sciendo

UDK: 336.7:005.44(594)
DOI: 10.2478/jcbtp-2020-0029

Journal of Central Banking Theory and Practice, 2020, special issue, pp. 215-235

Berry A. Harahap [*], ***Pakasa Bary*** [**], ***Anggita Cinditya M. Kusuma*** [***]

The Determinants of Indonesia's Business Cycle[1]

* *Department of Economic and Monetary Policy at Bank Indonesia, Jakarta, Indonesia*

E-mail: berry@bi.go.id

** *Department of Economic and Monetary Policy at Bank Indonesia, Jakarta, Indonesia*

E-mail: pakasa@bi.go.id

*** *Department of Economic and Monetary Policy at Bank Indonesia, Jakarta, Indonesia*

E-mail: anggita_cmk@bi.go.id

Abstract: This study investigates the determinants of Indonesian's business cycle using the global vector autoregressive (GVAR) approach, by including spillover responses within 33 countries with 2000 bootstrap replications. The results show that Indonesia's business cycle is influenced by both domestic and external factors. In addition to exogenous shocks from output, the dominant domestic factors are monetary policy and price competitiveness. The dominant external factors are global economic activity and liquidity conditions, particularly those originating from the Chinese economy. Spillovers from a number of economies appear to shape Indonesia's economic fluctuations. The paper discusses such relevant spillovers.

Keywords: Business cycle; Trade relations; Global vector autogressive approach.

JEL Classification: E32; F44; E30; C22

[1] The authors thank two anonymous referees in journal reviewing process, Reza Anglingkusumo, Maryam Akbari Nasiri, Bernard Njindan Iyke, Paresh K. Narayan, and participants at BMEB conference in Bali, Indonesia in August 2019. The views expressed in this paper are those of the authors and do not necessarily represents the views of Bank Indonesia.

1. Introduction

This paper assesses the determinants of Indonesia's business cycle. Business cycle can be very helpful for policy makers as well as the private sector, as it provides a tool for estimating short-term economic behavior, for evaluating the outcomes of certain policy decisions in different markets, or for assessing the implementation of policies in accordance with the cycle phase (Jimenez, 2001). Moreover, the awareness of current state of the economy is undeniably important, for instance Tarsidin, Idham, and Rakhman (2018) suggested that by knowing the state of the economy and projections of upcoming conditions, the policy maker can determine the appropriate policy response to adopt. Hence, a comprehensive understanding of business cycle determinants enables policy makers to design effective policy programs. Apart from this, it enables private sector to develop effective strategies for their businesses.

Although the analysis of business cycle is commonly conducted in number of studies (see for example, Burn and Mitchell, 1946; Walsh, 1999; Comin and Gertler 2006; Male, 2011; Drehmann et al, 2012; Altuğ and Bildirici, 2012 and Han 2019), study about the determinants of business cycle remain limited and elusive. Jimenez (2001) argues that the external sector plays a key role in shaping small and open business cycle dynamics, where the origin of business cycles in developing countries are understood as impulses originating from developed countries that condition the evolution of business cycles, especially the turning point. In other words, business cycles in developing countries are arguably not purely endogenous processes. The international origin of economic fluctuations in small open economies operate along two channels: (i) through the variation in relationships with major trading and financial partners (Schmitt-Grohe, 1998); and (ii) through random events, such as the oil crisis (Jimenez, 2001). For business cycle analysis, the first variation is important because persistence occurs from time to time[2].

Shocks originating from major trading and financial partners are usually distributed to small open economies through two transmission mechanisms, trade and financial channels. The trade channel is mainly related to changes in the small open country's exports (demand factors), while the financial channel relates to variations in domestic interest rates (cost factors) because of changes in world interest rates (Schmitt-Grohe, 1998). These transmission mechanisms are consistent with the intuition that a small open country's business and financial cycle determinants are closely related to its economic conditions, as well as to global economic conditions (Jimenez, 2001). Garratt, Lee, and Shields (2013) find support for this intuition by showing that economic performances across countries are linked through inter-

[2] Impulses coming from trading/financial partners are typically propagated in the small country through commercial and financial channel and it is more regularly occur rather than random events such as oil crisis (Jimenez, 2001).

national trade and capital markets such that business cycle fluctuations in a given country is usually transmitted to others. Dufrénot and Keddad (2014) in their study with a Markov-switching approach also provide evidence that the signals contained in some regional and global leading business cycles can impact business cycle in some ASEAN countries, furthermore their finding suggests that ASEAN economies are characterized by a strong dependence on external demand. In the Indonesian context, Silalahi, Wibowo, and Nurliana (2012) show that international shocks affect the bank lending.

In view of the preceding, our aim is to identify determinants of the business cycle in Indonesia, a small open economy. Prior studies (Alamsyah, Adamanti, Yumanita, and Astuti, 2004; Wimanda and Djuranovik, 2014a; 2014b; Andaiyani and Falianty, 2017) consider aspects on the country's business or financial cycles. Some other studies, for instance Kim, Kose, and Plummer (2003), examined the similarities and differences of business cycle characteristics of the Asian countries and compares the cyclical regularities in this region with those of G7 countries. Narayan (2011) study the role of permanent and transitory shocks in determining Indonesia's business cycle through using a simple real business cycle model and found that at business cycle horizons permanent shocks explain the bulk of variations in income, consumption and investment for Indonesia. Moreover, Moneta and Rüffer (2006) examined the extent and nature of synchronisation of business cycle in ten East Asian countries. They found that cross-country spill-over effects explain only a small part of the co-movement in the region and economic linkages with Europe and North America may have contributed to the observed synchronisation. However, none of those studies closely examines the determinants of the business cycle in certain economy. Dutu (2016) comes close, by showing that a decelerating trend of Indonesia's economic growth is reinforced by slower world growth.[3] In spite of this, a number of questions including which countries play the key role in Indonesia's slow economic growth, what is the contribution of domestic factors relative to external factors in the slow growth, among others, remain unanswered. Our study attempts to provide answers to these questions.

Indonesia is a small open economy. Hence, its business cycle is arguably influenced by both domestic and global factors. We take this into account by employing the GVAR approach and sample covering 33 countries that account for about 90% world

[3] Studies, such as Simorangkir (2012), and Anwar and Ali (2018), developed early warning systems to detect downturns. For a survey of these studies, see Padhan and Prabheesh (2019). Others such as Juhro and Iyke (2019a, b) developed financial condition indexes to track the direction of the financial system and the economy as a whole or demonstrated that consumer confidence is an important driver of consumption expenditure, which determines business cycle fluctuations in Indonesia.

GDP and over a period of 1979Q2 to 2016Q4[4]. We show the contribution of these determinants by generating forecast error variance decompositions (FEVDs) via 2000 bootstrap replications. The estimates suggest that the Indonesian business cycle is indeed influenced by domestic and global factors. Apart from the exogenous shock from output (productivity shock), the dominant domestic factors are monetary policy and price competitiveness. With regards to the global factors, we find global economic activity and liquidity conditions, particularly those origining from China, to be influential. This is consistent with Sznajderska (2019) who states that since China plays an important role in traditional global trade and the global supply chain, a slow down in its economy may have indirect effects on the rest of the world, especially through neighboring countries. We also find shocks originating from a number of relatively remote economies play a sizeable role in Indonesia's business cycle fluctuations. From a more general perspective, this suggest that spillover effects and indirect relations via a third country are important to measure, as they provide a clearer picture of the fluctuations in an economy. We provide some counterfactual analysis to 'normalize' the effect of China's rebalancing.

Our paper relates to the broader literature discussing transmission of external shocks such as Stock and Watson (2002); Kose, Otrok, and Whiteman (2003, 2008); Crucini, Kose, and Otrok (2011); Mumtaz, Simonelli, and Surico (2011); Vasishtha and Maier (2013); Jo (2014); Solomos, Papageorgiou, and Koumparoulis (2016); Kose, Otrok, and Prasad (2012); Inoue, Kaya, and Ohshige (2015); and Cashin, Mohaddes, Raissi (2017a). Crucini, Kose, and Otrok (2011), using the dynamic factor model, find that oil prices, productivity, and terms of trade are the drivers of business cycles. Vasishtha and Maier (2013) find, using the factor-augmented vector autoregressive (FAVAR) model with more than 260 series for 20 OECD countries, that Canada is mainly exposed to shocks against foreign activity and commodity prices. Solomos, Papageorgiou and Koumparoulis (2016) find, using the generalized linear model (GLM), that the total value of traded shares, private sector debt, and net inflows of FDI are significant determinants in the fluctuations in business cycles in 12 European countries. Inoue, Kaya, and Ohshige (2015) find, using GVAR model with 33 countries, that China's slowdown mostly affects commodity exporters such as Indonesia, and countries that are heavily dependent on exports, that include Japan, Malaysia, Singapore and Thailand. Consistent with Inoue, Kaya, and Ohshige (2015), Cashin, Mohaddes, and Raissi (2017a) find, using the GVAR model, that negative output shocks from China have the greatest influence on diversified commodity exporters and ASEAN-5 countries (Indonesia, Malaysia, Singapore, Thailand, without the Philippines).

[4] GVAR approach contains 33 countries, covering about 90% of world output as stated in the GVAR Handbook (Mauro & Pesaran, 2013). List of the countries is displayed in Table 1.

Our paper is most comparable to Boschi and Girardi (2011) and Boschi, Marzo, and Salotti (2015), since they explore the determinants of business cycles using GVAR as well. Our paper differs from theirs in at least three ways. First, it focuses on Indonesia, whereas they focus on Latin America and the Euro Area. By focusing on Indonesia, we add an important developing country to the existing sample in the literature. Second, this paper is not classifying countries from a certain region into one group, particularly to analyze the origin of the shocks. This is due to one objective of this paper is to determine countries which have a major role to economic fluctuation in Indonesia. Third, our paper extends the sample period in Boschi, Marzo, and Salotti (2015) by 10 years. Hence, our estimates, are perhaps more precised.

The paper proceeds as follows. Section 2 discusses our data and methodology. We discuss our main findings in Section 3. Section 4 sets forth our conclusions and policy recommendations.

2. Methodology and Data

We analyze the determinants of Indonesia's business cycle using GVAR model developed by Pesaran, Schuermann, and Weiner (2004) and later by Dees, Di Mauro Pesaran, and Smith (2007). GVAR model combines time series, cross-sectional, and factor analysis techniques to explain macroeconomic and financial phenomena. Technically, the model is an aggregation of country-specific vector autoregressions (VARs), whereby domestic variables are related to foreign variables that are specific to each country (Pesaran, Schuermann, and Weiner, 2004; Dees, Di Mauro Pesaran, and Smith, 2007). The foreign variables are connected to the domestic variables of a given country through trade, financial, or other patterns that are considered appropriate for that country (Dees, Di Mauro Pesaran, and Smith, 2007).

The seemless interaction of foreign with domestic variables within the GVAR model makes it popular in many applications including macro stress testing (Al-Haschimi, Dées, Mauro, and Jancokova, 2014), analysing the growing importance of China in the world economy (Cesa-Bianchi, Pesaran, Rebucci, and Xu, 2012; Cashin, Mohaddes, and Raissi, 2017a), analysing the global macroeconomic transmission of weather shocks (Cashin, Mohaddes, and Raissi 2017b), assessing the impact of commodity price shocks (Mohaddes and Pesaran, 2016, 2017; Cashin, Mohaddes, Raissi, and Raissi, 2014; Mohaddes and Raissi, 2019), assessing the impact of US monetary policy shocks (Harahap, Bary, Panjaitan, and Satyanugroho, 2019), analyzing other real and financial sector shocks (Chudik and Fratzscher, 2011; Eickmeier and Ng, 2015), and forecasting macroeconomic indicators (Favero, 2013).

The GVAR model is developed as follows. For each country, the conventional VAR model is expanded to capture foreign variables. These foreign variables are con-

structed as weighted averages of foreign variables that correspond to the domestic variable, typically using trade weights[5]. Suppose there are N + 1 countries in the global economy with index i = 0,1,2, ... N, where country 0 is used as numeraire (or reference) country. Then, individual $VARX^*(p_i, q_i)$ for each country (where $VARX^*$ denotes a VAR augmented with foreign variables) is as following:

$$x_{it} = a_{i0} + a_{i1}t + \sum_{s=1}^{p_i} \Phi_i x_{i,t-s} + \sum_{s=0}^{q_i} \wedge_i x^*_{i,t-s} + \varepsilon_{it}, \quad \varepsilon_{it} \sim i.i.d(0, \sum i) \qquad 1)$$

where x_{it} is a vector of domestic variables (i.e. GDP, CPI, interest rates and real exchange rate) of size $k_i \times 1$, x^*_{it} is the vector of foreign variables with size $l_i \times 1$, and ε_{it} is a serially uncorrelated and cross-sectionally weakly dependent process. The foreign variables are computed as weighted averages of the corresponding domestic variables of all countries, with the weights also being country-specific; that is

$$x^*_{it} = \sum_{j=0}^{N} \omega_{ij} x_{jt} \qquad 2)$$

where ω_{ij} are the weights such that $\omega_{ii} = 0$ and $\sum_{j=0}^{N} \omega_{ij} = 1$.

The value of ω_{ij} for country *i* is built based on the flow portion of country *j* to the total flow received by country *i*. This represents the trade relationship between country *i* and *j*. Country-specific foreign variables x^*_{it} are considered as weakly exogenous, and "long-run forcing" in the model (Dees, di Mauro, Pesaran, and Smith, 2007). This means the coefficient of the error correction term is set to zero in the foreign variable equation. Thus, the dynamics of the foreign variables are not affected by long-equilibrium paths, unlike those of domestic variables. For each country, the parameters are estimated using reduced-rank regressions and ordinary least squares (OLS).

The estimation of the GVAR model is completed using the country-level parameter estimates to indicate the global parameters. Although the estimation is carried out separately for each country, the GVAR model is solved simultaneously, because of sampe-period dependence between domestic variables x_{it} and foreign variables x^*_{it}. The estimates of the GVAR model can be used to obtain impulse responses.

If $z_{it} = (x_{it}, \ x^*_{it})'$, then equation (1) can be expressed as:

$$A_i z_{it} = a_{i0} + a_{i1}t + \sum_{s=1}^{p_i} B_{is} z_{i,t-s} + \varepsilon_{it} \qquad 3)$$

where $A_i = (I_{ki} - \wedge_{i0})$, $B_{is} = (\Phi_{is} \wedge_{is})$. a_{i0} and a_{i1} are parameters.

From equation (2), $z_{it} = W_i x_t$ where W_i is quality matrix with size $(k_i + l_i) \times k$ defined from specific qualities of countries, ω_{ij}. Therefore, equation (3) can be expressed as:

---

[5] For more comprehensive explanation about GVAR model, please refer to Mauro and Pesaran (2013).

$$A_i W_i x_t = a_{i0} + a_{i1} t + \sum_{s=1}^{p_i} B_{is} W_i x_{t-s} + \varepsilon_{it} \quad 4)$$

and individual state models are grouped together to become a global model x_t, which is:

$$G_o x_t = a_0 + a_1 . t + \sum_{s=1}^{pi} G_s x_{t-s} + \varepsilon_t, \quad 5)$$

where $a_0 = \begin{pmatrix} a_{00} \\ a_{10} \\ \cdots \\ a_{N0} \end{pmatrix}$, $a_a = \begin{pmatrix} a_{01} \\ a_{11} \\ \cdots \\ a_{N1} \end{pmatrix}$, $G_0 = \begin{pmatrix} A_{00} W_0 \\ A_{10} W_1 \\ \cdots \\ A_{N0} W_N \end{pmatrix}$, $G_S = \begin{pmatrix} A_{0s} W_0 \\ A_{1s} W_1 \\ \cdots \\ A_{Ns} W_N \end{pmatrix}$, $\varepsilon_t = \begin{pmatrix} \varepsilon_{0t} \\ \varepsilon_{1t} \\ \cdots \\ \varepsilon_{Nt} \end{pmatrix}$.

Multiplying (5) by G_0^{-1}, we obtain the following equation:

$$x_t = G_0^{-1} a_0 + G_0^{-1} a_1 . t + \sum_{s=1}^{p} G_0^{-1} G_s x_{t-s} + G_0^{-1} \varepsilon_t. \quad 6)$$

Specifications (5) can be solved recursively to obtain future values and to obtain impulse responses. Equation (6) can also be solved recursively and the variance generated and decomposed. This is the so-called FEVD, which we use to assess the contribution of each business cycle determinant to overall fluctuations. Boschi and Girardi (2011) use FEVD to analyze the determinants of business cycles.

Data used in the GVAR model are de-trended, while the noise components are normally captured as residuals. Hence, technically, the estimated relationships among the variables are actually the relationships between their cyclical components. Therefore, determinants of business cycle are always examined as determinants of aggregate macroeconomic variables. For example, Kose, Otrok, and Whiteman (2003) use three alternative variables, which are gross domestic product (GDP), investment and consumption. Holland and Scott (1998) use alternative variables, which are GDP, investment, consumption, real wages, and total working hours. It is known that one indicator, GDP, includes both investment and consumption. Therefore, we follow Claessens, Kose and Terrones (2012) and Boschi and Girardi (2011) to use GDP as our measure of economic activity, and hence discussing determinants of GDP as the determinants of business cycle.[6]

The GVAR data set covers economic and quarterly financial variables for 33 economies during the period 1979Q2-2016Q4 (Table 1). These 33 countries cover more than 90% of world GDP (Mauro and Pesaran, 2013). The dataset is obtained from

[6] As it includes consumption and investment, GDP represents other alternative variables as well. In addition, Claessens, Kose and Terrones (2012) argues that output or GDP is the best indicator available to measure economic activity. Moreover, Luthfiana and Nasrudin (2018) also stated that GDP is considered as the best measure of economic performance.

Mohaddes and Raissi (2018). Structural break unit root test was done using the Narayan and Popp (2010, 2013) test and results are available upon request.

Table 1. Variables in GVAR

Country-specific variables	
Variable name	Period
Real GDP	1979Q2 – 2016Q4
Inflation	1979Q2 – 2016Q4
Real equity prices	1979Q2 – 2016Q4
Real exchange rate	1979Q2 – 2016Q4
Nominal short-term interest rate	1979Q2 – 2016Q4
Nominal long-term interest rate	1979Q2 – 2016Q4
Global variables	
Variable name	Period
Oil price	1979Q2 – 2016Q4
Raw material price	1979Q2 – 2016Q4
Metal price	1979Q2 – 2016Q4

3. Results

The preliminary analysis entails certain features on the GVAR model. Table A2 and A3 reports tests of the model's soundness. Overall, the statistical tests show that the estimated GVAR model is stable, and hence can for analyzing the business cycle determinants. For instance, the weak exogeneity test shows that the external variables are weakly exogenous in most cases. Contemporaneous effects on domestic variables are generally in line with the presence of shocks on the same external variables. In addition, the persistence profile of system-wide shocks in all Indonesian cointegration equations falls to zero exponentially.

Another indication that the GVAR model is sound can be verified through the magnitude of residual correlation (Dees, di Mauro, Pesaran, and Smith, 2007). The residual correlation in each vector error correction model augmented with foreign variables (VECMX), reported in Table A3, looks quite small (i.e. they are in the range of 0 to 0.3). This shows that the estimated GVAR model is quite sound in accommodating factors that influence the endogenous variables. In addition, the low residual correlation indicates that the model is quite effective in explaining reciprocal relations between countries (Sun, Heinz, and Ho, 2013).

The estimation results are then used primarily for variance decomposition analysis. Following Boschi and Girardi (2011), we interprete the variance decomposition anal-

ysis on GDP as the business cycle determinants. Table 2 reports the variance decomposition of Indonesia's output. The results indicate that the Indonesian business cycle is influenced by domestic and global factors. In addition to output, the dominant domestic factors are short-term interest rates and Real Exchange Rate (RER)—contributes around 15% to the business cycle fluctuations. An alternative interpretation is that the monetary policy stance and international competitiveness are important determinants of Indonesia's business cycle.

Given that the variables used in GVAR are demand side variables, then when referring to business cycle theory, the result implies the business cycle is explained more by preference shocks (Holland and Scott, 1998). Productivity shocks are represented by the output variable, GDP, itself. Hence, in the short term, the business cycle is more influenced by productivity shocks, while, in the medium term, it is more influenced by shift in preferences or preference shocks. Our findings are consistent with Holland and Scott (1998), who find that correlations of productivity with macroeconomic aggregate variables tend to decrease over time, while correlations of preference shift with macroeconomic aggregate variables tend to increase over time.

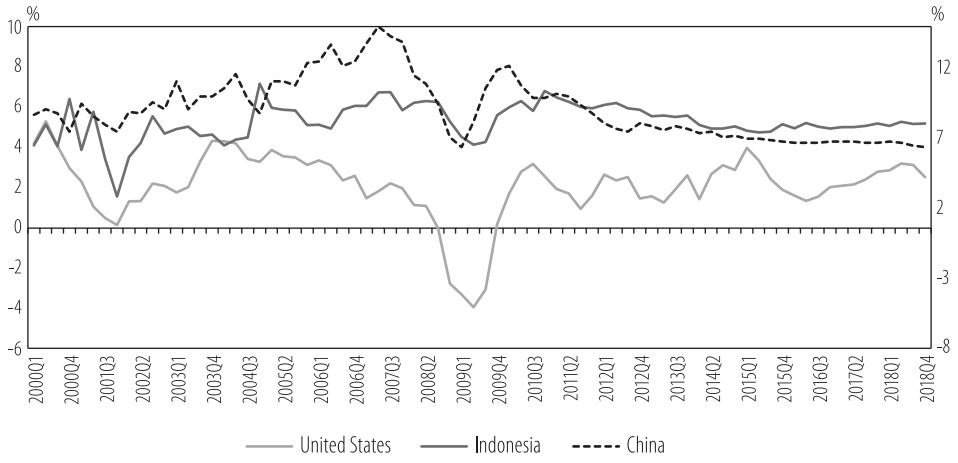
Table 2. Variance Decomposition of Indonesia's GDP

	Domestic				Foreign (rest of the world)	
	GDP	Inflation	RER	Interest Rate	GDP	Interest Rate
1	0.6119	0.0223	0.0958	0.0456	0.1330	0.1437
4	0.2676	0.0153	0.1441	0.1573	0.1294	0.1514
8	0.1485	0.0094	0.1432	0.1680	0.1282	0.1622
12	0.1055	0.0075	0.1328	0.1608	0.1258	0.1739

The table reports the decomposed variances of the GDP equation. It shows the contribution of each variable to GDP. The domestic variables and the foreign variables are GDP, inflation, RER, and interest rate. The sample is made up of 33 countries over the period of 1979Q1 to 2016Q4.

The dominant global factors affecting the Indonesian business cycle are the global short-term interest rates and the output of rest of the world, each contributing around 16% and 13% to the business cycle fluctuations. The implication is that Indonesia's business cycle is influenced by global liquidity, monetary policies, and economic activity. The estimates further suggest that macroeconomic spillovers, especially productivity shocks, from China are the most important for Indonesia's business cycle. This is consistent with data. The slowing down phase of Indonesia's economic growth since the global financial crisis is strongly related to China's economic growth that experienced rebalancing. Figure 1 shows that, in general, China's economic growth precedes Indonesia's.

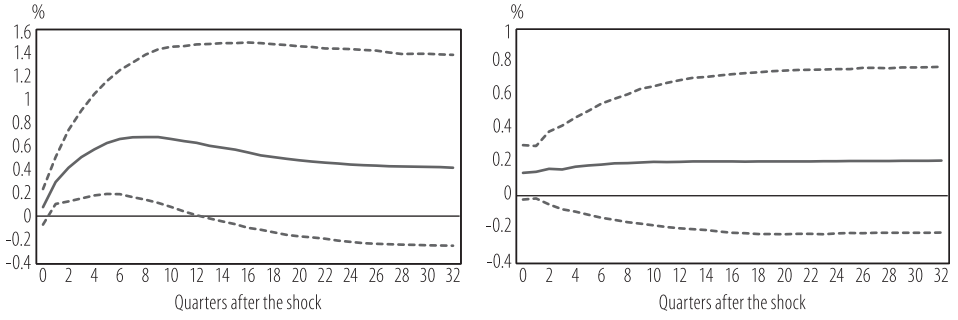
Figure 1. GDP Growth in Indonesia, China, United States (% yoy)



The figure shows GDP growth in Indonesia vis-à-vis China and the United States' growth. GDP growth is defined as the annual percentage change of real GDP in each country for the period 2004 - 2018.

This study focuses on discussing FEVDs as it attempts to explain determinants of Indonesia's business cycle. However, figure 2 shows several impulse responses for reporting and illustrative purposes, as it is usually reported on literatures using GVAR. The figure shows that GDP shock from China and Japan have positive impact on Indonesia's GDP. However, they have different magnitude and persistency.

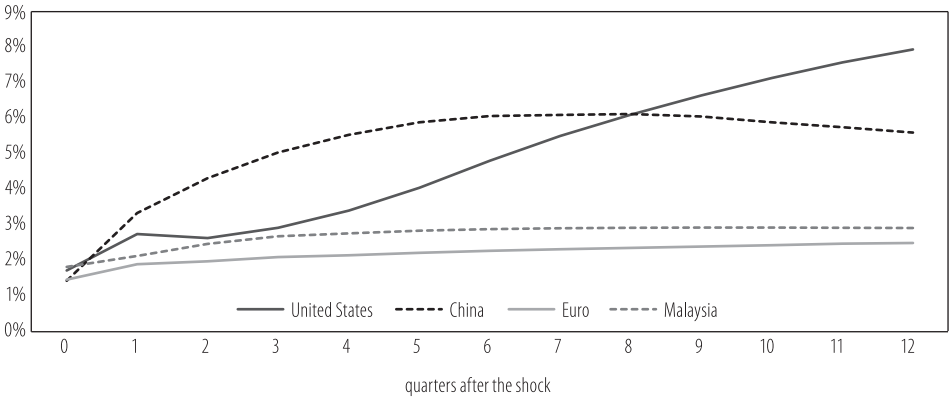
Figure 2. Impulse Responses – China and Japan's GDP to Indonesia's GDP



The figures show impulse response of China's GDP (left) and Japan's GDP (right) on Indonesia's GDP. The range is derived from bootstrap replications. The solid line represents median, while dotted lines represent lower and upper bounds.

Figure 3 shows spillovers from other countries to Indonesia. The spillovers from the US continue to gain importance in the Indonesian business cycle, especially in the medium term. In addition, spillovers from ASEAN countries, especially those originating from Malaysia, have a large influence on the Indonesian business cycle fluctuations. The important role played by spillovers from other developing countries to the business cycle fluctuations of a developing country is consistent with Boschi and Girardi (2011), who find this to hold true for Latin America. We find that spillovers from developing countries contribute greatly to Indonesia's business cycle fluctuations, when compared with spillovers from developed countries (Table 3).

Figure 3. Variance Decomposition – Other Countries' Contribution (All Variables) to Indonesia's GDP



The figure shows variance decomposition of Indonesia's GDP overtime (quarters) after the shock. The factors shown are the ones which come from several countries' macroeconomic variables that include GDP, inflation, interest rate, and real exchange rate.

Table 3. Variance Decomposition – Contribution of Other Countries' GDP to Indonesia's GDP

Quarter	China	US	Japan	ASEAN	Developed Countries	Developing Countries
1	0.023	0.002	0.007	0.035	0.051	0.088
4	0.043	0.002	0.005	0.025	0.036	0.098
8	0.046	0.003	0.004	0.022	0.033	0.099
12	0.040	0.003	0.003	0.021	0.034	0.095

The table shows comparison of variance decomposition of Indonesia's GDP which originates from other countries.

Table 4 ranks countries by their contribution to Indonesia's business cycle fluctuations. The China is the most important contributor to Indonesia's output fluctua-

tions. A number of Asian and non-Asian countries are also significant contributors to Indonesia's business cycle. Contributions from countries such as Malaysia, Brazil and Mexico are unexpected. Such a new finding can be explained by the superiority of the analytical methods that pay attention to the impact of indirect spillovers. The GVAR considers all the spillover effects—directly and indirectly—from global trade relations, which, so far, is difficult to interpret using descriptive data, which only shows direct relations. A closer look at the trade matrix suggests that Mexico–China and Brazil–China trades are very high, and for Brazil it is even higher than Brazil's trade with the US and Canada (Table A4). This fact, combined with Indonesia–China trade relations, which is also dominant, can cause changes in Mexico and Brazil's output to have a significant impact on Indonesia's output.

Table 4. Ranking of Influences on Indonesian Output

Rank	Country	Contribution on fourth quarter after shock
1	CHINA	0.0432
2	MALAYSIA	0.0138
3	BRAZIL	0.0066
4	MEXICO	0.0056
5	KOREA	0.0055
6	JAPAN	0.0049
7	THAILAND	0.0048

The table shows countries that contributes the most on variance decomposition of Indonesia's GDP.

Table 5 shows how other countries respond to spillovers from China. As can be seen, two ASEAN countries, namely Singapore and Thailand, are even more sensitive to spillovers from China, than Indonesia.

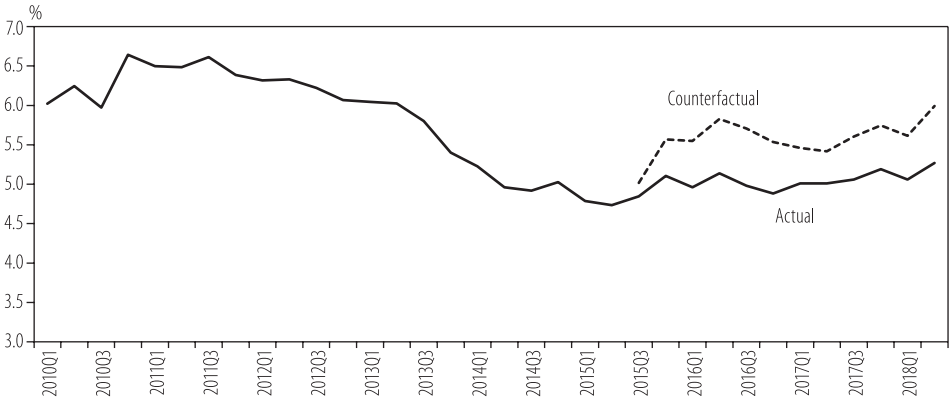
Table 5. Ranking of Sensitivity on China's GDP

Ranking	Country	Response after four quarters
1	Singapore	0.0074
2	Thailand	0.0056
3	Indonesia	0.0056
4	Malaysia	0.0056
5	Peru	0.0039
6	Japan	0.0035
7	Saudi Arabia	0.0032
8	Turkey	0.0027
9	India	0.0021

The table shows comparison of impulse responses due to 1 sd shock to China's GDP.

Figure 4 provides further illustration of China's significance in the Indonesian business cycle. This figure is a counterfactual analysis of China's output. The assumed counterfactual scenario is that China's output growth remains above 7% after 2015 (i.e. approximately 7.3%, to be more specific). Given this scenario, the path of Indonesia's business cycle becomes expansive, with an average growth of 5.6% throughout 2016-2018, and reaching almost 6% in the second quarter of 2018. This shows that the counterfactual scenario may cause different results on the path and acceleration speeds in the Indonesian business cycle.

Figure 4. Indonesia GDP Growth - Counterfactual and Actual



The figure shows actual and counterfactual GDP growth of Indonesia. The counterfactual GDP growth is computed using GVAR estimates by assuming that China's GDP growth has not decelerated.

4. Concluding Remarks

This study analyzed the determinants of the Indonesian business cycle within a GVAR model. Using a sample of 33 countries over a period of 1979Q2 to 2016Q4 and 2000 bootstrap replications, it generated FEVDs for GDP. It finds that the Indonesian business cycle is influenced by domestic and global factors. With regards to the domestic factors, monetary policy and price competitiveness are most influential in Indonesia's business cycle fluctuations. For the global factors, global liquidity, monetary policy, and economic activity contributed largely to the business cycle.

Among the external sources of fluctuations, those from China are dominant. A shocks originating from number of countries, Asian and non-Asian, are also important in Indonesia's business cycle. The main countries are Malaysia, Brazil and Mexico, whose impacts are rather surprising. This may be attributed to the fact that

the GVAR model considers direct and indirect global spillovers from trade relations, which are not evident in descriptive data.

These findings are meaningful in the real business cycle theory. Since the model captures demand-side variables, Indonesia's main business cycle determinants in the short term are productivity shocks, whereas, in the medium term (starting at 1 year), the fluctuations are driven by demand-side or preference shocks. Holland and Scott (1998) associate the demand side with a preference shift between work and leisure. This indicates that policies that affect the demand side will have a lagging impact, while policies that directly affect productivity, such as the application of new technologies, will have relatively instant effects.

The influence of China on Indonesia's business cycle is buttressed using a counterfactual analysis. The study finds that if China's did not experienced rebalancing in its economy after 2015, Indonesia may have a higher output growth followed by a phase of expansion of the business cycle at a higher level.

Because China's rebalancing is permanent with the changing phase of its economic development, Indonesia needs to look for new sources of external growth.

Monitoring the conditions in other developing countries will be more important than previously believed. For instance, Latin American countries, which are considered the farthest from Indonesia, should be monitored since they appear relevant to Indonesia's economic fluctuations. Furthermore, given that external factors contribute greatly to the Indonesian business cycle, if external conditions do not support the business cycle expansion phase, the business cycle can be pushed up through accommodative monetary policy, or by price competitiveness. The demand-side policy will take time to be felt within the economy. However, the impact can be immediate via the application of new technologies.

References

1. Alamsyah, H., Adamanti, J., Yumanita, D., & Astuti, R.I. (2004). Siklus Keuangan Indonesia. *Working Paper Bank Indonesia*. WP/8/2014.
2. Al-Haschimi, A., Dées, S., Mauro, F., & Jancokova, M. (2014). Linking Distress of Financial Institutions to Macrofinancial Shocks. *ECB Working Paper Series*, 1749 (December 2014).
3. Altuğ., S. and Bildirici., M. (2012) Business Cycles in Developed and Emerging Economies: Evidence from a Univariate Markov Switching Approach. *Emerging Markets Finance and Trade*, 48, 4-38.
4. Anwar, S., & Ali, A., (2018) ANNs-based early warning system for Indonesian Islamic banks, *Bulletin of Monetary Economics and Banking*, 20, 325-342.
5. Andaiyani, S., & Falianty, T. A. (2017). Asean Credit Growth And Asset Price Response To Global Financial Cycle, *Bulletin of Monetary Economics and Banking*, 20(2), 203-228.
6. Boschi, M., & Girardi, A. (2011). The contribution of domestic, regional and international factors to Latin America's business cycle. *Economic Modelling*, 28(3), 1235-1246.
7. Boschi, M., Marzo, M., & Salotti, S. (2015). Domestic versus international determinants of European business cycles: a GVAR approach. *Empirical Economics*, 49(2), 403-421.
8. Burns, A.F., & Mitchell, W.C. (1946). *Measuring Business Cycles*, National Bureau of Economic Research, New York.
9. Cashin, P., Mohaddes, K., & Raissi, M. (2014), The Differential Effects of Oil Demand and Supply Shocks on the Global Economy. *Energy Economics*, 44, 113–134.
10. Cashin, P., Mohaddes, K. and Raissi, M. (2017a), China's slowdown and global financial market volatility: is world growth losing out? *Emerging Markets Review*, 31, 164-175.
11. Cashin, P., Mohaddes, K., Raissi, M. (2017b), Fair Weather or Foul? The Macroeconomic Effects of El Nino. *Journal of International Economics*, 106, 37-54.
12. Cesa-Bianchi, A., Pesaran, M.H., Rebucci, A., & Xu, T. (2012), China's emergence in the world economy and business cycles in Latin America. *Economía*, 12(2), 1-75.
13. Chudik, A. & Fratzscher, M. (2011). Identifying the global transmission of the 2007-09 Financial crisis in a GVAR model. *European Economic Review*, 55, 325-339.Claessens, S., Kose, M.A., & Terrones, M. (2012). How Do Business and Financial Cycles Interact? *Journal of International Economics*, 87(1), 178-190.
14. Comin, D. & Gertler, M. (2006) Medium-term business cycles. *American Economic Review*, 96(3), 523-51.
15. Crucini, M.J., Kose, M.A., & Otrok, C. (2011). What are the Driving Forces of International Business Cycles? *Review of Economic Dynamics*, 14, 156-175.

16. Dees S., di Mauro, F., Pesaran, M.H., & Smith L.V. (2007), Exploring the international linkages of the euro area: a global VAR analysis, *Journal of Applied Econometrics*, 22(1), 1–38.
17. Drehmann, M., Borio, C. & Tsatsaronis, K. (2012), Characterising The Financial Cycle: Don't Lose Sight of The Medium Term!, *BIS Working Paper*, 380.
18. Dufrénot, G., & Keddad, B. (2014). Business cycles synchronization in East Asia: A Markov-switching approach. *Economic Modelling*, 42, 186-197.
19. Dutu, R. (2016). Why has economic growth slowed down in Indonesia? An investigation into the Indonesian business cycle using an estimated DSGE model. *Journal of Asian Economics*, 45: 46–55.
20. Eickmeier, S. & Ng, T. (2015) How Do Credit Supply Shocks Propagate Internationally? A GVAR Approach. *European Economic Review*, 74, 128-145.
21. Favero, C. (2013) Modelling and forecasting government bond spreads in the Euro area: a GVAR model, *Journal of Econometrics*, 177, 343–356.
22. Garratt, A., Lee, K., & Shields, K. (2013). *Global recessions and output interdependencies in a GVAR model of actual and expected output in the G7.* Oxford University Press.
23. Han., Q. (2019) International Real Business Cycles of the Chinese Economy: Asymmetric Preference, Incomplete Financial Markets, and Terms of Trade Shocks, *Emerging Markets Finance and Trade*, 55, 1926-1953.
24. Harahap, B., Bary, P., Panjaitan, L. & Satyanugroho, R. (2019) Spillovers of United States and People's Republic of China Shocks on Small Open Economies: The Case of Indonesia. In: Yoshino, N., Chantapacdepong, P., & Helble, M. (Eds) *Macroeconomic Shocks and Unconventional Monetary Policy: Impact on Emerging Markets*. Oxford University Press.
25. Holland, A. & Scott, A. (1998). The Determinants of UK Business Cycles. *The Economic Journal*, 108(449), 1067-1092.
26. Inoue, T., Kaya, D., & Ohshige, H. (2015) The impact of China's slowdown on the Asia Pacific region: an application of the GVAR model, *Policy Research Working Paper Series* 7442, The World Bank.
27. Jo., G. (2014) Transmission of U.S. Financial Shocks to Emerging Market Economies: Evidence from Claims by U.S. Banks. *Emerging Markets Finance and Trade*, 50, 237-253.
28. Jimenez, J.F.P. (2001). *Business Cycles in Small Open Economies: The Case of Costa Rica*. Institute of Social Studies, Working Paper 330, February 2001.
29. Juhro, S.M., and Iyke, B.N., (2019a) Monetary policy and financial conditions in Indonesia, *Bulletin of Monetary Economics and Banking*, 21, 283-302.
30. Juhro, S. M., & Iyke, B. N. (2019b). Consumer confidence and consumption expenditure in Indonesia. Economic Modelling. https://doi.org/10.1016/j.econmod.2019.11.001.
31. Kim, S. H., Kose, M. A., & Plummer, M. G. (2003). Dynamics of business cycles in Asia: differences and similarities. *Review of Development Economics*, 7(3), 462-477.

32. Kose, M.A., Otrok, C., & Prasad, E.S. (2012). Global Business Cycles: Convergence or Decoupling? *International Economic Review* 53(2), 511-538.
33. Kose, A., Otrok, C. & Whiteman, C.H. (2003). International Business Cycles: World, Region, and Country-Specific Factors. *American Economic Review* 93(4), 1216 – 1239.
34. Kose, M.A., Otrok, C., & Whiteman, C.H. (2008). Understanding the evolution of world business cycles. *Journal of International Economics* 75(1), 110-130.
35. Luthfiana, P.S., and Nasrudin. N. (2018). Disaggregation and Forecasting of the Monthly Indonesian Gross Domestic Product (GDP). *Bulletin of Monetary Economics and Banking*, Volume 20, Number 4, April 2018.
36. Male., R. (2011) Developing Country Business Cycles: Characterizing the Cycle. *Emerging Markets Finance and Trade*, 47: 20-39.
37. Mauro, F., & Pesaran, M.H. (2013). *The GVAR Handbook: Structure and Applications of a Macro Model of the Global Economy for Policy Analysis*. Oxford University Press.
38. Mohaddes, K. & Raissi, M. (2019). The U.S. Oil Supply Revolution and the Global Economy. *Empirical Economics*, 57(5), 1515-1546.
39. Mohaddes, K. & Pesaran, M. H. (2016). Country-Specific Oil Supply Shocks and the Global Economy: A Counterfactual Analysis. *Energy Economics*, 59, 382–399.
40. Mohaddes, K. & Pesaran, M.H. (2017). Oil Prices and the Global Economy? Is it Different This Time Around?. *Energy Economics*, 65, 315–325
41. Mohaddes, K. & Raissi, M. (2018). *Compilation, Revision and Updating of the Global VAR (GVAR) Database, 1979Q2-2016Q4*. University of Cambridge: Faculty of Economics (mimeo).
42. Moneta, F., & Rüffer, R. (2009). Business cycle synchronisation in East Asia. *Journal of Asian Economics*, 20(1), 1-12.
43. Mumtaz, H., Simonelli, S., & Surico, P. (2011). International comovements, business cycle and inflation: A historical perspective. *Review of Economic Dynamics*, 14, 176-198.
44. Narayan, P. K. (2011). An Analysis of Indonesia's Business Cycle. *The Indian Economic Journal*, 59(1), 162-173.
45. Narayan, P. K., & Popp, S. (2010). A new unit root test with two structural breaks in level and slope at unknown time. *Journal of Applied Statistics*, 37(9), 1425-1438.
46. Narayan, P. K., & Popp, S. (2013). Size and power properties of structural break unit root tests. *Applied Economics*, 45(6), 721-728.
47. Padhan, R., and Prabheesh, K.P., (2019) Effectiveness of early warning models: A critical review and new agenda for future direction, *Bulletin of Monetary Economics and Banking*, 22, 457-484.
48. Pesaran, M.H., Schuermann, T., Weiner, S. (2004) Modeling Regional Interdependencies Using a Global Error-Correcting Macroeconometric Model, *Journal of Business & Economic Statistics*, 22, 129–162.

49. Schmitt-Grohe, Stephanie (1998) The international transmission of economic fluctuations: effects of U.S business cycles on the Canadian economy. *Journal of International Economics*, 44: 257-287.
50. Silalahi, T., Wibowo, W. A., & Nurliana, L. (2012). Impact of global financial shock to international bank lending in Indonesia. *Bulletin of Monetary Economics and Banking*, 15(2), 77-114.
51. Simorangkir, I. (2012). Early warning indicators study of bank runs in Indonesia: Markov-switching approach. *Bulletin of Monetary Economics and Banking*, 15(1), 3-40.
52. Solomos, D., Papageorgiou, T., & Koumparoulis, D. (2016). Financial Sector and Business Cycles Determinants in the EMU Context: An Empirical Approach (1996-2011). *European Research Studies Journal*, 16(2), 34-58.
53. Stock, J.H., & Watson, M.W. (2002). Has the Business Cycle Changed and Why? *NBER Macroeconomics Annual*, 2002, 159-230.
54. Sun, Y., Heinz, F. F., & Ho, G. (2013). Cross-Country Linkages in Europe: A Global VAR Analysis. *IMF Working Papers*,13/194.
55. Sznajderska, A. (2019). The role of China in the world economy: evidence from a global VAR model. *Applied Economics*, 51(15), 1574-1587.
56. Tarsidin, Idham, & Rakhman, R. N. (2018) Nowcasting Household Consumption and Investment in Indonesia. *Bulletin of Monetary Economics and Banking*, Volume 20, Number 3, January 2018.
57. Vasishtha, G., and Maier, P. (2013). The Impact of the Global Business Cycle on Small Open Economies: A FAVAR Approach for Canada. *The North American Journal of Economics and Finance*, 24, 191-207.
58. Walsh, C. E. (1999). Changes in the Business Cycle. *FRBSF Economic Letter*, 1999(16).
59. Wimanda, R. E., & Djuranovik, L. (2014a). *Siklus Bisnis and Siklus Finansial Indonesia: Revisited*. Catatan Riset Grup Riset Ekonomi Bank Indonesia No. 16/9/DKEM/GRE/CR.
60. Wimanda, R. E., & Djuranovik, L. (2014b). *Business Cycles and Financial Cycles in Indonesia: Analysis by Components*. Catatan Riset Grup Riset Ekonomi Bank Indonesia No. 16/8/DKEM/GRE.

Appendix

Table A1. List of countries

Area	Countries
Americas	Argentina, Brazil, Canada, Chile, Mexico, Peru, USA
Europe	Euro (includes Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Spain), Norway, Sweden, Turkey, United Kingdom.
Asia-Pacific	Australia, China, Indonesia, India, Japan, Korea, Malaysia, New Zealand, Philippines, Singapore, Thailand
Africa and Middle East	South Africa, Saudi Arabia

Table A2. Weak Exogeneity Test

Country	Fcritical	Output	Inflation	Equity price	Real exchange rate	Short term interest rate	Long term interest rate
Argentina	3.1	1.0	1.0	0.3		3.3	1.4
Australia	2.7	1.9	2.4	0.9		0.6	2.6
Brazil	3.1	0.4	1.4	0.4		0.3	3.7
Canada	2.7	5.2	4.0	0.1		1.8	0.2
China	3.1	0.2	0.8	0.0		1.6	1.3
Chile	3.1	0.9	0.1	1.0		0.7	1.5
Euro	3.9	0.6	3.1	1.1		0.4	0.1
India	3.1	3.0	0.7	1.5		2.3	1.0
Indonesia	2.7	1.6	0.5	0.6		1.2	0.2
Japan	3.1	2.1	0.7	0.1		0.4	0.5
Korea	2.7	0.2	1.1	1.8		1.0	1.5
Malaysia	3.1	2.7	3.7	2.4		4.0	0.3
Mexico	3.1	0.4	4.2	0.3		1.1	1.4
Norway	2.7	3.1	1.9	1.1		0.2	0.9
New Zealand	2.7	4.3	0.6	0.7		0.8	0.1
Peru	3.1	0.4	1.0	0.7		3.0	0.2
Philippines	2.7	0.4	0.7	0.5		2.1	3.2
South Africa	3.1	0.2	0.3	0.1		2.1	0.4
Saudi Arabia	3.9	0.2	0.0	2.1		0.0	1.5
Singapore	3.9	1.4	0.3	6.1		2.6	2.3
Sweden	3.1	0.7	0.7	0.0		0.2	0.6
Switzerland	2.7	1.9	0.7	1.7		0.6	0.2
Thailand	3.1	0.5	0.9	0.3		0.8	0.7
Turkey	3.9	1.7	0.8	0.0		0.2	0.0
United Kingdom	3.1	2.8	0.5	0.1		0.7	1.2
United States	3.1	0.7	3.3		0.3		

The table reports F-statistics that indicate weak exogeneity of foreign variables.

Table A3. VECMX Residual Correlation

	Output	Inflation	Equity price	Real exchange rate	Short term interest rate	Long term interest rate
argentina	0.01	0.05	-0.02	0.03	0.01	
Australia	0.03	0.02	0.04	0.19	0.02	0.01
Brazil	0.04	-0.04		0.13	-0.03	
Canada	0.00	0.04	0.04	0.14	0.09	-0.02
China	-0.09	-0.02		0.03	0.02	
Chile	0.01	0.01	0.04	0.16	-0.02	
Euro	-0.01	0.05	-0.11	0.29	0.07	-0.09
India	-0.02	0.01	-0.03	0.14	0.04	-0.01
Indonesia	-0.02	0.02		0.08	0.03	
Japan	-0.02	0.02	-0.11	0.13	0.00	-0.06
Korea	0.02	0.05	-0.05	0.14	0.06	-0.06
Malaysia	-0.01	0.02	0.01	0.19	0.04	
Mexico	0.03	0.01		0.03	0.02	
Norway	-0.01	0.03	0.05	0.28	0.01	0.02
New Zealand	0.05	0.03	0.00	0.22	0.04	0.02
Peru	0.02	-0.04		0.05	0.03	
Philippines	0.01	0.00	0.01	0.15	0.02	
South Africa	0.05	0.03	0.06	0.19	0.03	0.00
Saudi Arabia	0.00	0.04		0.06		
Singapore	-0.02	0.03	0.00	0.24	0.01	
Sweden	0.02	0.06	0.00	0.23	0.00	0.02
Switzerland	0.02	0.05	-0.02	0.26	-0.01	0.01
Thailand	0.01	0.00	0.01	0.20	0.04	
Turkey	0.01	0.00		0.12	0.03	
United Kingdom	-0.01	0.00	0.00	0.19	0.04	0.00
United States	-0.04	0.07	-0.01		0.04	-0.01

The table reports average cross-sectional correlation of VECMX residuals.

Table A4. Trade Weight Matrix

Country	Brazil	China	Chile	Euro	Indonesia	Japan	Mexico	Peru	United Kingdom	United States
Brazil	0.00	0.03	0.08	0.02	0.01	0.01	0.01	0.05	0.01	0.02
China	0.23	0.00	0.28	0.16	0.18	0.27	0.10	0.26	0.10	0.19
Chile	0.03	0.01	0.00	0.01	0.00	0.01	0.00	0.04	0.00	0.01
Euro	0.20	0.16	0.14	0.00	0.08	0.10	0.07	0.13	0.48	0.15
Indonesia	0.01	0.02	0.00	0.01	0.00	0.03	0.00	0.00	0.00	0.01
Japan	0.03	0.11	0.07	0.04	0.13	0.00	0.03	0.04	0.02	0.06
Mexico	0.03	0.02	0.03	0.02	0.00	0.01	0.00	0.04	0.00	0.17
Peru	0.01	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
United Kingdom	0.02	0.03	0.01	0.17	0.01	0.02	0.01	0.01	0.00	0.04
United States	0.18	0.21	0.18	0.18	0.09	0.19	0.68	0.22	0.14	0.00

The table shows a portion of trade weight matrix used in GVAR estimation. The number represents trade portion of country in each column with partner country in rows.