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Macro-Financial Linkages in East Asia in Global Perspectives[*]

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Abstract:

This paper explores the global aspect of macro-financial linkages in East Asia and other emerging market economies during 1994-2019 in comparison with those in advanced economies. First, we estimate a dynamic factor model to identify global macroeconomic and financial factors affecting their corresponding domestic variables. Then, estimating a VAR model for each economy with these estimated global factors, we quantify the relative importance of the global factors to its macroeconomic fluctuations through variance decomposition. We find that the contributions of the global factors, especially financial factors, are significant, being as large as 15% of the fluctuations, and that there are some distinct similarities and differences both across groups of economies as well as across sub-periods.

JEL Code(s): **E3, F4, F6.**

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1. Introduction

In recent years, macro-financial linkages in both advanced and emerging market economies have been not only strengthened, but also globalised. Macroeconomic fluctuations are increasingly linked to financial variables, such as asset prices, and their financial cycles spill over among these economies. The Global Financial Crisis (GFC) in 2008 is a typical example resulted from these strengthening of global macro-financial linkages.

A large literature on macro-financial linkages focuses on the interactions between real macroeconomic and financial cycles, which are often magnified through intrinsic imperfections in financial markets (Claessens and Kose (2018)). However, the strength of the global macro-financial linkages can vary among countries. They also depend on the type of financial variables. Thus, while most of these economies suffered from serious economic recessions due to the GFC, their timing and degrees varied across economies. Sources and channels of shocks and their spillovers are far from homogeneous across economies. We also need to distinguish among financial variables such as stock, bonds and house prices and to identify whether the shocks are domestic or regional or global as well as variable-specific.

Empirical studies on macro-financial cycles and spillovers in a multi-country setting are burgeoning recently. Using a dynamic factor model, Ha et al. (2020) decompose macroeconomic cycles into those by global and domestic macroeconomic factors and those by spillovers from some global financial factors. They focus on G7 economies over the period of 1985-2019 and find that one global macro factor majorly explains G7 business cycles, but spillovers from global stock price and house price shocks also increasingly affect the cycles to a significant degree.

The purpose of this paper is to extend the research on macro-financial fluctuations for East Asia and other emerging economies in a global setting. Our research questions are: in comparison to advanced economies, whether and which emerging economies are more exposed to global fluctuations

in which types of financial markets? Did the exposure of emerging economies to global macroeconomic as well as financial fluctuations changed and how before and after the Global Financial Crisis?

To answer these questions, we adopt the following approach: First, by estimating a dynamic factor model, we identify global macroeconomic and financial factors among G-7 economies over the period of 1990-2019, focusing on three types of financial markets, i.e. house, stock, and bond markets, following Ha et al. (2020). We identified no single global financial factor across the financial variables, but variable-specific global factors. Then, using these global macroeconomic and financial factors as well as domestic financial and macroeconomic variables, we estimate a vector autoregression (VAR) model for advanced (G7) and some emerging market economies in East Asia, Europe and Latin America. We quantify to what extent these global factors can explain domestic macroeconomic fluctuations in each economy through variance decomposition of their GDP growths.

Our main findings are as follows. First, over the whole sample period 1994-2019, the contribution of global factors to growth variances is significant, but relatively less so on average in emerging market economies in East Asia (as large as 7-24 % as a share) as compared to G7 economies (12-37 %). This difference comes not much from the global macroeconomic factor but mostly from global financial factors (specifically, house and stock prices). In fact, the global macroeconomic factor (or the global business cycle) plays a significant, but not large role in both G7 and East Asia with around 5% as a share of their GDP growth variance.

Second, variance contributions of the global factors generally increase in the 2000s (1998-2007) and then reversed back in the 2010s (2009-2019) both in G7 and East Asia, but in a more magnified way in East Asia. Again, these swinging patterns are dominantly due to the global financial factors.

Third, in the post-GFC period 2009-2019, variance contributions of global factors are larger in emerging market economies in Europe and Latin America than in East Asia. Particularly in emerging

Europe, the role of global factors is as large as that in G7 and East Asia in the pre-GFC 2000s (1998-2007).

The remainder of this paper proceeds as follows: In Section 2, we summarize and discuss the related literature to ours, and present the features of this study. In Section 3, we explain our empirical method to measure an exposure of each emerging economy to global macroeconomic and financial fluctuations. In Section 4, we present our estimation results, and finally, Section 5 concludes.

2. Literature Survey

This paper is related to the literature on the interaction between the financial sector and real economy. Much of this literature focuses on financial crises, financial booms followed by busts (i.e. financial cycles), and interactions between financial and business cycles (Claessens and Kose, 2018). Claessens, Kose, and Terrones (2011) analyse cycles in credit, housing prices, and equity prices in 21 advanced countries from 1960 to 2007. They found key features of financial cycles, such as duration and amplitude. I focus on their finding of cycles in credit and house prices that tend to be highly synchronised within countries. Claessens, Kose, and Terrones (2012) analyse the interaction between financial and business cycles based on data from 44 countries over the period 1960–2010. They confirm that recessions associated with housing and equity price busts tend to be longer and deeper than those associated with other recessions.

The strong synchronisation between credit and housing price cycles may be due to an increase in mortgage lending to households. Jordà, Schularick, and Taylor (2014) examine the long-run database on bank credit that distinguishes between credit to businesses and to households, in 17 advanced economies after 1870. They find that the composition of bank lending has changed; that is, the share of household lending has increased since 1950. Some studies argue that increasing household credit has a negative impact on the real economy, unlike corporate credit (Mian et al., 2015; Jordà et al.,

2020). Studies confirm the increasing share of bank lending to households not only in developed countries but also in some emerging countries (Enya,2016).

Second, this paper is also related to the literature on co-movements in real economies, capital inflows and financial variables across countries (Kose, Otrok, and Whiteman, 2003; Rey, 2015; Igan and Loungani, 2012). Rey (2015) demonstrates co-movements in capital inflows and outflows, asset prices, and credit growth between countries, that is, global financial cycles, based on data from 53 countries over the period 1990–2013. Some studies have identified global cycles across countries in particular financial markets. Hirata et al. (2012) identify global fluctuations in the housing market across 18 advanced economies over the past 40 years.

The following studies examine the drivers of global fluctuations. Hirata et al. (2012) analyse factor augmented VAR (FAVAR), which includes some global factors, and find that the drivers of global housing fluctuations are global interest rate shocks. Igan and Loungani (2012) find that the main common drivers of house price changes in 22 advanced countries are affordability, income, and credit. Milcheva and Zhu (2016) also highlight the importance of bank credit and bank integration, measured by cross-border bank flows, as a driving force for the global housing price cycle. Using global Bayesian VAR analysis, which estimates the VAR model including global financial variables, Miranda-Agrippino and Rey (2015) find that US monetary policy shocks drive global financial cycles.

Furthermore, this study is also related to the literature on the impact of global financial shocks on emerging economies. Many studies analyse the impacts of global factors on capital flows in emerging economies (Cerutti, Claessens, and Rose, 2017; Enya, Kohsaka, and Sugimoto, 2019). However, few studies empirically analyse the linkages between global and domestic financial factors and real economies, that is, global macro-finance. Ha et al. (2020) examine global macroeconomic and financial cycles and the spillovers between them for G7 countries over the period 1985–2019. By estimating Bayesian dynamic factor models, they find that some global cycles are specific to each

financial variable, such as housing prices, stock prices and interest rates. Then, they find spillovers from global housing and stock factors to global macroeconomic factors and the important role of global macroeconomic factors in explaining business cycle fluctuations.

The focus of this study is similar to that of Ha et al. (2020). This study differs from previous studies in the following ways. First, we focus on global macro-finance in emerging economies. We evaluate the relative importance of global and domestic financial factors in explaining macroeconomic fluctuations in emerging economies. Second, we estimate dynamic factor models using the maximum likelihood (ML) method to identify the global factors. The ML method can obtain statistically significant factors.

3. Methodology

3-1. Models for capturing global financial and macroeconomic factors

This study defines the global financial fluctuation as a common fluctuation in asset prices in G7 countries. The study also focuses on three asset prices: housing prices, stock prices, and short-term interest rates. This study estimates a dynamic factor model to capture the common global financial factors. All co-movements among financial and macroeconomic variables in our dynamic factor model are captured by a set of k latent variables F_t. Let Y_t denote an $n \times 1$ vector of observable data. The dynamic factor model is defined as follows:

$$Y_t = \beta F_t + \Gamma_t \quad (1)$$

$$\Gamma_t = \Psi(L)\Gamma_{t-1} + U_t \quad (2)$$

$$F_t = \Phi(L)F_{t-1} + V_t \quad (3)$$

where $E_t\left(U_t U_t^{'}\right) = \Omega$ and $E_t\left(V_t V_t^{'}\right) = I_k$. Γ_t is an $n \times 1$ vector of idiosyncratic components

that captures the movement in each observable series that are specific to that time series. Each element of Γ_t is assumed to follow an independent $AR(q)$ process; hence, $\Psi(L)$ is a block diagonal lag polynomial matrix. Ω is a covariance matrix restricted to the diagonal. The latent factors are denoted by the $k \times 1$ vector F_t, whose dynamics follow an $AR(p)$ process. The $n \times k$ matrix β contains the factor loadings that measure the response of each observable variable to each factor ($k < n$).

When $m = kp$, which is the dimension of the state vector F, it comprises an $m \times 1$ vector of unobservable factors and its lags and $\Phi(L)$ is a matrix lag polynomial. We assume that the variance-covariance matrix in Eq. (3) is an identity matrix for normalisation. We also assume that $\Phi(L)$ is a block diagonal, meaning that the latent factors are uncorrelated.[2]

A dynamic factor model can be estimated using Bayesian estimation or the ML method. Estimation using the ML method has the advantage in that a statistically significant calculation result can be obtained. However, it has a disadvantage: The calculation does not converge for low significance. In this analysis, we value the significance of the estimation results and estimate Eqs. (1), (2), and (3) using the ML method[3]. The ML estimator is implemented by writing the model in state-space form and using the Kalman filter to derive and implement the log likelihood. The maximum number of iterations is set to 100. If the ML method does not converge within the maximum iteration number in the calculation, we regard it as a sign of the absence of a common factor.

First, we estimate a dynamic factor model with one common factor using all financial variables in all G7 countries. Then, we estimate the dynamic factor model that, in addition to global factors, includes (i) variable-specific factors that capture common cross-country fluctuations specific to each financial variable country and (ii) both variable-specific factors and country-specific factors that capture the common to financial variables within a particular country. However, the ML method does

[2] By relaxing this assumption, we can model spillovers across different factors.
[3] Ha et al. estimate a dynamic factor model by Bayesian estimation method.

not converge. Therefore, we believe that our data contain only variable-specific global factors.

We then detect variable-specific global financial factors common to G7 countries by estimating a dynamic factor model with a one-factor model for each financial variable, such as housing prices, stock prices, and interest rates. Furthermore, we identify a global macro factor that captures the co-movement of GDPs of G7 countries by estimating a dynamic factor model.

3-2. Methods for analysing global macro-finance linkage

With recent financial developments, the linkage between the financial sector and the macroeconomy has strengthened not only in developed countries but also in emerging countries. Economic and financial globalisation has increasingly affected foreign financial fluctuations. Thus, both domestic and global financial fluctuations affect macroeconomic fluctuations in emerging countries. This study evaluates the global aspect of macro-financial linkages in emerging countries in East Asia in comparison with those in advanced and other emerging countries.

This study uses a variance decomposition analysis to assess the relative importance of global financial and macroeconomic factors in macroeconomic fluctuations in each economy. We estimate a VAR model with estimated global macroeconomic and financial factors for each country and then examine the global factor's contribution to GDP growth at a horizon of 30 quarters by Cholesky decomposition. We use the VAR model that contains only the minimum necessary variables to examine the global aspect of macro-financial linkages, such as global and domestic variables related to finance and macroeconomy. The VAR model includes three estimated variable-specific global financial factors, one estimated global macroeconomic factor, three domestic financial variables, the real effective exchange rate, and GDP. Thus, we apply the VAR model, which consists of four global variables and five domestic variables. All variables are log-differenced. The only difference is in the interest rate.

The order of variables in the VAR model is the following: global macroeconomic factor, domestic

GDP, global financial factors (housing price, stock price, interest rate factors), domestic financial variables (housing price, stock price, interest rate factors), and exchange rate. This order is motivated by the fact that real variables are likely to adjust slower than financial variables, so the order is from the slow adjustment variable to the fast adjustment variable[4]. Hirata et al. (2012) uses the similar order. The lag order is 2.

3-3. Data

We examine financial and macroeconomic variables in G7 economies for the period 1989 Q3–2019 Q4 to identify global financial and macroeconomic fluctuations. We focus on quarterly price fluctuations of three financial assets: housing, stock, and bond markets and real GDP in G7 countries. We use real housing prices from the property price database of BIS, real stock price, short-term real interest rate, and real GDP from the IFS database and the Organisation for Economic Co-operation and Development's main economic indicator database.

After identifying the global factors, we estimate the VAR model with the identified global macroeconomic and financial factors and domestic macroeconomic and financial variables for each economy, for advanced (G7) and 15 emerging countries. We use real housing prices, real stock prices, short-term real interest rates, and real effective exchange rate variables as domestic financial variables and real GDP as domestic macroeconomic variables.

All variables are deflated by CPI, seasonally adjusted, and log-differenced (except for interest rate). The data availability period for each country is uneven. Tables 1 and 3 show the sample countries and periods, respectively. Table 2 lists the data sources.

[4] For robustness testing, we also analysed in other orders. The contribution of early-order variables to GDP fluctuations tends to be slightly greater, but the main results remain largely unchanged.

Table 1: List of sample countries

Table 2: Data definitions and sources

Table 3: Sample period

4. Results

4-1. Global financial and macroeconomic factors

First, we consider whether global factors are common between financial and macroeconomic variables. We estimate dynamic factor models that assume common global factors between them using the ML method; however, the ML method does not converge. Therefore, we consider that no significant global factor is common to macroeconomic variables and financial variables (as Ha et al., 2020), and we estimate dynamic factor models for global financial factors and global macro factors separately.

Second, this study focuses on variable-specific global factors for global financial factors. As our financial data contain three dimensions (world, country, and financial variable), the following global financial factors can exist: (i) a global financial factor common to all financial variables and all countries; (ii) a global factor common to each financial variable (variable-specific global factor); (iii) a country financial factor common to all financial variables in each country, and an idiosyncratic component for each series. We estimate the models that assume both global financial factors ((i) type factors) and variable-specific global factors ((ii) type factors); however, the ML method does not converge. Therefore, we believe that our data contain only variable-specific global factors.

Panel A of Table 4 shows the results of estimating dynamic factor models with two lag structures in error terms (in Eq. (2)) and factors (in Eq. (3)) for housing price-specific global factors. The housing price-specific global factor we identified (**G_HousingP**) is significantly correlated with housing prices in Canada, France, the United Kingdom, and the United States but not with housing prices in Germany,

Italy, and Japan. This factor is significantly correlated with both the first and second lags. Panel B of Table 4 shows the results for the stock-price-specified global factor[5]. The stock price-specific global factor (**G_StockP** in Panel B-1) correlates with all stock prices in all G7 countries. However, this factor is not significantly correlated with both the first and second lags. Therefore, we use factors obtained by estimating a static factor model that do not allow for dynamics in the factor (**G_StockP** in Panel B-2). Panels C and D of Table 4 show the results for the short-term interest rate-specified global factor and global macroeconomic factor, respectively[6]. We identify that both factors (**G_InterestR** and **G_GDP**) are significantly correlated with variables in all G7 countries and with their two lags.

Table 4: Estimation results for dynamic factor models

Figure 1 shows four variable-specified global financial and macroeconomic factors. We identify a housing price-specified global financial factor (**G_HousingP**), a stock price-specified global financial factor (**G_StockP**), short-term interest rate-specified global financial factor (**G_InterestR**), and global macroeconomic factor (**G_GDP**).

Figure 1: Estimated variable-specific global factors across G7 countries

4-2. Variance decompositions of GDP growth

4-2-1 Contributions of global factors for G7 and EA3 countries

[5] Regarding stock price data, this study uses the stock price return (log difference), which is standardised by the GARCH residual. We believe that this will avoid the problems caused by the heteroscedasticity of stock price returns.

[6] This study does not include a constant term in Eq. (1) for a short-term specified global factor to converge the calculation.

The left two panels in Figure 2 show the G7 averages of the growth variance contributions of global factors (A.1) and domestic variables (A.2.) across four periods. First, over the whole period (1990–2019), the contributions of global factors to growth variance are almost 30% of growth variances on average in G7 countries. Most of them are due to the contribution of global financial factors (especially housing and stock price factors). Second, the contribution of global factors increases in the period before the GFC (1998–2007); then, it decreases slightly after the crisis (2009–2019). This is consistent with Ha et al. (2020): The growth contributions of global financial factors are larger in the period leading up to the financial crisis than in other periods.

The right two panels in Figure 2 show the average contributions of the three emerging economies in East Asia (Korea, Malaysia, and Thailand, EA3) across the four periods (Panel B.1. is for global factor, and Panel B.2. is for domestic variables). In the whole period (1994–2019), the contributions of global factors to growth variance are almost 20% of the growth variance, slightly lower than those of G7. The growth contributions of the global factors of EA3 are larger in the pre-crisis period than in other periods. These values are similar to those of G7. Emerging economies in Asia are becoming not only more integrated with global financial markets but also more macroeconomically and regionally integrated through regional production networks with countries within the region, including China. The finding that the contribution of global finance in EA3 is lower than that of G7 may reflect the situation of advanced regional production integration.

4-2-2 Contributions of global factors in the post-crisis period (2009–2019)

Figure 3 shows the regional averages of the growth variance contributions of global factors (Panel A) and domestic variables (Panel B) in the post-crisis period (2009–2019) across four regions: advanced economies (G7), emerging economies in East Asia (EA5), Europe (EE7), and Latin America

(LA3)[7]. The variance contributions of global factors are larger in EE7 economies on average than in the other emerging economies (EA5 and LA3), while those in EA5 are the smallest among all regional contributions.

The growth variance contributions of global factors in developed and emerging economies between 1990 and 2019 are summarised below.

First, in the whole sample period (1994–2019), the contribution of global factors to growth variances is significant; however, it is relatively less significant on average in emerging economies in East Asia than in G7 economies. This difference originates not much from the global macroeconomic factor, but mostly from global financial factors (specifically, house, and stock prices). In fact, global macroeconomic factors play a small but significant role in both G7 and East Asia, with around 5% as a share of their GDP growth variance.

Second, the variance contributions of the global factors generally increase in the 2000s (1998–2007) and then reverse in the 2010s (2009–2019) both in G7 and East Asia; however, this trend is more significant in emerging economies in East Asia. These swinging patterns are dominantly on account of global financial factors.

Third, in the post-crisis period (2009–2019), the variance contributions of global factors are larger in emerging economies in Europe and Latin America than in East Asia. The variance of global factors in EA5 is the smallest among those in all regions.

Figure 2: Variance decomposition of GDP growth: G7 and East Asian 3 average across periods

Figure 3: Variance decomposition of GDP growth in 2009–2019, average across regions

[7] EA3 consists of Indonesia, China, Korea, Malaysia, and Thailand. EE7 consists of Bulgaria, Czech Republic, Croatia, Hungary, Poland, Slovakia, and Slovenia. LA3 consists of Brazil, Colombia, and Mexico.

4-2-3 Country-specific contributions of global factors

Table 5 shows the variance contributions of global factors to GDP growth for each of the G7 countries across the four periods. During the entire period (1990–2019, Panel A), the contributions of global factors, especially the global housing price factor and global stock price factor, are large (27%–37% of growth variance) in Canada, France, Germany, and Italy. Although over the whole period, the contributions of global factors show an increasing trend in all G7 countries, they increase largely in the period before the crisis (1998–2007) in Canada, France, Germany, and the United States. These country-specific results largely confirm the average-level results. The exceptions are Japan and Great Britain.

Table 6 shows the variance contributions of global factors to GDP growth for each of the emerging countries across the four periods. The blanks in the table indicate that contributions cannot be estimated because the data are not available.

In the 2000s, before the crisis (1998–2007, Panel C), the contributions of global factors are large in all four countries where contributions could be estimated. Global factor contributions have declined in many emerging economies after the crisis, but some European emerging economies, such as Bulgaria, the Czech Republic, Hungary, Slovakia, and Slovenia, have maintained relatively high global factor contributions.

Table 5: Variance decomposition of GDP growth for G7 economies

Table 6: Variance decomposition of GDP growth for emerging economies

5. Conclusion

One of the main findings of this study is that global macro-financial fluctuations, mainly global

financial fluctuations, have significantly affected the macroeconomic fluctuations of G7 as well as some emerging market economies (EMEs) in East Asia since the 1990s, with as large as 20%–50% of the fluctuations on average. Next, we find that the global influence peaked in the post-GFC period to some degree in G7 and some EMEs, including those in East Asia; this is not always the case in some EMEs.

Meanwhile, Tables 5 and 6 show that there are exceptions to the average pattern summarised above. Among G7, Italy, Japan, and Great Britain show distinct patterns in growth contributions of global factors across periods and variables from the other members, which is also applicable to Indonesia, China, Hungary, Slovakia, and Slovenia.

We should note that our results depend on our models and methodology, so we should carefully interpret their quantitative implications. For example, Ha et al. (2020, Table 2), in their model with equity prices, suggest that the contribution of global financial cycles to macroeconomic cycles in G7 is at most 17.3% on average in GDP growth for 1998–2019, which is more modest than our results. This is possibly because they assume only non-contemporaneous spillovers from global financial cycles, as compared to more than 25% in our VAR model results.

Our 'global factors' are not exactly 'global' common factors across full sample economies; this is because we cannot find the existence of global common factors across full sample economies due to the statistical availability of EMEs' data and the ML method. In addition, although we performed various robustness checks on model selection, our VAR model may overlook some important variables relevant to the dynamics of our macroeconomic and financial variables.

Despite these and other limitations, our results indicate significant impacts of global macroeconomic and financial cycles on domestic business cycles quantitatively and their possibly heterogeneous patterns across periods as well as groups of economies; this would generate a good starting point for us to understand the macroeconomic dynamics of the global economy further and

better.

References

Cerutti, Eugenio, Stijn Claessens, and Andrew Rose. 2017. "How Important Is the Global Financial Cycle? Evidence from Capital Flows." NBER Working Paper, 23699.

Claessens, Stijn, and M. Ayhan Kose. 2018. "Frontiers of Macrofinancial Linkages." BIS Papers, 95.

Claessens, Stijn, M. Ayhan Kose, and Marco E. Terrones. 2012. "How Do Business and Financial Cycles Interact?" *Journal of International Economics* 87 (1): 178–90.

Claessens, Stijn, M Ayhan Kose, and Marco E Terrones. 2011. "Financial Cycles: What? How? When?" *IMF Working Paper*, IMF Working Paper, WP/11/76.

Enya, Masahiro. 2016. "Financial and Business Cycles in Emerging East Asian Economies : Features, Interactions, and Changes." *Kanazawa University Economic Review* 36 (2): 133–60.

Enya, Masahiro, Akira Kohsaka, and Kimiko Sugimoto. 2019. "Capital Flow Dynamics in Emerging Market Economies." OSIPP Discussion Paper, 19e011.

Ha, Jongrim, M. Ayhan Kose, Christopher Otrok, and Eswar Prasad. 2020. "Global Macro-Financial Cycles and Spillovers." NBER Working Paper, 26798.

Hirata, Hideaki, M Ayhan, Kose Christopher Otrok, and Marco E Terrones. 2012. "Global House Price Fluctuations: Synchronization and Determinants." NBER Working Paper, 18362.

Igan, Deniz O, and Prakash Loungani. 2012. "Global Housing Cycles." *IMF Working Paper*, IMF Working Paper, WP/12/217.

Jordà, Òscar, Martin Kornejew, Moritz Schularick, and Alan M Taylor. 2020. "Zombies at Large?

Corporate Debt Overhang and the Macroeconomy." NBER Working Paper, 28197.

Jordà, Òscar, Moritz Schularick, and Alan M Taylor. 2014. "The Great Mortgaging: Housing Finance, Crises, and Business Cycles." NBER Working Paper, 20501.

Kose, M. Ayhan, Christopher Otrok, and Charles H Whiteman. 2003. "International Business Cycles: World, Region, and Country-Specific Factors." *American Economic Review* 93 (4): 1216–39.

Mian, Atif R, Amir Sufi, Emil Verner, Dell ' Ariccia, Andy Haldane, Óscar Jordá, Anil Kashyap, et al. 2015. "Household Debt and Business Cycles Worldwide." NBER Working Paper, 21581.

Milcheva, Stanimira, and Bing Zhu. 2016. "Bank Integration and Co-Movements across Housing Markets." *Journal of Banking and Finance* 72 (November): S148–71.

Miranda-Agrippino, Silvia, and Hélène Rey. 2015. "US Monetary Policy and the Global Financial Cycle." NBER Working Paper, 21722.

———. 2020. "The Global Financial Cycle after Lehman." *AEA Papers and Proceedings* 110: 523–28..

Rey, Hélène. 2015. "Dilemma Not Trilemma: The Global Financial Cycle and Monetary Policy Independence." NBER Working Paper, 21162.

Table 1: List of Sample Counties

	G7	Emerging		
Regions		Asia	Latin America	Europe
Full periods: 1990Q1-2019Q4 for G7 1994Q1-2019Q4 for emerging	Canada (CAN) France (FRA) Germany (DEU) Italy (ITA) Japan (JPN) United Kingdom (GBR) United States (USA)	Korea (KOR) Malaysia (MYS) Thailand (THA)	Colombia (COL)	Hungary (HUN)
Sub periods:		Indonesia (IDN) China (CHN)	Brazile (BRA) Mexico (MEX)	Cezch (CZE) Poland (POL) Slovakia (SVK) Slovenia (SVN) Bulgaria (BGR) Croatia (HRV)

Source: Author

Table 2: Data Definitions and Sources

Variable	Definition	Source	Transformation
HousingPrice (fh)	real housing price	BIS: Real property price, Index The Magyar Nemzeti Bank for HUN; Natinal Statistics for BRA, MEX, CZE, POL	log diference
StockPrice (fs)	real stock price	OECD, IFS: Total Share Prices for All Shares	log diference
InterestRate (fr)	3-month interest rate (tresuary bill or interbank)	OECD, IFS: 3-Month or 90-day Rates and Yields	diference
GDP (mgdp)	real GDP	OECD, IFS: Gross Domestic Product by Expenditure in Constant Prices	log diference
G_HousingPrice	Global housing price facor	Comovement of HousingPrice (fh) across G7 countries	
G_StockPrice	Global stock price facor	Comovement of StockPrice (fs) across G7 countries	
G_InterestRate	Global interest rate facor	Comovement of InterestRate (fr) across G7 countries	
G_GDP	Global macro facor	Comovement of GDP (mgdp) across G7 countries	

Notes: Data frequency is quarterly. Macroeconomic and financial variables are all seasonally adjusted. Financial variables are deflated by the CPI of each country. We use log differences of all variables (except for interest rates).

Source: Author

Table 3: Sample period

	Sample period
G-7 countries	1989Q3 - 2019Q4
Emerging Asia	
KOR	1994Q4 - 2019Q4
MYS	1994Q4 - 2019Q4
THA	1994Q4 - 2019Q4
IDN	2002Q4 - 2019Q4
CHN	2006Q1 - 2019Q4
Latin America	
COL	1994Q4 - 2019Q4
BRA	2003Q4 - 2019Q4
MEX	2005Q4 - 2019Q4
Emerging Europe	
HUN	1995Q4 - 2019Q4
CZE	2005Q4 - 2019Q4
POL	2007Q2 - 2019Q4
SVK	2006Q4 - 2019Q4
SVN	2007Q4 - 2019Q4
BRG	2005Q4 - 2019Q4
HRV	2003Q3 - 2019Q4

Source: Author

Table 4: Results of estimating a dynamic factor model

A: Results for a housing price-specified global factor

	can_fh	fra_fh	deu_fh	ita_fh	jpn_fh	gbr_fh	usa_fh
G_HousingP	0.002	0.002	0.000	0.000	0.001	0.003	0.002
	[1.821]*	[3.163]***	[-0.213]	[0.196]	[1.376]	[1.962]**	[1.958]*
constant	0.007	0.006	0.002	0.003	-0.001	0.005	0.003
	[2.206]**	[1.536]	[0.854]	[0.706]	[-0.288]	[0.957]	[0.645]

	G_HousingP
G_HousingP	1.547
(t-1)	[7.060]***
G_HousingP	-0.607
(t-2)	[-2.959]***

Notes: Upper panel shows the estimated coefficients and t-values (in brackets) in the model that observed housing price of each country is regressed on constant and unobserved factor that follows a second-order autoregressive process. Lower panel shows estimated coefficient and t-values (in brackets) in the model for unobserved factor. * p < 0.10, ** p < 0.05, *** p < 0.01.

B: Results for a stock price-specified global factor

B-1: Estimation result for a dynamic factor model

	can_fs	fra_fs	deu_fs	ita_fs	jpn_fs	gbr_fs	usa_fs
G_StockP	0.811	0.944	0.886	0.856	0.579	0.884	0.787
	[10.800]***	[14.033]***	[13.199]***	[11.619]***	[6.558]***	[12.089]***	[10.893]***
constant	0.002	0.002	0.000	0.000	0.002	0.001	0.002
	[0.024]	[0.021]	[0.005]	[-0.003]	[0.018]	[0.009]	[0.019]

	G_StockP
G_StockP(t-1)	0.076
	[0.787]
G_StockP(t-2)	0.008
	[0.079]

Notes: Upper panel shows the estimated coefficients and t-values (in brackets) in the model that observed stock price of each country is regressed on constant and unobserved factor that follows a second-order autoregressive process. Lower panel shows estimated coefficient and t-values (in brackets) in the model for unobserved factor. * p < 0.10, ** p < 0.05, *** p < 0.01.

Table 4: Results of estimating a dynamic factor model (Continued)

B-2: Estimation result for a static factor model

	can_fs	fra_fs	deu_fs	ita_fs	jpn_fs	gbr_fs	usa_fs
G_StockP	0.782	0.956	0.895	0.862	0.585	0.896	0.825
	[9.948]***	[13.525]***	[12.917]***	[11.281]***	[6.508]***	[11.997]***	[11.053]***
constant							

Notes: Table shows the estimated coefficients and t-values (in brackets) in the model that observed stock price of each country is regressed on unobserved factor that does not follow an autoregressive process. * p < 0.10, ** p < 0.05, *** p < 0.01.

C: Results for a short-term interest rate-specified global factor

	can_fr	fra_fr	deu_fr	ita_fr	jpn_fr	gbr_fr	usa_fr
G_InterestR	1.257	0.93	1.008	0.674	0.515	0.619	1.499
	[6.839]**	[9.261]**	[7.694]**	[6.630]**	[2.995]**	[5.698]**	[8.552]**
constant							

	G_InterestR
G_InterestR(t-1)	-0.413
	[-3.830]***
G_InterestR(t-2)	-0.278
	[-2.725]***

Notes: Upper panel shows the estimated coefficients and t-values (in brackets) in the model that observed interest rate of each country is regressed on unobserved factor that follows a second-order autoregressive process. Lower panel shows estimated coefficient and t-values (in brackets) in the model for unobserved factor. * p < 0.10, ** p < 0.05, *** p < 0.01.

Table 4: Results of estimating a dynamic factor model (Continued)

D: Results for a global macroeconomic factor

	can_mgdp	fra_mgdp	deu_mgdp	ita_mgdp	jpn_mgdp	gbr_mgdp	usa_mgdp
G_GDP	0.002	0.002	0.003	0.003	0.003	0.002	0.002
	[4.751]**	[7.251]**	[5.546]**	[6.896]**	[4.544]**	[4.570]**	[5.040]**
constant	0.005	0.004	0.004	0.002	0.003	0.005	0.006
	[5.274]**	[5.333]**	[3.223]**	[1.867]*	[2.431]**	[4.604]**	[7.406]**

	G_GDP
G_GDP (t-1)	1.083
	[7.299]***
G_GDP(t-2)	-0.372
	[-2.665]***

Notes: Upper panel shows the estimated coefficients and t-values (in brackets) in the model that observed GDP of each country is regressed on unobserved factor that follows a second-order autoregressive process. Lower panel shows estimated coefficient and t-values (in brackets) in the model for unobserved factor. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5. Variance Decomposition of GDP growth for G7 economies

A. 1990q1-2019q4: Full sample

	CAN	FRA	DEU	ITA	JPN	GBR	USA
G_HousingPrice	8.3	14.5	6.0	13.4	3.5	8.0	5.6
G_StockPrice	14.3	16.6	13.4	9.5	2.6	0.8	2.0
G_InterestRate	2.2	0.3	0.6	1.2	2.3	0.4	0.8
G_GDP	6.4	5.8	8.9	2.9	7.0	3.5	3.5
global	31.3	37.2	29.0	27.0	15.5	12.6	12.0
HousingPrice	0.9	1.7	8.7	1.3	3.4	8.8	14.9
StockPrice	2.2	0.3	1.9	1.1	0.2	5.8	2.1
InterestRate	2.1	1.1	1.7	2.8	0.7	3.9	0.7
REER	2.0	0.7	2.0	0.8	9.0	3.0	3.4
GDP	61.6	59.0	56.7	67.1	71.3	65.9	66.8
domestic	68.7	62.8	71.0	73.0	84.5	87.4	88.0
total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

B. 1990q1-2007q4: Before the GFC

	CAN	FRA	DEU	ITA	JPN	GBR	USA
G_HousingPrice	3.1	9.4	8.5	3.0	5.2	0.4	2.2
G_StockPrice	20.4	22.2	11.8	3.3	1.4	0.7	8.0
G_InterestRate	1.3	0.9	3.0	2.7	3.3	1.7	4.3
G_GDP	12.6	10.5	4.5	3.9	3.0	1.0	7.6
global	37.5	43.0	27.8	12.9	12.9	3.7	22.2
HousingPrice	1.9	2.5	5.4	3.7	4.7	2.8	2.6
StockPrice	2.1	0.9	2.5	3.1	0.7	7.0	2.8
InterestRate	2.4	2.0	10.6	9.0	0.4	0.3	5.8
REER	3.6	10.7	2.0	6.7	1.1	1.9	1.1
GDP	52.5	40.9	51.7	64.6	80.2	84.3	65.5
domestic	62.5	57.0	72.2	87.1	87.1	96.3	77.8
total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 5. Variance Decomposition of GDP growth for G7 economies (Continued)

C. 1998q1-2007q4: From the AFC to the GFC

	CAN	FRA	DEU	ITA	JPN	GBR	USA
G_HousingPrice	5.6	3.4	11.7	3.7	3.6	0.6	1.2
G_StockPrice	26.8	32.1	16.4	1.3	7.7	3.8	10.5
G_InterestRate	7.2	4.0	1.7	2.7	3.8	6.1	2.5
G_GDP	15.7	6.0	4.1	5.9	3.2	8.0	10.6
global	55.3	45.5	33.8	13.5	18.4	18.5	24.8
HousingPrice	4.9	5.1	3.7	4.6	12.5	0.7	3.6
StockPrice	1.8	0.5	7.5	5.7	2.5	3.7	1.8
InterestRate	4.6	2.4	9.9	3.0	2.2	1.5	9.4
REER	10.3	11.9	0.9	15.8	1.0	12.4	1.4
GDP	23.1	34.6	44.2	57.3	63.3	63.3	58.9
domestic	44.7	54.5	66.2	86.5	81.6	81.5	75.2
total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

D. 2009q1-2019q4: After the GFC

	CAN	FRA	DEU	ITA	JPN	GBR	USA
G_HousingPrice	5.6	7.3	2.1	7.6	4.8	11.3	7.0
G_StockPrice	12.2	9.4	6.0	2.5	7.9	1.9	1.3
G_InterestRate	1.4	0.6	2.6	1.1	2.9	1.6	2.9
G_GDP	2.8	2.0	20.2	24.4	6.8	9.7	9.1
global	22.1	19.3	30.9	35.5	22.4	24.5	20.3
HousingPrice	9.2	22.9	11.6	3.0	3.2	6.0	4.1
StockPrice	19.1	8.8	6.0	3.7	1.9	13.8	0.4
InterestRate	6.7	8.6	6.5	1.1	3.1	6.7	0.3
REER	5.4	4.2	7.0	4.8	6.9	6.1	2.1
GDP	37.6	36.3	37.9	51.9	62.5	42.8	73.0
domestic	77.9	80.7	69.1	64.5	77.6	75.5	79.7
total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Notes: The growth variance contributions of the relevant factors are reported for each country across periods. The variance contribution is Cholesky decomposition at a horizon of 30 quarters.

Source: Author's calculation

Table 6. Variance Decomposition of GDP growth for emerging economies

A. Full sample: -2019q4

	IDN	CHN	KOR	MYS	THA	BRA	COL	MEX	BGR	CZE	HRV	HUN	POL	SVK	SVN
Start period	2002 q4	2006 q1	1994 q4	1994 q4	1994 q4	2003 q4	1994 q4	2005 q4	2005 q4	2005 q4	2003 q3	1995 q4	2007 q2	2006 q4-	2007 q4-
G_HousingPrice	7.6	1.5	1.4	4.6	3.6	8.3	2.8	22.8	25.7	26.9	18.9	21.6	3.8	15.8	17.3
G_StockPrice	3.2	1.4	1.9	7.1	2.2	1.5	2.9	4.4	4.6	6.2	1.1	2.7	1.5	5.9	1.3
G_InterestRate	1.2	1.7	0.2	2.2	1.5	4.1	1.9	2.5	1.2	0.6	1.1	1.6	1.5	2.7	3.8
G_GDP	5.0	7.2	3.6	10.1	5.7	13.0	3.7	7.8	10.7	1.4	11.4	4.4	5.2	13.2	7.9
global	17.0	11.6	7.1	23.9	13.0	26.9	11.3	37.6	42.3	35.2	32.6	30.3	12.0	37.6	30.3
HousingPrice	0.6	6.0	2.2	20.1	3.3	13.1	8.4	10.3	9.8	2.1	1.3	5.3	12.7	7.7	5.1
StockPrice	10.9	10.8	20.2	8.4	5.8	6.2	2.6	1.1	3.2	3.1	3.1	0.2	9.0	4.5	3.1
InterestRate	2.3	2.8	0.9	3.6	2.5	10.5	2.5	1.7	3.0	4.9	4.4	0.0	3.5	4.8	2.6
REER	1.5	1.8	3.4	4.8	9.4	1.2	0.8	12.4	6.3	15.8	4.0	2.6	2.5	2.4	6.1
GDP	67.8	66.9	66.3	39.3	66.0	42.0	74.4	37.0	35.3	39.0	54.6	61.5	60.3	43.0	52.8
domestic	83.0	88.4	92.9	76.1	87.0	73.1	88.7	62.4	57.7	64.8	67.4	69.7	88.0	62.4	69.7
total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

B. 1994q4 (1995q4)-2007q4: Before the GFC

	IDN	CHN	KOR	MYS	THA	BRA	COL	MEX	BGR	CZE	HRV	HUN	POL	SVK	SVN
Start period			1994 q4-	1994 q4-	1994 q4-		1994 q4-					1995 q4-			
G_HousingPrice			1.6	2.3	2.5		10.8					5.3			
G_StockPrice			2.3	7.0	3.2		2.8					1.1			
G_InterestRate			2.8	4.4	9.5		7.4					8.6			
G_GDP			9.1	8.6	5.4		2.8					6.8			
global			15.8	22.4	20.7		23.7					21.8			
HousingPrice			3.5	28.0	9.4		11.5					2.5			
StockPrice			13.7	9.4	7.4		2.5					1.0			
InterestRate			0.7	1.7	1.7		2.8					0.8			
REER			6.6	9.9	12.9		3.0					4.5			
GDP			59.7	28.7	47.8		56.5					69.5			
domestic			84.2	77.6	79.3		76.3					78.2			
total			100.0	100.0	100.0		100.0					100.0			

Table 6. Variance Decomposition of GDP growth for emerging economies (Continued)

C. 1998q1-2007q4: From the AFC to the GFC

	IDN	CHN	KOR	MYS	THA	BRA	COL	MEX	BGR	CZE	HRV	HUN	POL	SVK	SVN
Start period			1998 q1-	1998 q1-	1998 q1-		1998 q1-					1998 q1-			
G_HousingPrice			4.6	4.6	7.4		9.6					5.3			
G_StockPrice			5.1	17.9	7.1		5.7					1.4			
G_InterestRate			3.7	6.2	6.1		17.6					9.1			
G_GDP			9.7	5.0	5.3		2.6					9.4			
global			23.0	33.5	26.0		35.6					25.2			
HousingPrice			10.6	4.1	3.5		8.3					1.1			
StockPrice			6.5	7.4	3.9		1.3					2.0			
InterestRate			1.1	9.6	9.0		3.6					7.8			
REER			6.9	8.8	8.0		4.0					8.7			
GDP			51.8	36.6	49.6		47.1					55.1			
domestic			77.0	66.5	74.0		64.4					74.8			
total			100.0	100.0	100.0		100.0					100.0			

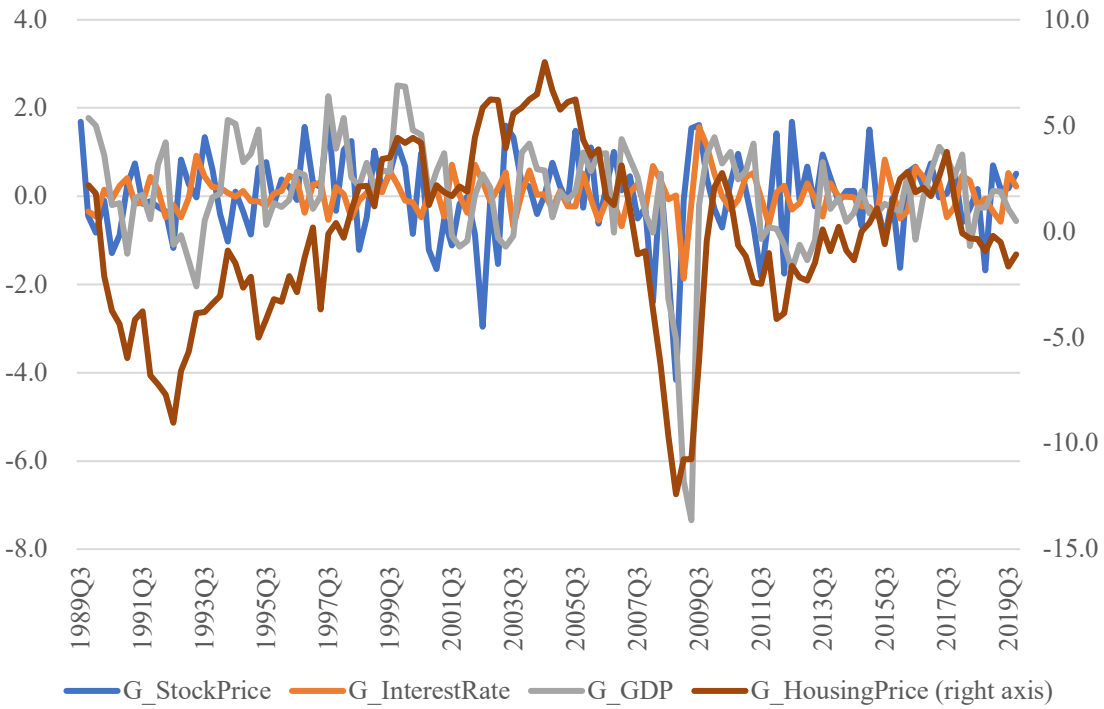
D. 2009q1-2019q4: After the GFC

	IDN	CHN	KOR	MYS	THA	BRA	COL	MEX	BGR	CZE	HRV	HUN	POL	SVK	SVN
Start period	2009 q1-	2009 q1-	2009 q1-	2009 q1-	2009 q1-	2009 q1-	2009 q1-	2009 q1-	2009 q1-	2009 q1-	2009 q1-	2009 q1-	2009 q1-	2009 q1-	2009 q1-
G_HousingPrice	13.2	9.8	2.2	3.8	1.8	7.2	6.0	8.6	18.1	5.5	7.7	5.1	4.8	2.7	5.9
G_StockPrice	5.3	2.0	1.7	4.4	5.7	4.1	7.2	6.8	4.8	8.3	1.5	3.7	0.7	5.1	9.7
G_InterestRate	1.2	1.6	2.6	7.1	0.7	6.7	2.7	2.7	1.6	1.2	1.5	0.8	2.7	1.5	3.7
G_GDP	5.5	1.4	3.3	12.6	6.4	7.7	2.5	12.1	8.7	3.4	8.5	10.1	7.3	16.6	11.5
global	25.2	14.8	9.9	27.9	14.6	25.7	18.3	30.2	33.2	18.4	19.2	19.8	15.6	25.9	30.8
HousingPrice	11.8	2.2	4.3	6.5	7.8	21.3	3.1	7.5	3.6	9.9	6.6	8.5	8.0	1.7	5.8
StockPrice	2.6	1.7	10.3	2.6	2.3	5.5	1.3	2.1	2.7	5.5	7.5	3.4	7.5	0.9	4.2
InterestRate	9.1	5.2	5.2	4.7	1.6	11.7	7.3	3.2	4.2	2.6	4.7	3.0	2.3	2.4	3.0
REER	1.0	5.5	1.8	3.9	5.1	1.9	0.9	6.7	2.4	1.5	5.8	16.5	2.6	6.6	4.9
GDP	50.2	70.6	68.4	54.3	68.5	33.8	69.1	50.4	53.9	62.1	56.3	48.8	64.1	62.6	51.4
domestic	74.8	85.2	90.1	72.1	85.4	74.3	81.7	69.8	66.8	81.6	80.8	80.2	84.4	74.1	69.2
total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Notes: The growth variance contributions of the relevant factors are reported for each country across periods. The variance contribution is calculated by Cholesky decomposition at a horizon of 30 quarters.

Source: Author's calculation

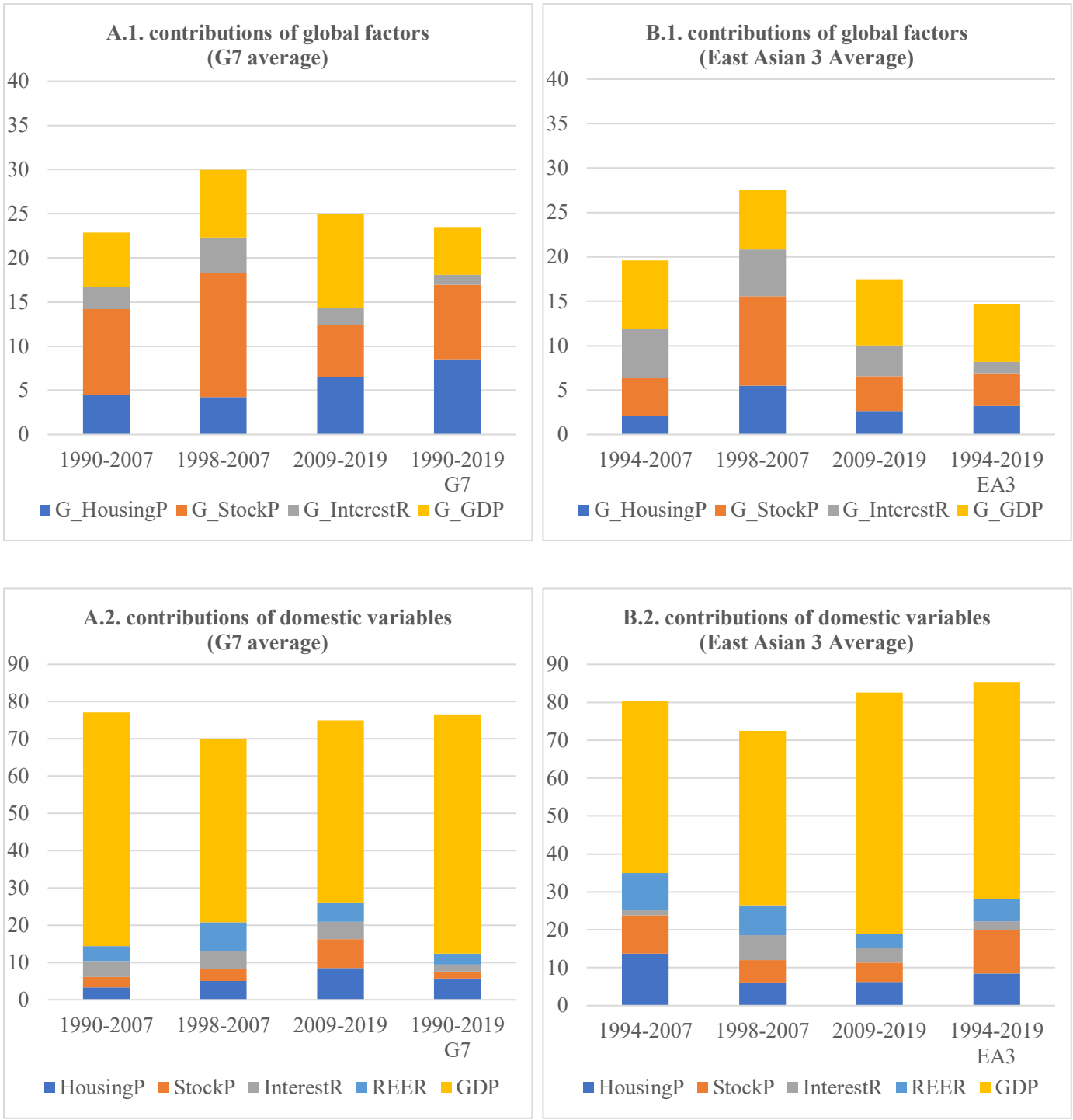
Figure 1: Variable-specific global factors across the G-7 countries: housing p, stock p, ST interest rate, and gdp



Notes: G_HousingPrice is a housing price-specific global financial factor, G_StockPrice is a stock price-specific global financial factor, G_InterestRate is a short-term interest rate-specific global financial factor, and G_GDP is a GDP-specific global macroeconomic factor. Global financial and macro factors are identified by a dynamic or static factor model estimation.

Source: Author's calculation

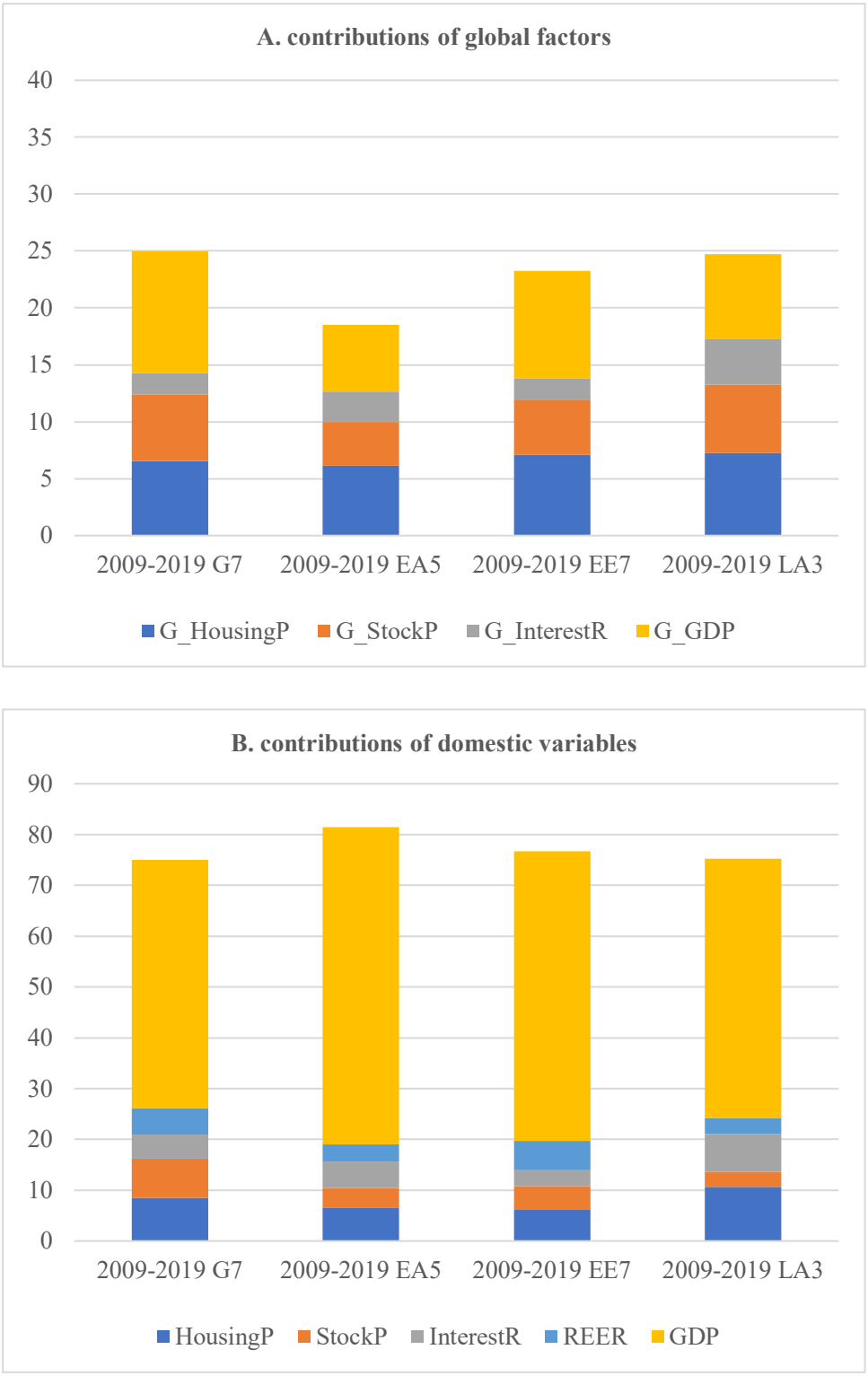
Figure 2. Variance Decomposition of GDP growth: G7 and East Asian 3 Average across periods



Notes: The two figures on the left report the G7 averages of growth variance contributions of the relevant factors across four periods. The two figures on the right report the East Asian 3 averages of that. East Asian 3 consists of Korea, Malaysia, and Thailand. The variance contribution is Cholesky decomposition at a horizon of 30 quarters.

Source: Author's calculation

Figure 3. Variance Decomposition of GDP growth in 2009-2019, Average across regions



Source: Author's calculation