
Switzerland	-2.8398***	-2.6673***
Turkey	-2.9158***	-4.0875***
Ukraine	-2.1644**	-1.7239*
United States	-1.894*	-3.3295***

Note: The results from the Augmented Dickey-Fuller (ADF) unit root test, where ***,**,* indicate statistical significance at the 0.01, 0.05, 0.1 levels, respectively.

Table 3 Granger Causality Test

Country name	(1) TRADE to FIN	(2) FIN to TRADE	(3) ΔTRADE to ΔFIN	(4) ΔFIN to ΔTRADE
United Kingdom	5.226	5.823	4.291	0.54
Australia	5.499	24.59***	7.703	24.744***
Austria	2.292	12.065**	2.151	12.766**
Belgium	2.463	2.292	1.899	1.245
Bolivia	8.572*	13.181**	5.777	15.693***
Brazil	10.19**	7.473	2.932	5.794
Bulgaria	7.469	14.669***	7.681	8.188*
Canada	4.732	14.418***	12.737**	19.73***
Chile	7.529	33.053***	3.552	37.835***
Colombia	3.499	3.782	3.957	7.754
Costa Rica	3.133	7.822*	3.401	7.928*
Czech Republic	6.105	5.371	5.136	5.369
Denmark	4.173	8.736*	3.556	9.287*
Finland	2.665	4.575	2.934	3.89
France	2.726	16.808***	2.407	16.579***
Georgia	14.795***	10.503**	9.793**	9.551**
Germany	5.544	3.898	7.829*	1.504
Greece	1.451	5.886	1.391	6.074
Guatemala	16.248***	12.983**	8.856*	13.263**
Honduras	4.433	13.18**	7.51	5.947
Hungary	4.077	4.504	2.803	1.169
India	8.292*	3.984	12.072**	1.91
Israel	2.281	4.352	2.503	15.766***
Italy	2.531	14.408***	4.249	5.226
Kazakhstan	9.082*	9.481*	6.915	4.218
Korea Rep.	11.683**	10.164**	15.096***	8.484*
Netherlands	4.163	4.68	2.585	3.652
New Zealand	5.325	24.543***	8.412*	24.106***
Peru	14.484***	15.583***	11.532**	13.747***
Poland	2.896	10.294**	2.076	7.141
Portugal	6.39	11.401**	2.782	9.114*
Romania	17.839***	9.698**	11.631**	3.366
Slovenia	7.776	5.806	12.431**	1.972
Spain	3.019	7.597	5.28	5.643
Sweden	5.161	5.985	2.819	6.59
Switzerland	2.763	5.032	4.486	4.65
Turkey	12.457**	10.627**	12.109**	8.12*
Ukraine	10.041**	2.966	12.281**	4.246
United States	5.486	14.014***	4.305	16.278***

Note: ***,**,* indicate statistical significance at the 0.01, 0.05, 0.1 level, respectively.

3. Empirical Method

In this section, we explain the framework for our empirical analysis.

3.1. Heterogeneous Panel VAR

We examine the relationship between trade and financial integration by using panel VAR models, which allow full heterogeneity across countries. VAR models are a useful methodology to investigate this issue for a number of reasons. First, dynamic feedback effects between two types of integration can be inferred from VAR models. For example, the model captures how changes in one type of integration affect changes in the other type of integration over time. Second, VAR models are relatively free of ad-hoc identifying assumptions so that data-oriented empirical results can be generated. In addition, we allow full heterogeneity among countries because the relation between two integration can be quite different across countries, as the result of the Granger-causality test shows.

Let's assume that a country i (i=1,2,…,I) is described by the following structural form equation:

(1) $$\mathrm{G}(L)^i y_t^i = d^i + e_t^i$$

where $G(L)^i$ is a matrix polynomial in the lag operator L, y_t^i is an m×1 data vector, d^i is m×1 constant vector, m is the number of variables in the model, and e_t^i denotes a vector of structural disturbances. By assuming that structural disturbances are mutually uncorrelated, $var(\, e_t^i)$ can be denoted by Λ^i, which is a diagonal matrix where diagonal elements are the variances of structural disturbances. Heterogeneity among countries is considered not only for the constant term (d^i) but also for all other parameters ($G(L)^i$).

We estimate the reduced form VAR:

(2) $$y_t^i = c^i + \mathrm{B}(L)^i y_{t-1}^i + u_t^i$$

where c^i is an m×1 constant vector, $\mathrm{B}(L)^i$ is a matrix polynomial in the lag operator L, and $var(\, u_t^i) = \Sigma^i$.

There are several ways of recovering the parameters in the structural form equation from the estimated parameters in the reduced form equation. The identification schemes under consideration impose recursive zero restrictions on contemporaneous structural parameters by applying Cholesky decomposition to the reduced form residuals, Λ^i, as in Sims (1980).

As suggested by Canova (2007, chapter 8) and Canova and Ciccarelli (2013), we estimate the model and compute the impulse response functions for each country and average them over the cross-section since T is relatively large in our case. Let α be the vector that collects the population mean parameters and α^i the same vector for the parameters of country $i = 1, \dots, I$. Let h_k be the impulse response function evaluated at horizon $k = 1, \dots, K,$ a well-defined, continuous function of the parameters of the system. We assume that:

(3) $$h_k(\alpha^i) = h_k(\alpha) + v_{hk}^i$$

where ν_{hk}^{i} , $i = 1, \dots, I$, $k = 1, \dots, K$ are *iid* $(0,\sigma_k^2)$. The average time series estimator (suggested by Canova (2007)) is computed as follows:

(4) $$\hat{h}_k = \frac{1}{I}\sum_{i=1}^{I} h_k(\hat{\alpha}^i)$$

An estimate of the variance-covariance matrix of the estimator is given by:

(5) $$\hat{\Sigma}_{hk} = \frac{1}{I(I-1)}\sum_{i=1}^{I}(h_k(\hat{\alpha}^i) - \hat{h}_k)(h_k(\hat{\alpha}^i) - \hat{h}_k)'$$

Note that we use the cross-section to estimate the common or average effects by pooling the estimators of the impulse response functions.

We estimate an individual VAR for each country and estimate the impulse responses of each country with the Monte-Carlo integration method, a Bayesian method, following RATS (2013). Based on the median of the impulse responses of each country, we calculate the average time series estimator and its standard error bands. Note that our statistical inference is not affected by the presence of non-stationarity when we follow a Bayesian inference (see Sims, 1988, and Sims and Uhlig, 1991).

3.2. Empirical Model

First, we construct a simple two-variable model (Model 1) to infer the interactions between TRADE and FIN. The data vector, y_t^i, is {$TRADE_t^i$, FIN_t^i}. We assume that TRADE is contemporaneously exogenous to FIN. This identifying assumption relies on the timing of the data construction. TRADE is based on flow data for a given quarter, while FIN is based on the end-of-period stock data (i.e., assets and liabilities at the end of each quarter). This data property provides a natural identifying assumption on the contemporaneous relationship between these two measures in a recursive VAR model.

Second, we extend the model to construct a six-variable model (Model 2). In addition to TRADE and FINANCE, we include four variables to control economic activities and financial conditions that may affect trade and financial integration. They are the real gross domestic product (RGDP), consumer price index (CPI), policy interest rate (R), and exchange rate (ER, expressed as local currency per US dollar). Macroeconomic conditions captured by macroeconomic variables such as RGDP and CPI likely affect trade and financial transactions. In addition, key financial variables such as R and ER also likely affect trade and financial transactions.

For the second model, the following identifying assumptions are used. (1) RGDP and CPI are contemporaneously exogenous to TRADE and FIN. (2) R and ER are contemporaneously exogenous to FIN. (3) RGDP, CPI, and TRADE are contemporaneously exogenous to R, ER, and FINANCE. (3) is the extension of the previous identifying assumption based on data construction timing - i.e., we use the end-of-period data for R, ER, and FIN, but the period average data or flow data for a given quarter for RGDP, CPI, and TRADE. In addition, we assume (1) to control for RGDP and CPI movements that are likely to affect TRADE and FINANCE contemporaneously. We also assume (2) to control for R and ER movements that are likely to affect FINANCE contemporaneously.

In both models, we also include some exogenous variables such as real GDP (USRGDP) and the Federal Funds Rate (USFFR) of the United States. These US (or world) variables are likely to affect the economic and financial relations of each country with the rest of the world. Since we include these US variables as exogenous variables, we exclude the US from our sample countries when we estimate the VAR models.

A logarithm transformation is applied to RGDP, CPI, and ER and then multiplied by 100. More details on the variables and data sources are reported in Appendix 1.[5] Four and two lags are included in the two- and six-variable models, respectively. A crisis dummy variable to account for the Global Financial Crisis (Q3 2008 – Q2 2009) is also included. In the six-variable model, we exclude some countries from our sample because their sample period is too short, given that many parameters are needed to be estimated in the six-variable model. [6]

4. Empirical Results

In this section, we report and discuss our main empirical findings.

4.1. Baseline Model

Figure 3 shows the impulse responses with 90% probability bands. Each column of graphs shows the impulse responses to each shock over 20 quarter horizons. The column and row headings indicate the name of shock and responding variables, respectively. In the first column of the graph, a positive TRADE shock increases FIN. The increase in FIN continues to differ from zero with a 95% probability at all horizons. The size of the effects on FIN is also substantial. TRADE shocks increase TRADE by approximately 0.028 on impact, then TRADE decreases back toward the initial level but still remains above the initial level by approximately 0.005 at 20 quarter horizons. In response to such TRADE shocks, FIN increases by 0.025 on impact, and it is at a similar level even at 20 quarter horizons. This result suggests that trade integration is followed by financial market openness, as suggested in Aizenman (2008). To summarize, the effect of trade integration on financial integration is positive and persistent, and the size of the effect is substantial.

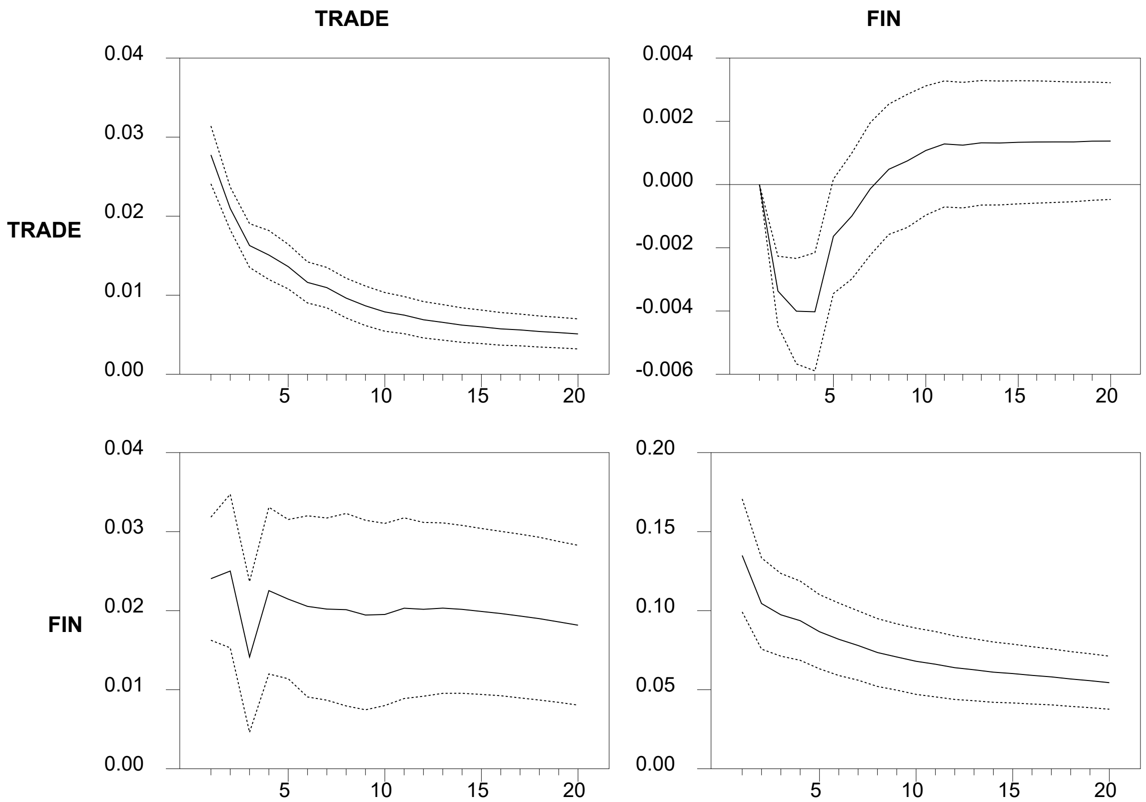
In response to a positive FIN shock, TRADE falls for four quarters, and its effect is significantly different from zero with a 95% probability. However, from the fifth quarter after the shock, the effect is not significant. The point estimate shows a positive response from the eighth quarter after the shock, but insignificant. This result suggests that the medium to long-run effects from financial market integration to trade integration are uncertain. In addition, the size of FIN response is relatively small. In response to FIN shocks, FIN increases approximately by 0.14 and remains above the initial level by approximately 0.05 after 5 years. The maximum decrease of TRADE is approximately -0.004.[7] To summarize, the effect of financial integration on trade integration is negative in the short run, and the medium- and long-run effects are insignificant in this two-variable model.

[5] All variables are seasonally adjusted.
[6] The excluded countries are Chile, Brazil, Bulgaria, Georgia, Honduras, India, Kazakhstan, Slovenia, Turkey, and Ukraine.
[7] The size of the change in TRADE is far smaller than the size of changes in FIN. However, the difference is smaller than those shown in those numbers because TRADE is smaller than FINANCE on average as reported in Table 1.

Figure 4 reports the results from the six-variable model. Each column shows the impulse responses to each shock. In particular, the third and sixth columns show the impulse responses to TRADE and FIN shocks, respectively. In response to TRADE shock, financial integration increases for 20 quarters, which is different from zero with a 95% probability at all horizons. This positive and persistent effect is consistent with the result of the bivariate model. The size of FIN response, compared to TRADE changes, is smaller than in the two-variable model but still substantial.

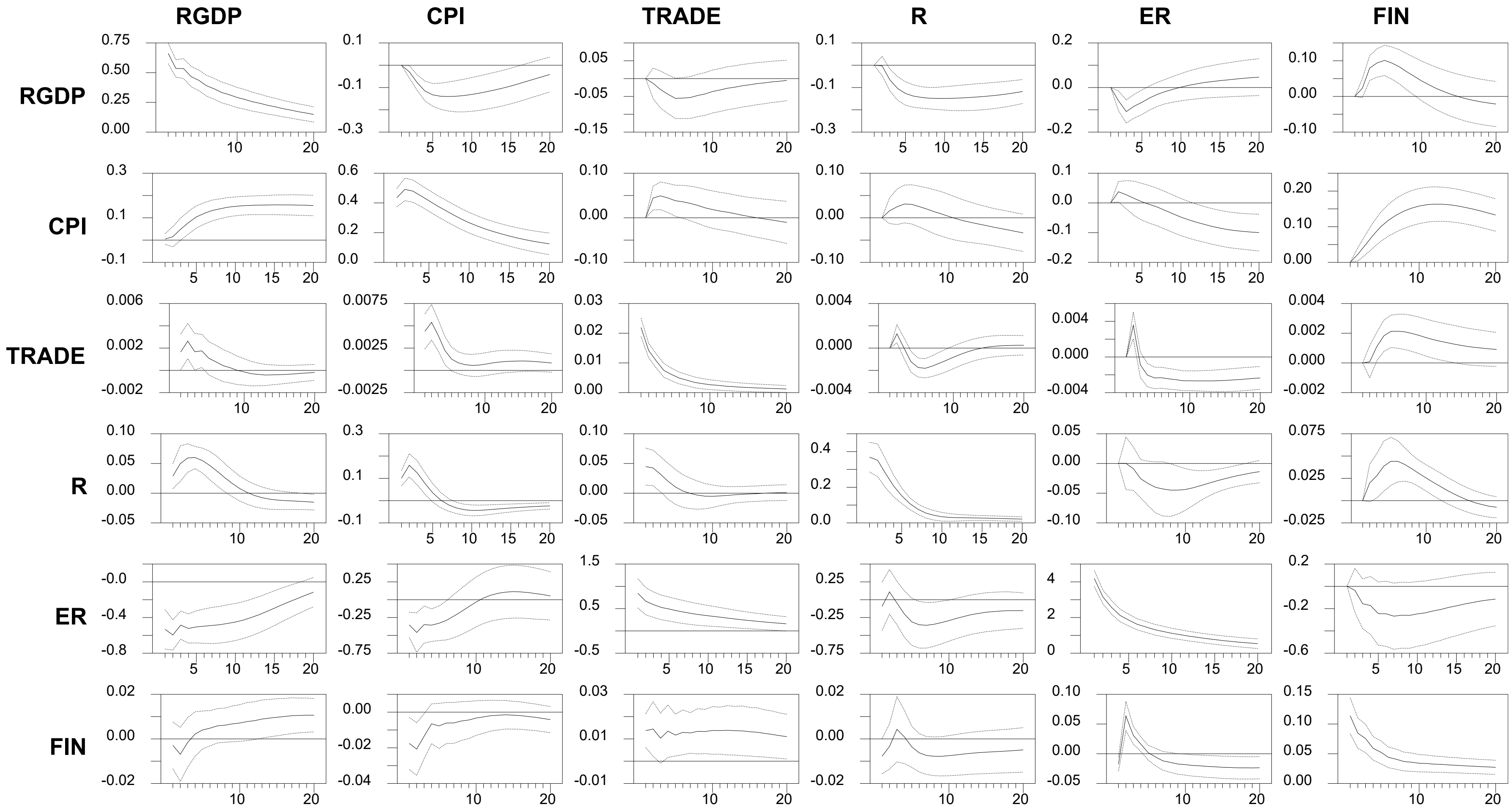
On the other hand, after controlling relevant variables, there are some notable differences in the impulse responses of TRADE to FIN shocks. FIN shocks have a positive effect on TRADE, which is different from the negative effect found in the two-variable model. Increases in TRADE from the fourth to the thirteenth quarters after the shock is different from zero with a 95% probability. This result is quite interesting. After controlling for relevant variables, the effects of financial integration on trade integration turn out to be positive. TRADE response peaks by 0.002 increase in the sixth quarter and decreases back toward the initial level. In response to FIN shocks, FIN increases approximately by 0.11 on impact and still remains above the initial level by 0.03 after 5 years.

Figure 3 Impulse Responses for the Heterogeneous panel VAR – Model 1



TRADE = trade integration; FIN = financial integration
Note: The solid lines refer to the mean group estimates and the dotted lines show 90% probabililty bands.

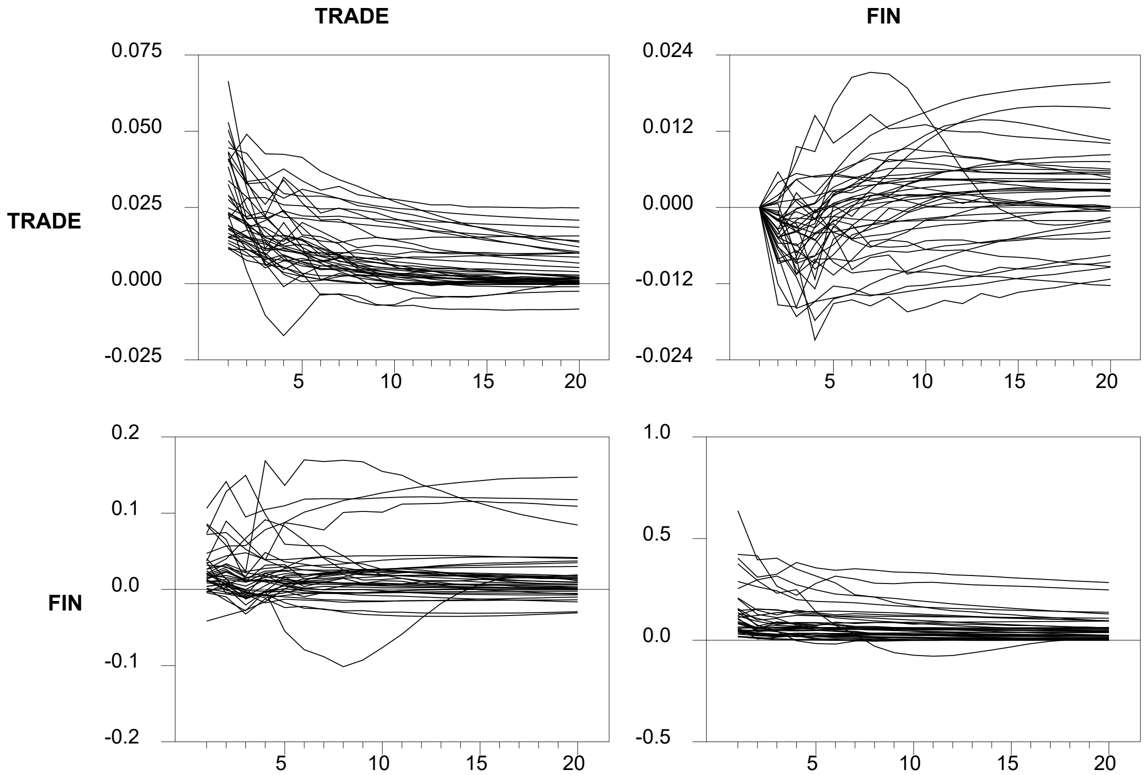
Figure 4 Impulse Responses for the Heterogeneous panel VAR – Model 2



TRADE = trade integration; FIN = financial integration; RGDP = real gross domestic product; CPI = consumer price index; R = policy rate; ER = exchange rate.
Note: The solid lines refer to the mean group estimates and the dotted lines show 90% probabililty bands.

Figures 5 and 6 show the results of individual countries for Models 1 and 2, respectively. The figures confirm that individual heterogeneity is indeed huge, which suggests that allowing heterogeneity in the panel VAR model is suitable in our case. The responses of FIN to TRADE shocks are quite diverse across countries. In some cases, the response of FIN is negative. We find even larger heterogeneity in the responses of TRADE to FIN shocks.

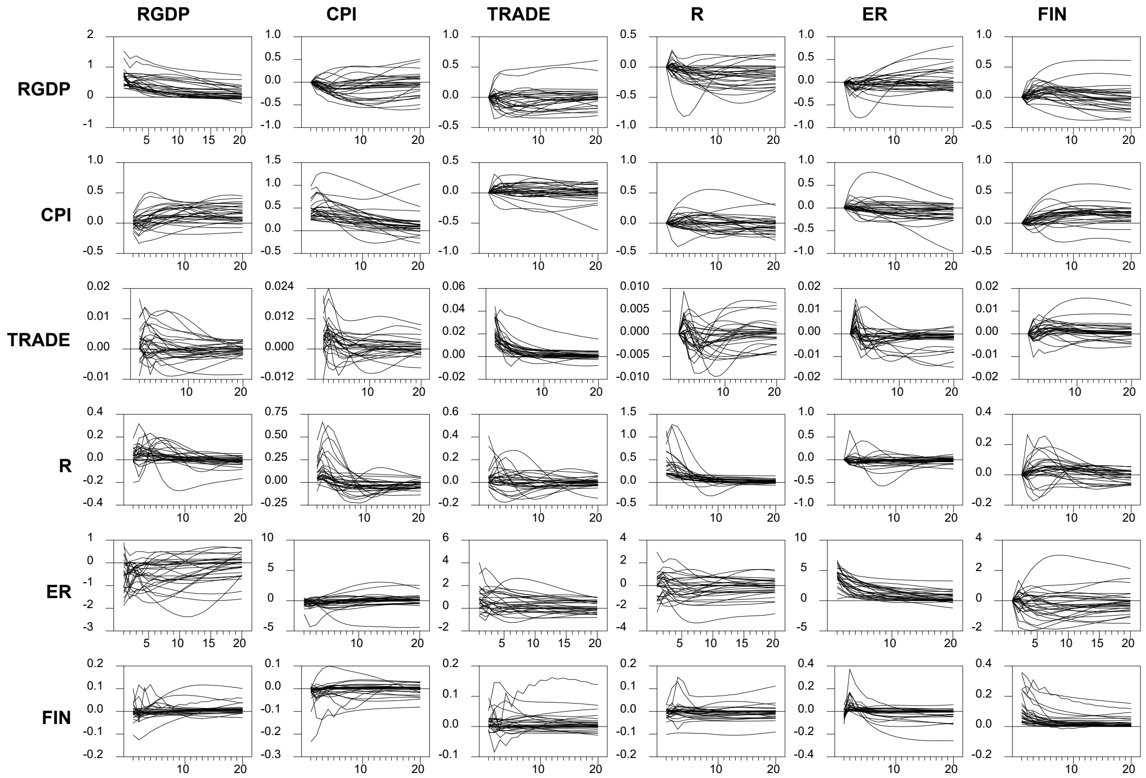
Figure 5 Impulse Responses of Individual Countries – Model 1



TRADE = trade integration; FIN = financial integration

Note: The solid line is the median of the impulse response of each country. Confidence bands are removed to avoid cluttering.

Figure 6 Impulse Responses of Individual Countries – Model 2



TRADE = trade integration; FIN = financial integration; RGDP = real gross domestic product; CPI = consumer price index; R = policy rate; ER = exchange rate.
Note: The solid line is the median of the impulse response of each country. Confidence bands are removed to avoid cluttering.

4.2. Extended Experiments

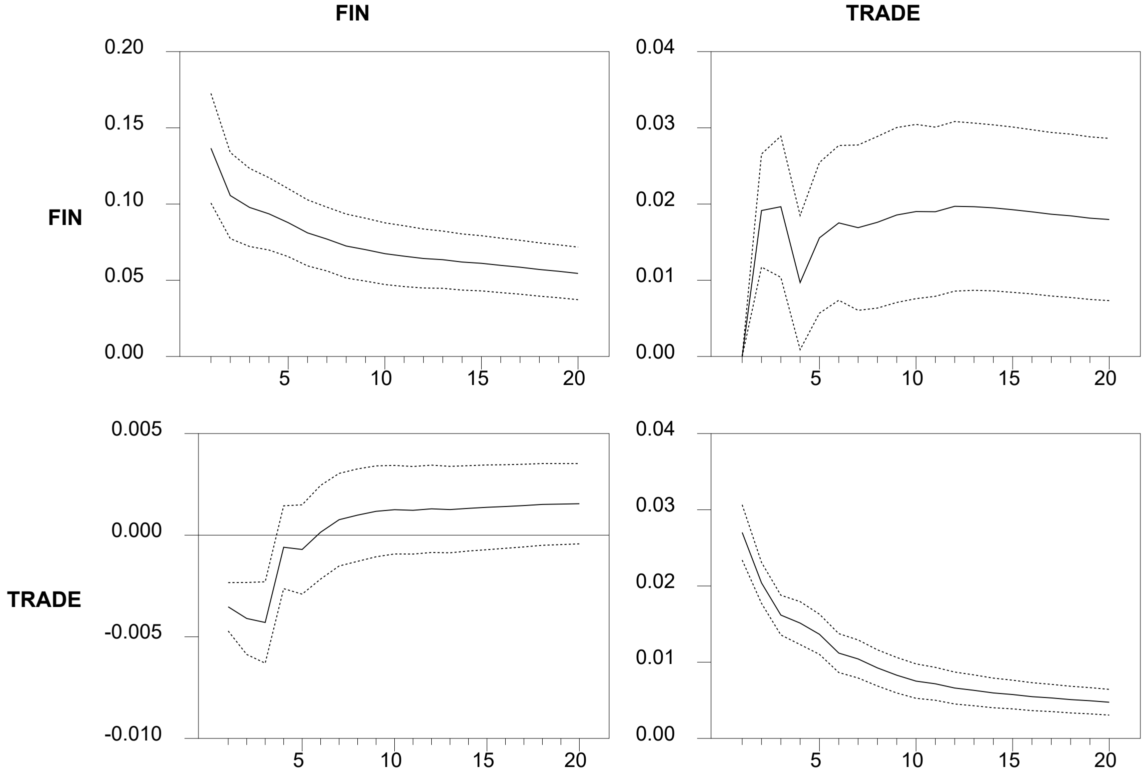
In this section, we report and discuss the results of some extended analysis.

4.2.1 Alternative Identifying Assumptions

Based on the data construction timing of the integration measures, we assumed that TRADE is contemporaneously exogenous to FIN in the baseline models. We now consider alternative orderings between the two integration measures by assuming that FIN is contemporaneously exogenous to TRADE. In this model, one-period lagged values of FIN are used. In this way, FIN at time *t* represents the value at the beginning of time *t*, and thus FIN is naturally contemporaneously exogenous to TRADE, which is the flow data during period *t*.

Figure 7 shows the results of the two-variable model. The main results remain unchanged. In response to TRADE shock, FIN increases after the shock, and its effect continue to differ from zero with a 95% probability at all horizons. These results are consistent with those of the baseline model. In response to FIN shocks, TRADE falls significantly for three quarters and then increases above the initial level from the seventh quarter after the shock, although insignificant. The medium- and long-run effect from FIN shocks to TRADE is insignificant.

Figure 7 Impulse Responses – Alternative Identifying Assumptions 1

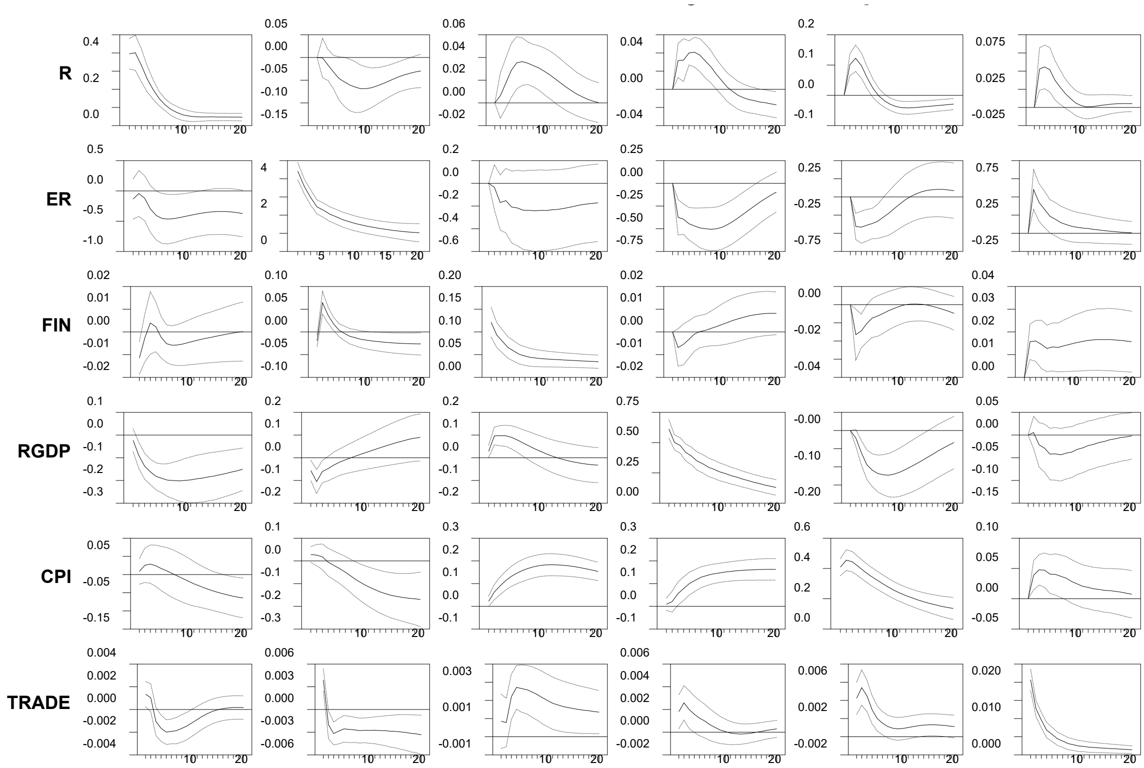


TRADE = trade integration; FIN = financial integration
Note: The solid lines refer to the mean group estimates and the dotted lines show 90% probabililty bands. The one-period lagged values of FIN are used.

For the six-variable model, we use the following ordering: {R, ER, FIN, RGDP, CPI, TRADE} where contemporaneously exogenous one is ordered first. Since the data for the policy rate (R) and exchange rate (ER) are end-of-period data, we used one-period lagged values of R and ER as their values at time *t*.

Again, the main results are in general similar to those from the baseline model. As shown in Figure 8, TRADE shocks have significant positive effects on FIN. The positive effect is very persistent. FIN shocks also have significant positive effects on TRADE. One notable difference is that the effect of FIN shocks on TRADE is more persistent than in the baseline model. The increase in TRADE is different from zero with a 95% probability from the third to the twentieth quarter after the shock.

Figure 8 Impulse Responses – Alternative Identifying Assumptions 2



TRADE = trade integration; FIN = financial integration; RGDP = real gross domestic product; CPI = consumer price index; R = policy rate; ER = exchange rate.
Note: The solid lines refer to the mean group estimates, and the dotted lines show 90% probability bands. The one-period lagged values of R, ER, and FIN are used.

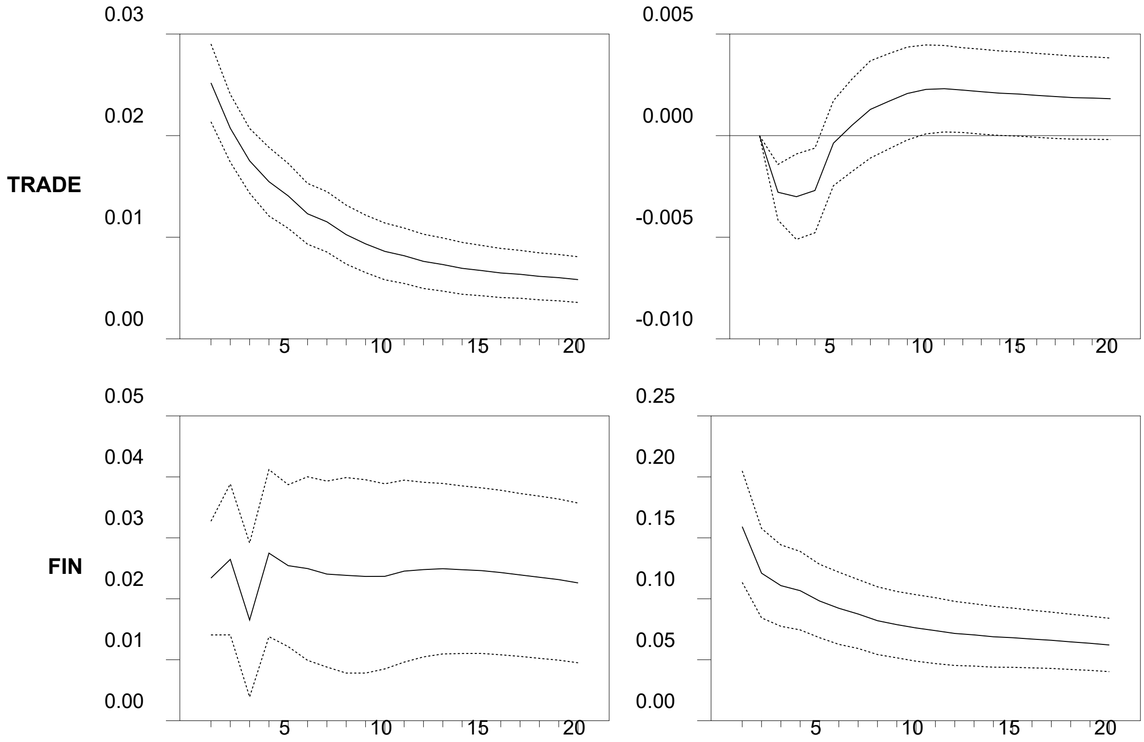
4.2.2. Two versus Six Variable Models

We use a sample of only twenty-eight countries to estimate the six-variable model because the data is not available for some countries. In this section, we investigate whether the change in sample countries is the main reason for the different results on the effects of FIN on TRADE in two- and six- variable models. We do so by estimating the two-variable model with a sample of only twenty-eight countries.

Figure 9 reports the results. Compared to the baseline model with the whole sample countries, the effects of trade integration shocks to TRADE and FIN are qualitatively and quantitively similar. However, the effects of FIN shocks on TRADE are slightly different. TRADE decreases in the short-run but subsequently increases above the initial level. In the baseline model, the medium- and long-run increase is not significant at any horizons. But now the positive effects from 10 quarters to 13 quarters are significant.

This result suggests that the positive effect of FIN shocks on TRADE found in the six-variable model may be partly due to the reduced country sample used in the six-variable model. However, for the reduced sample, the two-variable model still shows a short-run negative effect and significant positive effects at only a few horizons. Therefore, the strong positive effect of FIN shocks on TRADE found in the six-variable model is not entirely due to the reduced sample.

Figure 9 Impulse Responses – Reduced Sample

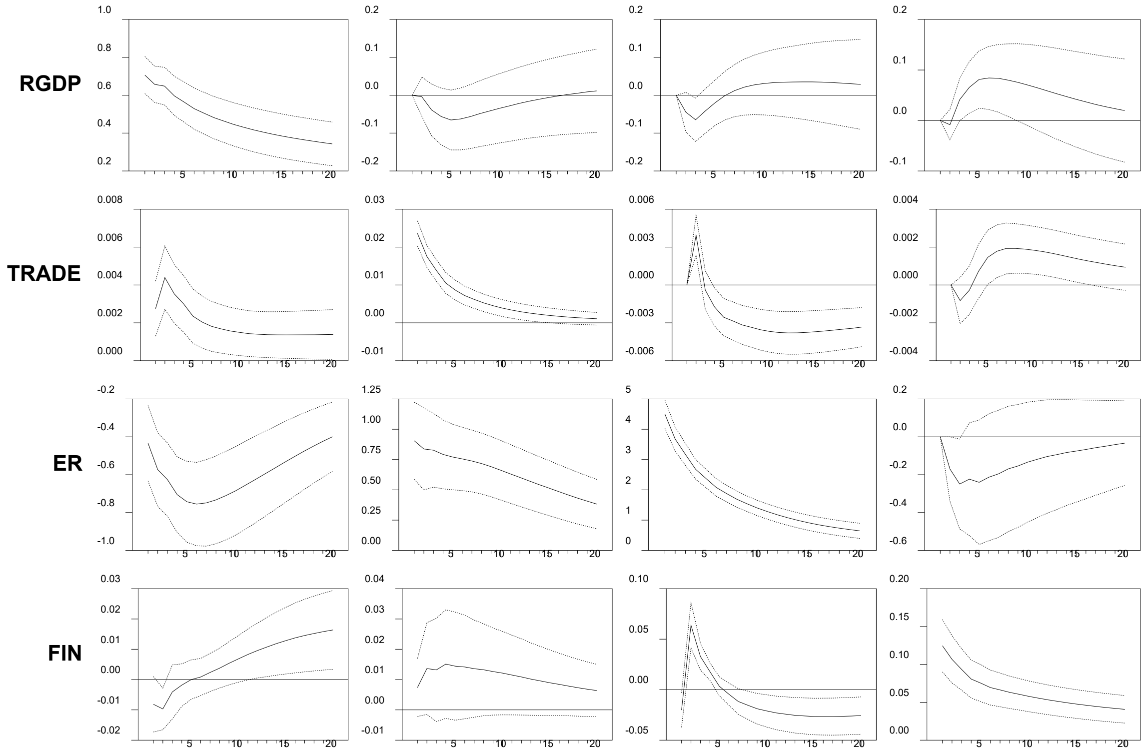


TRADE = trade integration; FIN = financial integration
Note: The solid lines refer to the mean group estimates and the dotted lines show 90% probability bands.

We further explore which control variable contributes to the positive effect of FIN shocks on TRADE. We experiment with various combinations of the four control variables. We find that RGDP and ER are needed to exclude a short-run decrease of TRADE and obtain a more significant increase in TRADE. Figure 10 reports the results from the four-variable model.[11]

[11] In this four-variable model, the responses of FIN to TRADE shocks are not significantly different from zero, considering the wide probability bands. When we additionally include CPI in the model, they are significantly different from zero with 95% probability.

Figure 10 Impulse Responses – Combinations of Control Variables

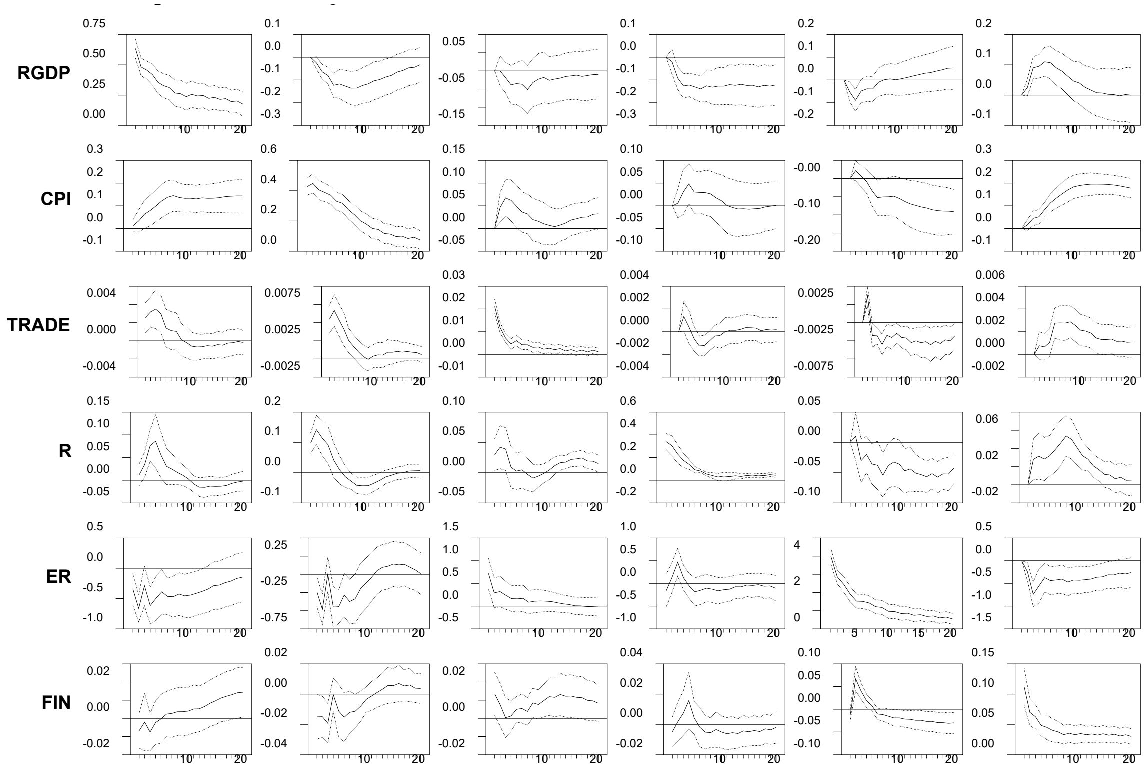


TRADE = trade integration; FIN = financial integration; RGDP = real gross domestic product; ER = exchange rate.
Note: The solid lines refer to the mean group estimates and the dotted lines show 90% probability bands. Since the sample period of the exchange rate is too short for some countries, we include 2 lags in this experiment.

4.2.3 Other Experiments

We include two lags for the six-variable model, but now we experiment with four lags. Figure 11 shows the impulse responses for a six-variable model with four lags. The main results are generally similar to those of the baseline six-variable model.

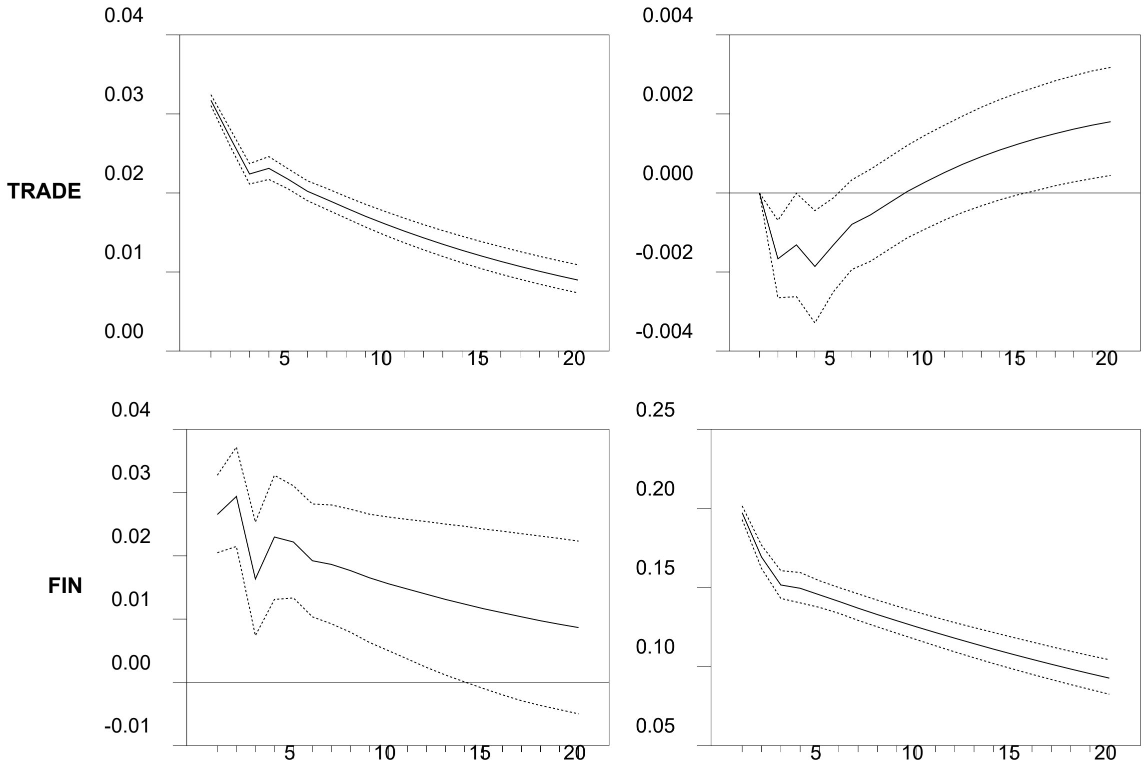
Figure 11 Impulse Responses – Six-variable Model Including 4 Lags



TRADE = trade integration; FIN = financial integration; RGDP = real gross domestic product; CPI = consumer price index; R = policy rate; ER = exchange rate.
Note: The solid lines refer to the mean group estimates and the dotted lines show 90% probability bands.

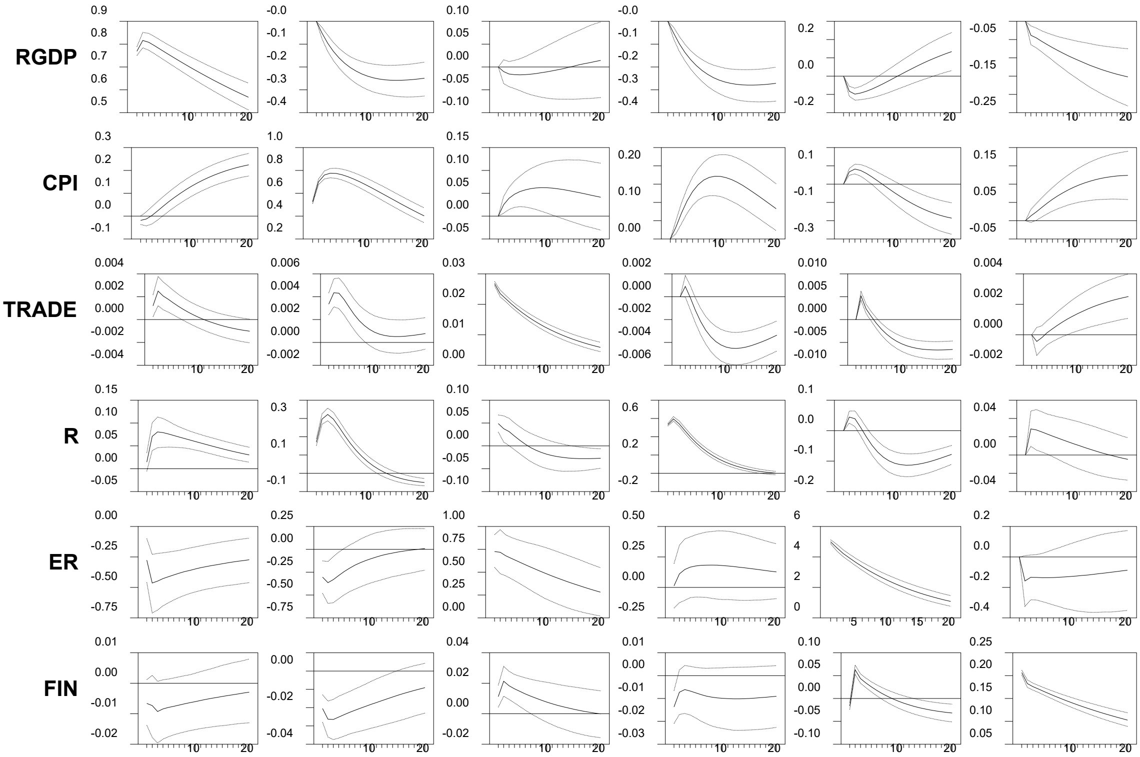
Furthermore, we pooled the data and estimated the panel VAR with individual fixed effects. All other specifications are the same as the baseline model. Figures 12 and 13 show the impulse responses with 90% probability bands for the two- and six-variable models, respectively. Some results are similar to those of baseline models, but others are not. One important difference is the persistence of the effect. The positive effects of TRADE shocks on FIN in this model are less persistent than those in the baseline model. On the other hand, the positive effects of FIN shocks on TRADE in this model are more persistent than those in the baseline model. This suggests that the persistence of the effects can be misleading if we do not properly account for cross-country heterogeneity.

Figure 12 Impulse Responses for Pooled Panel VAR – Model 1



TRADE = trade integration; FIN = financial integration
Note: The solid lines refer to the mean group estimates and the dotted lines show 90% probability bands..

Figure 13 Impulse Responses for Pooled Panel VAR – Model 2



TRADE = trade integration; FIN = financial integration; RGDP = real gross domestic product; CPI = consumer price index; R = policy rate; ER = exchange rate.
Note: The solid lines refer to the mean group estimates and the dotted lines show 90% probability bands.

5. Conclusion

The seemingly unstoppable momentum of postwar economic globalization has slowed down noticeably since the global financial crisis. In particular, trade globalization, as measured by trade relative to GDP, has not only slowed down but gone into reverse. The COVID-19 pandemic, which painfully revealed the sizable downside risks of trade globalization, is likely to add further momentum toward trade deglobalization.

Intuitively, there are good reasons to suspect that trade globalization and financial globalization may affect each other. For example, more trade helps countries become more knowledgeable about and familiar with other countries, thus promoting more cross-border investment. Indeed, the substantial empirical literature has emerged to examine the relationship between the two types of globalization. Given the prospect of post-COVID deglobalization, now is an opportune time to re-visit the relationship.

More specifically, we estimated the dynamic interactions between trade and financial integration using the panel VAR models that allow heterogeneity among individual countries. As the individual Granger-causality tests and the individual country VAR estimations showed, the interactions between trade and financial integrations were not homogenous across countries. Thus, we relaxed the homogeneity assumption and employed the heterogeneous panel VAR. Tackling heterogeneity across countries but providing a clear general conclusion is our original contribution to the literature.

Our most consistent finding is that trade integration has positive and persistent effects on financial integration, and the size of the effect is quite substantial. This result is robust to the various specifications of the empirical models. In addition, we found that financial integration has a positive effect on trade integration. We obtain all these results after controlling for variables such as real GDP and exchange rate that likely affect the two types of integration measures.

The central result of our empirical analysis—the positive and persistent effect of trade integration on financial integration—has provided some important implications for financial integration in the post-COVID-19 era. If the COVID-19 shock does indeed accelerate trade deglobalization, our evidence implies that financial globalization will be adversely affected. However, the world will not necessarily experience financial de-globalization because other countervailing forces promote the financial globalization process. For example, the ongoing financial opening up and liberalization of China, the world's second-biggest economy, will be a significant driver of financial globalization. Besides, financial globalization can be accelerated with the help of FinTech and information technology developments, which have been highly favored during the COVID-19. On the other hand, financial globalization may help slow down the de-globalization of trade after COVID-19, as we found the positive effect of financial integration on trade integration.

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Appendix 1. Data Descriptions and Sources

The variables used in the heterogeneous panel VAR estimation are described below. The data that are not seasonally adjusted by the data provider is seasonally adjusted using X-12 ARIMA.

Table A 1 Data Descriptions and Sources

Variable Name	Description	Source
RGDP	Real Gross Domestic Product, constant 2010 US$ millions	World Bank
CPI	Consumer Price Index, 2010=100	World Bank
R	Policy Rate, end of period, %	IFS, IMF CEIC
ER	Exchange Rate, local currency per US$	IFS, IMF CEIC
GDP	Nominal Gross Domestic Product, current US$ millions	World Bank
TRADE	Exports: Current Account: Goods and Services: Credit, US$ millions Imports: Current Account: Goods and Services: Debit, US$ millions	BOP, IMF
FIN	Assets: IIP: Assets (with Fund Record), US$ millions Liabilities: IIP: Liabilities, US$ millions	IIP, IMF
USRGDP	US Real Gross Domestic Product, constant 2010 US$ millions	World Bank
USFFR	Effective Federal Funds Rate, average of period, %	FRED

Appendix 2. Panel Unit Root Test

We used several tests such as Im-Pesaran-Shin (IPS) tests, augmented Dickey-Fuller tests (ADF), and Phillips-Perron (PP) tests, which are available for unbalanced panel (Im et al., 2003; Choi, 2001). The panel unit root test includes all sample countries. We include time trends and four lags in the regressions. The results in Table A2 show that the null hypothesis of a unit root is not rejected for FIN for all three tests. On the other hand, all test results for TRADE support the stationarity of TRADE in the panel framework.

Table A 2 Panel Unit Root Test

	IPS test	ADF test	PP test
FIN	1.8271	2.4789	-0.6346
TRADE	-2.7131**	-2.4414**	-4.4299***

Note: ***,**,* indicate statistical significance at the 0.01, 0.05, 0.1 levels, respectively.