The macroeconomic effects of oil price and risk-premium shocks on Vietnam: Evidence from an over-identifying SVAR analysis

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12 May 2019

The macroeconomic effects of oil price and risk-premium shocks on Vietnam: Evidence from an over-identifying SVAR analysis[♣]

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Abstract

This paper studies the macroeconomic effects of oil price shocks in Vietnam. It expands Kilian's (2009) framework to simultaneously consider risk-premium shocks and comprehensively assess their consequences on international competitiveness and the State Bank management of the monetary policy. Methodologically, this implies dealing with an over-identified structural vector autoregression (SVAR) model. Data wise, the analysis is performed on a unique dataset with variables defined at a monthly frequency running from 1998:01 to 2018:12. Demand-side, global-, and specific-oil price shocks determine inflation and international competitiveness, and play an essential role in explaining the long-run variations of several Vietnamese macroeconomic indicators (mainly the trade balance, three-month interest rates, and the inflation rate). Vietnam's Dong pegging to the US Dollar results in a stronger impact of these shocks when real exchange rates and the rate of exports are modelled, than when real effective exchange rates and the trade balance are modelled. In the latter case, shock absorption is quicker given the multilateral trade context in which no single pegging holds. In association to the strong tie between Vietnam's Dong and the U.S. dollar, we also uncover remarkable effects of risk-premium (or U.S. Federal Fund rate) shocks. Supply-side oil price shocks have little impact on inflation and international competitiveness but condition the monetary policy. Neglecting such influence in the past may have resulted in an excessively conservative monetary policy.

Keywords: Oil price shocks; risk-premium shocks; SVAR; international trade; Vietnam.

JEL codes: Q41; Q43; F41; F62.

Declaration of interest: None.

Word count: ~ 8000 words.

[♣] **Acknowledgments**: Binh Thai Pham gratefully acknowledges the financial support from Universitat Autònoma de Barcelona. Hector Sala is grateful to the Spanish Ministry of Economy and Competitiveness for financial support through grant ECO2016-75623-R.

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1. Introduction

The strong upswing in crude oil price in the 2000s, and the subsequent Global Financial Crisis (GFC) in 2008 sparked an extensive research agenda on comprehending the causes and macroeconomic effects of oil price innovations.[1] In a seminal publication, Kilian (2009) claimed that the transmission of oil price increases may be different than traditionally understood, due not only to their fundamental underlying shocks (i.e. fundamental supply versus demand shocks), but also to their interactions with specific investment activities and with the biggest oil consumption country – the U.S. economy. It was also stressed that temporary oil production disruptions owing to political tensions were less important than fundamental shocks in explaining oil price movements and their consequences.

Taking an oil importer perspective, cost-push shocks due to oil and/or commodity price rises push up domestic prices of goods and services, thus triggering indirectly monetary policy measures to stabilise macroeconomic conditions. The transmission of the upsurge in oil prices into national main aggregates can be modelled using the traditional Cobb-Douglas production function (Bohi, 1991), which predicts that income will decline if energy (input) prices increase because of the higher cost-share of energy in the manufacturing process for the oil-importing economy. As a result, the macroeconomic performance will be worse in episodes of high oil prices (Hamilton, 1983, 2003), with negative impacts on living standards (Considine, 1988). For example, the rise of oil prices jeopardises GDP and increases the consumer price index (CPI) and unemployment in many OECD and emerging countries (Katircioglu et al., 2015; Choi et al., 2018). High oil prices may also weaken the country's competitiveness in exporting raw materials and intermediates (Cavalcanti and Jalles, 2013; Korhonen and Ledyaeva, 2010; Lee and Chiu, 2011), but the effect is unlikely to be symmetric in case of low oil prices (An et al., 2014; Tatom, 1988). Moreover, the local currency exchange rate against the US dollar often depreciates when oil prices soar up (Lizardo and

[1] According to Scopus database 78.1% of oil- and commodity-related articles in the "economics", "business" and "social sciences" literature were published in 2008 – 2018. Articles in English containing "oil price" or "oil shock" in the title or keywords, or "commodity price" in the title were searched for a period above 100 years, 1911-2018 (search conducted in April 2019). If the category "Energy" is included, this proportion remains constant (78.6%).

Mollick, 2010), affecting the terms of trade unfavourably (Kilian et al., 2009; Le and Chang, 2013; Rafiq et al., 2016; Salvatore and Winczewski, 1990).

This paper studies the impact of oil price shocks on the macroeconomic dynamics of Vietnam over the two decades since the 1997 Asian financial crisis. Vietnam's economy is an appealing case of analysis for a twofold reason. First, it has been a 'de-facto' small open economy characterised by exporting crude oil since 1992. Second, it imports up to 70% of its domestic gasoline demand and most of cracked petroleum products despite the operation of its first and only oil refinery Dung Quat since 2009.[2] Vietnam was actually a net oil exporter until 2009 as depicted in Figure 1 (panel B), but rapid growth alongside the steady expansion of exports and private vehicles have made the Vietnamese (VN henceforth) economy more oil-dependent in the recent years. The situation may even worsen in the near future given the current VN oil production, reserve levels and exploration difficulties due to political tensions in Vietnam territorial waters. It should be noted, however, (i) that the VN state-owned enterprises have exerted control in all oil-related activities such as oil exploration, production, and distribution; and (ii) that the government budget systematically benefited both from exporting crude oil and importing petrol products by levying different taxes (for example, export/import tax, excise tax, consumption tax, among others). As a consequence, the transmission of world oil price changes on the prices of domestic goods and services is not so obvious due to a heavily regulated retail gasoline market.

Figure 1 depicts some crucial macroeconomic information for Vietnam's economy. Panels A and C disclose two negative relationships, one between the real oil price and the trade-balance-over-output (TBY), and another one between global real economic activity, the so-called Kilian index, and the real effective exchange rate (REER). Higher world demand may induce better trade competitiveness in Vietnam, as expressed by the lower REER, because it has long exported low added-value goods and agricultural products. Given this information, and the corresponding higher anticipated income, VN households may demand and import more sophisticated goods whose prices are also inflated, leading to a worsened trade

[2] The second oil refinery, Nghi Son, just began operation at the end of 2018, after several years delay.

balance due to the appreciation of Vietnam's Dong (VND hereafter). In turn, real oil prices tend to rise in parallel to increases in world demand. This reinforces the deterioration of the TBY while simultaneously pushing up inflation. Conversely, it seems that changes in oil production do not exhibit significant correlations with VN macroeconomic aggregates.[3]

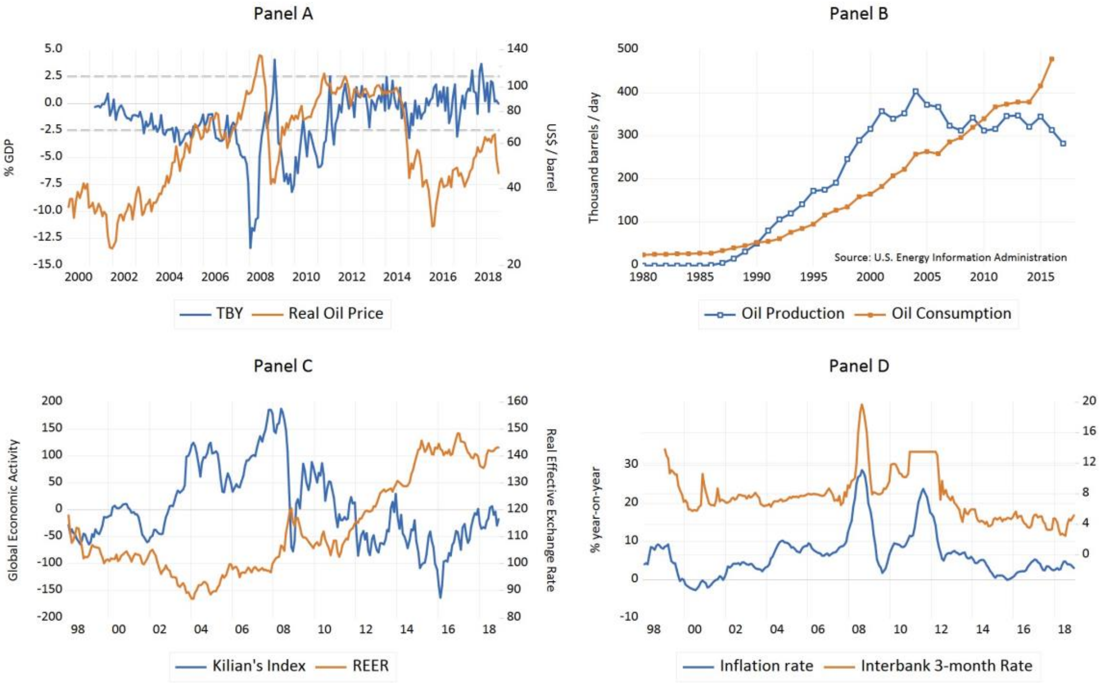

Figure 1: Panel (A): Vietnamese trade-balance-over-output (TBY) and real oil price in 2001 – 2018; Panel (B): Vietnamese oil production versus oil consumption over 1980 – 2017; Panel C: Kilian's (2009) global economic activity index versus VN real effective exchange rate; Panel D: VN inflation rate (year-on-year percentage) and 3-month interbank interest rate (percentage per annum). All series are on a monthly basis except for the VN oil production and consumption which are annual-based.

Over the period 2008 – 2012, the VN economy experienced economic turmoil because of the GFC. Its year-on-year inflation rate (blue line in panel D, Figure 1) climbed to peaks of 28.6% and 23.7% in the third quarters of 2008 and 2009, respectively. Meanwhile, the trade balance deteriorated severely, by -10% of GDP on average. This notable macroeconomic instability triggered a battery of monetary measures that helped the rebalancing of the VN economy in 2013 – 2015. The State Bank of Vietnam (henceforth SBV)

[3] The correlation coefficients between changes in oil production and VN inflation rate, interest rate, real export growth, changes in real (effective) exchange rate, and trade-balance-over-output, respectively, are basically within the range [-0.1, 0.1].

raised the short-term interest rate (red line in panel D, Figure 1) to a record high of 19.7% in the first inflationary episode, 2008:01 – 2009:03. In the second one, instead, the SBV maintained a flat interest rate of 13.5% over sixteen months, 2010:12 – 2012:03, accompanying a steady decline in headline inflation to below 5% in 2014:04. Moreover, the sizable current account deficits over four years 2007 – 2011 stimulated the SBV to devalue the VND by 30% from 2008:04 to 2011:04. These policies actually brought about the recovery of the trade deficit in years later.

These developments provide a first rough evidence that global demand shocks may be harmful for the VN economy and thus require an appropriate design of the monetary policy. Nevertheless, the existing macroeconomic literature on Vietnam's economy is relatively scarce. Pham et al. (2019) put forward a small open economy real business cycle model showing that VN trade-balance-over-output has been sensitive to international shocks in the past three decades, 1986 – 2015. No explicit attention is paid, however, to the role of oil price shocks. Trang et al. (2017), using a VAR model with Cholesky decomposition, claim that oil price shocks inflate domestic prices while diminishing government budgets. Anwar and Nguyen (2018) consider oil prices in their two-block SVAR study of the transmission of oil price rises to the VN monetary policy between 1995 and 2010. Their results imply that "the monetary policy of Vietnam was quite sensitive and vulnerable to fluctuations in the world price of oil". Still, none of these VAR analyses is able to disentangle structural oil supply and demand shocks in Kilian's (2009) sense, as the research thereafter has done (for example, Ahmed and Wadud, 2011; Cuñado et al., 2015; Iwaisako and Nakata, 2017; Lorusso and Pieroni, 2018, among many others).[4] Bhattacharya (2014) and Narayan (2013) are rare papers from international scholars considering Vietnam. Bhattacharya examined the movements of inflation in the short-run and connected the effectiveness of the monetary policy to changes in the nominal effective exchange rate, and to the credit expansion policy over the period 2004 – 2012. In turn, Narayan suggested that hikes in oil prices tend to depreciate the VND in the near future.

[4] In addition, their results may be liable to some inaccuracy from the linear extrapolation used to convert annual data to quarterly frequency observations in order to be able to expand backwards their sample period of analysis.

The drawback of these studies is that the triangle inflation-oil prices-monetary policy has been examined by components and not holistically. Hence, departing from the foregoing literature, we fill a void in the literature and comprehensively assess the pass-through of oil price fluctuations into the VN economy in two dimensions. First, we question how different oil price shocks affect the VN inflation rate, the real (effective) exchange rate, and foreign trade. Then, we analyse the responses to these shocks of VN monetary instruments, which comprise the three-month Interbank interest rate and the nominal exchange rate of VND against the U.S. Dollar. In all the analysis, we use monthly data covering the period 1998:01-2018:12.

The methodological contribution is threefold. First, although we depart from Kilian's (2009) framework of analysis, we work with an extended SVAR model with expanded foreign and domestic blocks. Second, we deal, as a consequence, with an over identified SVAR model whose predictive reliability requires accepting the over-identifying restrictions. Third, in using monthly data we are able to focus on a shorter sample period without falling short of degrees of freedom. This allows us to avoid any noise from a potential need of a low-to-high frequency data conversion.

The paper is structured as follows. Section 2 presents a summary of recent related literature on major Asian economies. Section 3 outlines the SVAR methodology, model specifications and data description. Sections 4 and 5 deal with the empirical results and variance analysis. Section 6 concludes.

2. Recent evidence on the macroeconomic effects of oil price shocks in major Asian countries

A number of studies have focused on the macroeconomic effects of oil price and global demand shocks in several major Asian countries – namely, Japan, China, India, and other ASEAN economies. With the exception of Malaysia, these are all twenty-first century net oil importers.

Although not unanimous, the evidence for Japan points to harmful macroeconomic effects of oil price shocks. For the shocks in the mid-1970s and 1979-1980, Lee et al. (2001) showed not only direct negative impacts, but also indirect effects caused by the subsequent tightening of the monetary policy that resulted in a higher money call rate. Zhang (2008) studied the non-linearity of these impacts and disclosed asymmetric effects on the Japanese macroeconomic performance with oil price increases causing larger negative impacts on income growth than the positive ones from equivalent price cuts. Fukunaga et al. (2011) used Kilian's (2009) framework to show negligible effects of oil price shocks on the Japanese economy, but Jiménez-Rodríguez and Sánchez (2012) found evidence of the reverse for the early 1980s. Against the feeling that Japanese industrial production seems immune to oil price increases these days, the most recent evidence claims that global demand shocks and oil market-specific shocks not only are relevant but should be considered as chief stimulants of dynamism in the Japanese aggregates (Rahman and Zoundi, 2018). Notably, Iwaisako and Nakata (2017) assert that positive non-fundamental oil price shocks supported Japanese exports in the 2000s.

China, the second biggest economy and oil consumer in the world, endogenously affects the world oil price due to its enormous size and export expansion strategy (Faria et al., 2009). Kim et al. (2017) use different SVAR estimation techniques to find evidence of a price stabilisation policy of Chinese policymakers to counteract the inflationary effect of oil price shocks between 2001 and 2014. Nevertheless, the cumulative impact of China's broad money supply is responsible for the strong recovery of oil prices during 2009, as noted by Ratti and Vespignani (2013). Taking a microeconomic-based approach, Zhao et al. (2016) propose a calibrated open economy DSGE model proving that oil supply shocks driven by non-political events, aggregate shocks to the demand of industrial commodities, and oil-specific demand shocks have long-term impacts on China's output and inflation fluctuations. Interestingly, Osorio and Unsal (2013) find that inflation in China has spillover effects on economies in the ASEAN community and India owing to their huge demand of commodity goods.

Likewise, India – the second most populous country in the world – imports as much as 80% of its fuel demand, thus rendering its economy exposed to oil and commodity price shocks. Holtemöller and Mallick (2016) show that Indian consumer prices are highly sensitive to inflationary supply shocks (oil price, food price, and other cost-pushes), but question policy measures such as raising interest rates because of the harm that a monetary contraction would cause on output growth. It has also been observed that the oil price does not Granger cause the USD/INR exchange rate (Inumula and Solanki, 2017), implying that a policy of stabilising and strengthening the Indian Rupee would contribute to brake the pass-through of global shocks on domestic inflation.

Finally, there are several studies on the ASEAN-5 countries, namely, Malaysia, Indonesia, Philippines, Singapore, and Thailand. The battery co-integration tests by Kisswani (2016) reports a two-way relationship between real oil prices and real exchange rates in the long run, but Basnet and Upadhyaya (2015) claim that oil price shocks have only temporary effects on the ASEAN-5 markets. In particular, they show that inflation reflects oil price rises in all countries in the first two quarters after the shock, but restrict the positive impact of such rises on real output to Indonesia, Malaysia, and Singapore. Sultonov (2017) studies the negative side of the oil price shocks from 2014 for the ASEAN-5 countries. He shows that crude oil price statistically affect exchange rates, and that the oil price volatility spills over from the crude oil market to the foreign exchange market.

3. Empirical methodology and data description

3.1. Methodology

The small open economy SVAR model used in Kilian's (2009) framework is typically set up in two blocks with a foreign (or exogeneous) block consisting of several variables accounting for oil price and/or other international shocks. For a small open economy, the second block includes domestically endogenous variables supposed to have negligible influence on their foreign block counterparts. Specifically, the two-block SVAR has a form[5]

$$\underbrace{\begin{bmatrix} A_0^{11} A_0^{12} \\ A_0^{21} A_0^{22} \end{bmatrix}}_{A_0} \underbrace{\begin{bmatrix} y_t^f \\ y_t^d \end{bmatrix}}_{y_t} = \sum_{p=1}^{\mathcal{P}} \left(\underbrace{\begin{bmatrix} A_p^{11} & A_p^{12} \\ A_p^{21} & A_p^{22} \end{bmatrix}}_{A_p} \underbrace{\begin{bmatrix} y_{t-p}^f \\ y_{t-p}^d \end{bmatrix}}_{y_{t-p}} \right) + \underbrace{\begin{bmatrix} B_0^{11} B_0^{12} \\ B_0^{12} B_0^{22} \end{bmatrix}}_{B_0} \underbrace{\begin{bmatrix} u_t^f \\ u_t^d \end{bmatrix}}_{u_t} \tag{1}$$

where y_t^f and $y_{,t}^d$ are vectors of k_f foreign and k_d domestic variables, respectively; $p = 1 \ldots \mathcal{P}$ denotes lagged index of the time series; A_0, $A_{1..\mathcal{P}}$ and B_0 are structural coefficient matrices that cannot be directly

[5] We have suppressed deterministic terms to simplify the exposition.

estimated; and u_t is therefore the so-called vector of structural residuals assumed to be independently identically distributed such that $E(u_t u_t') = I_{K \equiv k_f + k_d}$.

Pre-multiplying both sides of equation (1) by A_0^{-1} (assuming A_0 is invertible), one obtains the unrestricted reduced form as

$$y_t = \sum_{p=1}^{\mathcal{P}} A_0^{-1} A_p y_{t-p} + A_0^{-1} B_0 u_t$$

which can be also rewritten in the more compact form $B(L)y_t = \epsilon_t$, with the lag polynomial $B(L) = I + B_1 L + \cdots + B_p L^p$ and the vector of reduced residuals $\epsilon_t = A_0^{-1} B_0 u_t$, so that $E(\epsilon_t \epsilon_t') = \Omega_\epsilon$ is diagonal, i.e. $\epsilon_t \overset{iid}{\sim} N(0, \Omega_\epsilon)$. Furthermore, block exogeneity due to the small open economy assumption postulates that all elements of matrix B_p^{12} are restricted to zeros. This results in an unbalanced VAR model which behaves similarly to seemingly unrelated regression (SUR) models.

Explicitly, the relationship between ϵ_t and u_t in the sense of Amisano and Giannini (1997) is

$$A_0 \epsilon_t = B_0 u_t$$

To recover either A_0 or B_0 or both from the consistent estimate of ϵ_t, some restrictions need to be imposed on elements of A_0 and/or B_0 because of the symmetry of $\widehat{\Omega}_\epsilon$. For example, if $u_t \overset{iid}{\sim} N(0, I_K)$ and the diagonal elements of A_0 are normalised to unity, then the just-identified identification requires a total of $K^2 + K(K-1)/2$ restrictions on both A_0 and B_0.

We consider several SVAR specifications. The structure, common to the proposed models in the literature, is based on three standard variables in the exogenous block that emerged from Kilian's study (2009) – oil production (Oilpd), a global economic activity index (Globix), and the real oil price (Oilpr). Restrictions on the A_0 and/or B_0's elements are a fundamental matter in any SVAR analysis. Following Kilian (2009), the A_0^{11} block should have a recursive structure like

$$A_0^{11} \equiv \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \equiv \begin{bmatrix} * & 0 & 0 \\ * & * & 0 \\ * & * & * \end{bmatrix}$$

where the asterisks (*) represent free parameters to be estimated. The ordering (oil production, global economic activity, real oil price) implies that contemporaneous impacts on the oil price may originate from oil supply disruption, oil consumption demand, or oil-specific market demand such as precautionary or non-fundamental shocks. Elements of the A_0^{21} block are free in the baseline setting, but we do impose additional zero-restrictions on the A_0^{21} matrix in the augmented models, as will become clear below. In regard to the domestic block, A_0^{22}, the recursive structure is again applied to the small set of two variables, say the VN consumer price index (CPI) and the bilateral VND/USD real exchange rate (RER), so that the normalised matrices A_0 and B_0 of the baseline model are

$$A_0^{base} \equiv \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ * & 1 & 0 & 0 & 0 \\ * & * & 1 & 0 & 0 \\ * & * & * & 1 & 0 \\ * & * & * & * & 1 \end{bmatrix} \qquad B_0^{base} \equiv \begin{bmatrix} * & 0 & 0 & 0 & 0 \\ 0 & * & 0 & 0 & 0 \\ 0 & 0 & * & 0 & 0 \\ 0 & 0 & 0 & * & 0 \\ 0 & 0 & 0 & 0 & * \end{bmatrix}$$

Abstracting from the matrices structure just described, the baseline model by Kilian (2009) can be summarized as[6]

Baseline model: $\left(\overbrace{\text{DOilpd} \quad \text{Globix} \quad \text{LnOilpr}}^{Foreign\ block} \quad \overbrace{\text{DLnCPI} \quad \text{DLnRER}}^{Domestic\ block} \right)$

3.2. Augmented models

We take a step forward with respect to Kilian's (2009) model and consider the possibility of risk-premium shocks reflected in interest rate changes. We thus add the U.S. Federal Fund rate (Fedfunds) to

[6] Prefixes D, Ln, and DLn refer respectively to logarithm, first-difference, and log-difference operators, where the last is $DLn(y_t) = \log(y_t) - \log(y_{t-1})$.

the foreign block such that the effects of world risk premium shocks can be taken into account in the analysis.

In addition, the domestic block is augmented by taking into account real exports (REXP). This yields:

Model I $$\left(\overbrace{\mathrm{DOilpd}\quad \mathrm{Globix}\quad \mathrm{LnOilpr}\quad \mathbf{Fedfunds}}^{Foreign\ block}\quad \overbrace{\mathrm{DLnCPI}\quad \mathrm{DLnRER}\quad \mathbf{LnREXP}}^{Domestic\ block}\right)$$

In connection to the real exchange rate, the addition of real exports allows us to model more precisely the impact of the oil price and risk-premium shocks on the external demand of VN goods and services. This can be further refined, however, by considering a wider approach to Vietnam's international competitiveness. In this widen setting, the real exchange rate is substituted by the real effective exchange rate (REER) while real exports are replaced by the trade balance (TBY). This delivers:

Model II $$\left(\overbrace{\mathrm{DOilpd}\quad \mathrm{Globix}\quad \mathrm{LnOilpr}\quad \mathrm{Fedfunds}}^{Foreign\ block}\quad \overbrace{\mathrm{DLnCPI}\quad \mathbf{DLnREER}\quad \mathbf{TBY}}^{Domestic\ block}\right)$$

Finally, we are also interested in assessing how the SBV has dealt with the impact of oil price and risk-premium shocks in order to maintain inflation under control. This is certainly crucial for a small open economy such as VN. Consequently, we replace the real effective exchange rate and the trade balance by the interbank 3-month interest rate (Rate3M) and the nominal exchange rate Dong/$ (FX):

Model III $$\left(\overbrace{\mathrm{DOilpd}\quad \mathrm{Globix}\quad \mathrm{LnOilpr}\quad \mathrm{Fedfunds}}^{Foreign\ block}\quad \overbrace{\mathrm{DLnCPI}\quad \mathbf{Rate3M}\quad \mathbf{LnFX}}^{Domestic\ block}\right)$$

In this way, the domestic block is made of the main variables of interest of a central bank so that its monetary policy response to oil price and risk-premium shocks can be properly assessed.

The reasons for augmenting Kilian's (2009) set up by recruiting different proxies for Vietnam's external trade and monetary policy can be found in Pham *et al.* (2019). They showed that country risk premium shocks account for about one-fifth of Vietnam's output growth variability, on the one hand; while, on the other, have a large explanatory power of the variations in the trade-balance-over-output ratio over the past two decades.

The first three columns of Table 1 summarise our model's variable choices. In the three models I, II and III, we restrict (i) the oil supply shocks to have no contemporaneous effects on Vietnam's domestic variables (i.e., in the month impact); and (ii) the risk-premium shocks to have no contemporaneous effects on Vietnam's inflation either. This implies that our three SVAR specifications are over-identified and should then pass the Likelihood-Ratio test for over-identifying restrictions. This is indeed the case, as shown in the last two columns of Table 1.

Model	Foreign Block	Domestic Block	VAR(p)	Largest Root	Over-identification Test
Baseline	Kilian (2009)	DLnCPI, DLnRER	6	0.97035	-
A1	Kilian (2009), U.S. Fedfunds	DLnCPI, DLnRER, DLnREXP	3	0. 99623	0.699
A2	Kilian (2009), U.S. Fedfunds	DLnCPI, DLnREER, TBY	3	0.95522	0.717
B	Kilian (2009), U.S. Fedfunds	DLnCPI, Rate3M, LnFX	3	0.99140	0.634

Notes: Kilian's (2009) variables are oil production (OilProd), the global economic activity index (Globix), and the real oil price (Oilpr). Prefixes D, Ln, and DLn refer to logarithm, first-difference, and log-difference operators, with $DLn(y_t) = \log(y_t) - \log(y_{t-1})$; FX, RER, and REER are, respectively, the nominal VND/USD exchange rate, the bilateral VND/USD real exchange rate, and the real effective exchange rate; REXP denotes real exports; TBY represents trade-balance-over-output; Rate3M is the three-month Interbank interest rate; and CPI denotes the consumer price index. Zero-restrictions on A_0^{21} matrix of models I, II, and III are as $\begin{bmatrix} 0 & * & * & 0 \\ 0 & * & * & * \\ 0 & * & * & * \end{bmatrix}$. Numbers in the last columns are p-values.

Table 1: Model specifications

According to Akaike's information criteria and the rule-of-thumb in VAR order selection, we pick up the suitable order, VAR(p), of 3 for models I, II and III. In contrast, the baseline model is intentionally estimated with a six-month lag to entirely capture the effects of oil price shocks on the VN CPI and RER dynamics.[7] The fifth column reports that all VAR models are stable since their largest inverse roots of the AR characteristic polynomial lie inside the unit circle.

3.3. Data description

It should be stressed that the constructed dataset is on a monthly basis. This is important because it allows our analysis to focus on a recent period, 1999-2018, without running out of degrees of freedom in the estimation. In addition, it is important to remark that no yearly-quarterly data interpolation has been needed, as it is often the case in studies on close emerging economies. We obtained the VN CPI, the nominal

[7] See Table A.1 in the appendix for further details.

exchange rate of the VND against the U.S. Dollar (FX), and export (EXP) data from the Vietnamese General Statistical Office (GSO) via Datastream. The interbank 3-month interest rate (Rate3M) was taken from the SBV. Real effective exchange rate (REER) running up to 2018:12 was extracted from Darvas (2012), since the IMF does not officially provide this series for Vietnam. Kilian's studies (2009, 2019) supplied the corrected global economic activity index (Globix), which is a proxy for the world demand of goods. It should be noted that Hamilton (2018) criticises Kilian's (2009) index for failing to account for global consumption demand. Nonetheless, Kilian (2019) adds a corrigendum justifying that the gap between the old and the new index is highly unlikely to bias any related studies.

The U.S. Energy Information Administration (EIA) provided oil production (Oilprod) data in terms of a monthly average in thousands of barrels per day. For real oil price (Oilpr), we computed the average of West Texas Intermediate (WTI) and Brent oil prices, also obtained from EIA, after adjusting by the U.S. consumer price index. All data series cover the timespan 1998:01 – 2018:12 except for the Rate3M series starting in 1999:01. Trading-balance-to-output (TBY) is calculated as $\frac{RealExports_t - RealImports_t}{Output_t}$. Since output data for Vietnam in terms of US Dollar currency[8] is only available at quarterly frequency from 2001:01, the Chow-Lin interpolation method is used for the low-to-high frequency conversion. Figure A.1 in the Appendix, shows the dynamics of the considered time series, whereas Tables 2 and A.2 in the Appendix report, respectively, descriptive statistics and the corresponding correlation matrix.

Variables	Oilprod	Globix	Oilpr	DLnCPI	DLnFX	DLnRER	REER	Rate3M	TBY	DLnREXP
Mean	73945	5.76	59.18	0.11	0.24	-0.08	112.97	7.73	-1.62	1.05
Median	73931	-9.07	54.42	0.09	0.05	-0.10	106.77	7.37	-1.13	0.99
Max	84225	188.00	132.97	0.79	8.77	6.94	148.36	19.69	4.06	45.80
Min	64307	-163.00	13.98	-0.28	-0.54	-3.09	87.01	2.47	-13.37	-24.99
Std.Dev	4908	71.35	27.49	0.15	0.87	1.01	17.54	3.14	2.72	8.63
Obs	252	252	252	252	252	252	252	240	214	252

Notes: Oilprod (thousand barrels / day), Oilpr (US$ / barrel), DLnCPI (% m-o-m), DLnFX (% m-o-m), DLnRER (% m-o-m), Rate3M (% pa), TBY (% GDP), DLnREXP (% m-o-m).

Table 2: Descriptive statistics, 1998:01 – 2018:12.

[8] Downloaded from CEIC data provider.

4. Empirical results and discussion

In this section, we present and then discuss the estimated impulse-response functions (IRFs) of four models, from which the transmission of foreign shocks to the VN economy is quantitatively assessed over the full sample 1998 – 2012 period.[9] These are Kilian's (2009) baseline specification and its subsequent expanded versions – Models I, II, and III.

We interpret a positive (negative) shock to any variable in the foreign block as causing increases (decreases) either in oil production, the global demand of goods, or in the level of speculation in the oil market. Similarly, a rise (fall) in the U.S. Federal Fund rate tightens (loosens) the monetary policy pushing up the cost of borrowing. Therefore, in the rest of this paper we use positive or negative shock interchangeably depending upon the context, but the IRFs are always computed and plotted as positive impacts.

4.1. The baseline model

Figure 2 shows the baseline IRFs, with one-standard-deviation error bands in red dotted lines. The first row of panel A shows that oil supply surprises only have a short-lived impact on both domestic endogenous variables (CPI, RER), as their responses vanish within two quarters. On the contrary, oil demand shocks induced by global economic activity or speculation/innovation induce highly persistent responses in the VN inflation and real exchange rates. Specifically, the responses of the inflation rate to oil demand and oil-specific demand shocks reach their peaks in two and eight months, respectively, and then asynchronously revert to equilibrium. However, the recovery of the inflation rate under non-fundamental oil price shocks is much faster than under shocks influenced by global demand, with the former clearly dying down within a one-year horizon.

[9] Beyond the direct estimation of equation (1), we have also estimated the system including dummy variables that control for the possible inflection point experienced by the VN economy in 2009, when it became a net oil importer. All the reported results in this paper hold in the presence of these dummy variables, which take value 1 in 2009-2018 and zero otherwise. We interpret this robustness as evidence that 2009 did not cause a structural break in the economic relationships under scrutiny. These additional results are available upon request.

From the second row of panel B, we observe that one standard deviation of an oil demand shock (about 18 index points) raises the VN CPI by an annualised percentage of 1.9%, 3.6%, and 4.8% over one-, two- and three-year horizons, respectively. Correspondingly, the RER falls greatly, by 6.5, 13.1%, and 17.4% per annum in the same three horizons, respectively, leading to a strong appreciation of the VND against the U.S. Dollar.

Hence, Kilian's (2009) baseline model reveals that, even though supply-side shocks are innocuous, the VN CPI and RER are fairly responsive to both types of oil demand shock.

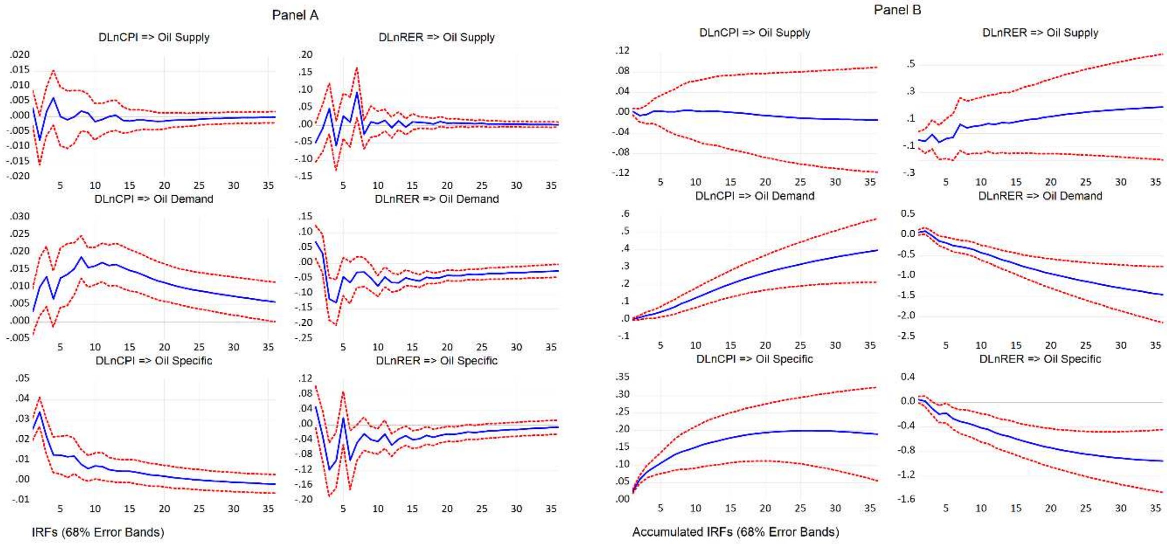

Figure 2: The baseline model (DOilpd, Globix, LnOilpr, DLnCPI, DLnRER). Panel A: Recursive impulse - response functions (IRFs) of VN CPI and RER to one standard deviation structural shocks, defined as oil supply, oil demand, and oil market-specific demand; Panel B: accumulated IRFs of the corresponding ones in panel A. The red dotted lines are the 68% error bands.

4.2. Models I and II

The estimated IRFs for models I and II yield particular insights into the dynamics of VN external trade variables. They reveal, first of all, that VN export and trade balances were immune to any surprising change in global oil production. Although, this tends to confirm the innocuous effects of supply-side oil price shocks, Figure 3 clarifies that oil production increases have marginally significant and short-lived impacts on the time-paths of VN (real) effective exchange rates and domestic prices.

The IRFs of RER and REER are quite similar under the effects of oil supply disruptions, but they behave in the opposite way when hit by oil demand shocks. To be precise, a positive global demand oil shock raises the VN REER significantly and persistently for almost a year after the impact. In contrast, an oil-specific demand shock initially decreases REER growth rate by about 0.3 percent per month, but rapidly returns to its equilibrium before climbing to a positive peak of 0.15% in the fourth month. This indicates that the VN economy starts losing its relative competitive advantage in just one quarter after a speculative oil price shock hits the economy. Conversely, the resulting strengthened values of the VND result in cheaper foreign goods for the VN households in a year or more and compromise the trade balance. On this account, note that the responses of TBY depicted in the third row of Figure 3 – Panel B show that oil price increases actually impair the VN trade balance in the short-to-medium run, and of course the current account, even though exports also improve.

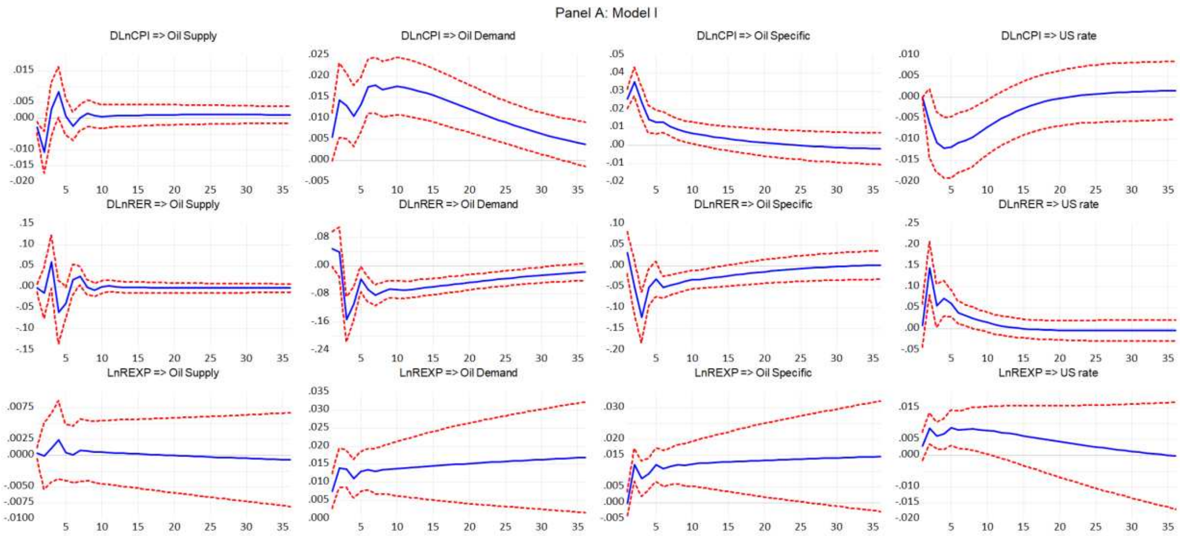

Figure 3: The IRFs of model I (DOilpd, Globix, LnOilpr, Fedfunds, DLnCPI, DLnRER, LnREXP). The dotted lines are the 68% error bands.

Equally important, Kilian's (2009) expanded models uncover that the U.S. Federal Fund rate has remarkable effects on the VN economy because of the strong tie between the two currencies, as pointed out by Anwar and Nguyen (2018). The fourth column of Figure 3 – Panel A shows that the VN inflation rate significantly improves (negative adjustment) in two quarters or more, if there is a hike in the U.S. policy rate. However, it slowly recovers subsequently and then reverts to the zero-line in the mid-term. Note that the response of inflation to the Federal Funds rate in model I is stronger than its counterpart in model II. In the first case, we evaluate the reaction of the RER, which is highly conditioned by VND pegging to the US dollar.[10] In the second case (Figure 3 – Panel B), in contrast, the response is much less persistent in consistence to the multilateral setting captured by the REER. The REER reflects an enlarged system of trade relationships in which adjustments take place quicker than in the bilateral setting depicted by Model I.

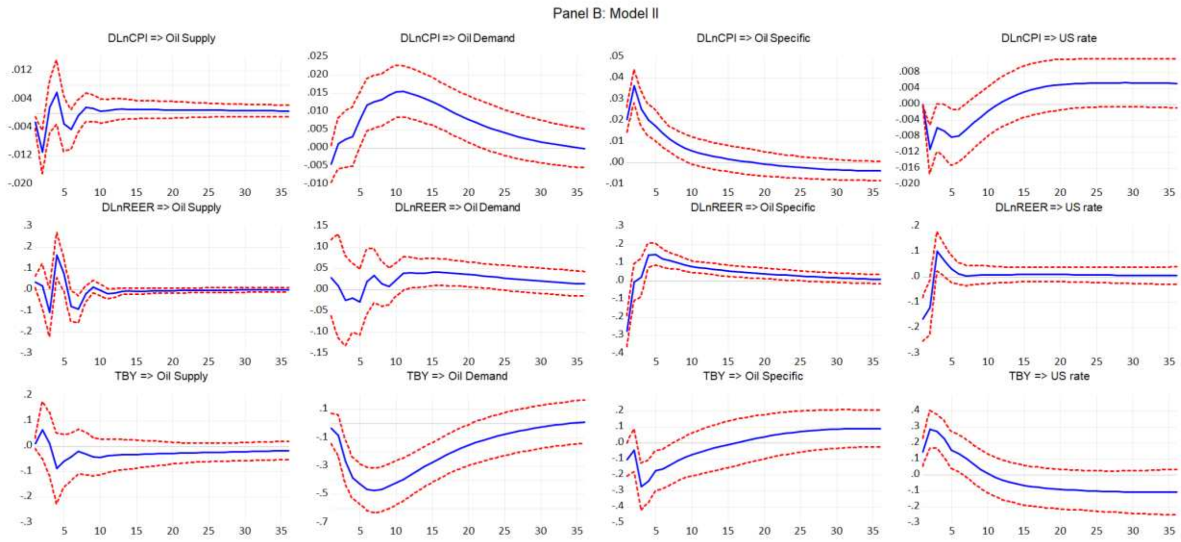

Figure 3 (continue): The IRFs of model II (DOilpd, Globix, LnOilpr, Fedfunds, DLnCPI, DLnREER, TBY). The dotted lines are the 68% error bands.

By the same token, the VN trade balance significantly positively reacts to an increase in the exogenous risk premium in five months after the initial impact, since that type of shock depreciates the VND in the following six months (see the last column of Figure 3 – Panel A), after reaching the peak response of 0.15% at the second month and afterwards diminishing to the negative side but the latter is statistically insignificant.

[10] Note that $RER = FX\frac{CPI^f}{CPI^d}$. This explains the systematic inverse responses of the RER and domestic inflation.

4.3. Model III

Figure 4 presents the adjustments of Vietnam's monetary policy – domestic interest rates and nominal VND/USD exchange rates –, in response to oil prices and international risk premium innovations. Global demand shocks indirectly provoke the rises in VN interest rates, with a lag of two months in response to the consumption price rally. The peak interest rate response occurs in the sixteenth month, nearly ten months after the peak of changes in the inflation rate, implying that the effects of oil demand shocks on the VN economy are prolonged. When the Vietnam's economy is hit by an 8.3% increase in crude oil prices, which is estimated to be one standard deviation of oil market-specific demand shock, the short-term interest rate climbs dramatically to a peak of 0.5% at four months after the response of inflation rate attains its largest magnitude in the second period. Likewise, the nominal VND/USD exchange rate only commences to depreciate significantly after a five-month lag after an oil-specific demand shock. This reflects the strong connection between the nominal exchange rate and the short-term interest rate.

The detachment between the responses of inflation, on one side, and domestic interest rates and nominal VND/USD exchange rates, on the other, during the first two months after a risk-premium shock, can be interpreted as a manifestation of the "price puzzle" (see Castelnuovo and Surico, 2006). Our reading of these results is that the VN authorities have implemented the monetary policy in a cautious fashion. In particular, the interest rate policy seems to have been too passive regarding international demand shocks and/or not strong enough to counteract the rapid inflation rate growth resulting from such innovations. This interpretation is consistent with Bhattacharya's (2014) finding of persistently larger rates of inflation in Vietnam than in its neighbouring emerging economies.

Supporting this argument, Figure A.3 adds complementary information showing model's III IRFs of the three variables in the domestic block in response to their own innovations. The autonomous responses of the inflation rate vanish in two quarters, in clear contrast to the interest rate response to this same shock, which steadily rises to reach its peak over the same six-month period and only converges back to zero over a fifteen-month period. Contrariwise, the inflation rate responds weakly to a rise in the interest rate, which is in fact consistent with the findings of Bhattacharya (2014). In the case of an exchange rate shock, the interest rate tends to react strongly in the first half-year (note that its initial response of 0.1% equates 90% of the peak), while the inflation rate only responds significantly in three consecutive months after the initial impact. Finally, the nominal VND/USD exchange rate adjusts upwards in the aftermath of a positive shock to either the inflation or the interest rate, but soon stabilises over the short- to medium-term.

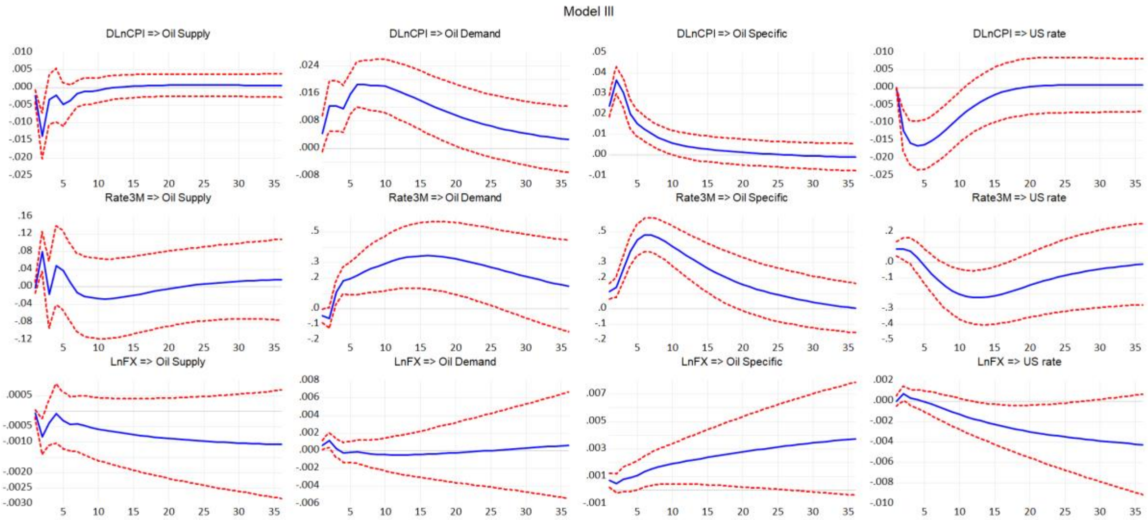

Figure 4: The IRFs of model III (DOilpd, Globix, LnOilpr, Fedfunds, DLnCPI, Rate3M, LnFX). Red dotted lines are the 68% error bands.

5. Variance analysis

5.1. Forecasting variance decomposition

The above analysis tells us how VN macroeconomic indicators behave in response to foreign surprises as well as their own innovations, but it cannot explain how much of their variation is explained by those shocks for either forecasting or historical analysis. Table 3 summarises the variance contribution of each structural shock to each domestic endogenous variable across Models I, II and III (we only show the first twenty-four months, as they are fairly stable afterward). Note that, for the inflation rate, we average the contributions of four foreign shocks because their model-specific values are remarkably similar, and it is not worth presenting them separately. Figure A.4 in the Appendix depicts these variance shares for each endogenous series in detail.

At the first six-month horizon, we find that domestic variables are predominantly affected by their own shocks. It is worth highlighting, however, that among the foreign block shocks, precautionary oil demand shocks have the strongest explanatory power, accounting for around one-fifth of the variation in the VN inflation rate and three-month interest rate.

In the middle run and beyond, from 12 to 24 months, autonomous shocks explain about 50% of the fluctuations in the trade balance and inflation rate, 26% of the fluctuations in the three-month interest rate, and between 66% and 80% of the fluctuations in the other domestic variables. Compared to other structural shocks, global demand shocks seem to be the most important macroeconomic drivers, as they account for about one-third of the fluctuation in TBY, one-fifth in inflation, one quarter in interest rates, and roughly one-tenth in exports and the RER. However, they make only a negligible contribution to nominal exchange rates and the REER. In sharp contrast, oil production disruption has an extremely low explanatory power of these variances.

Additionally, oil market-specific shocks are highly likely to play a crucial role in explaining the long-run variance in interest and inflation rates. To be precise, its contribution to interest rates approximately equals the size of the own shock (close to one-fourth), while its contribution to inflation rates is around 17%. The results also show that an oil-specific shock accounts for 8%, 10%, and 8% of the long-run variance of the nominal exchange rate, exports, and REER, respectively. Regarding the risk premium shock induced by the U.S. monetary policy, we find that, after 24 months, it has only a small impact on all domestic variables, explaining between 2.5% and 7.3% of their long-run volatilities.

Summing up, our findings indicate that apart from the prime power of own shocks in the short run, both types of oil demand shock play an essential role in explaining the long-run variations of several VN macroeconomic indicators. Oil demand shocks most particularly affect the trade balance, whereas the three-month interest rate is strongly influenced by oil-specific demand innovations. In addition, both types of shock are equally important for the inflation rate. Lastly, it is shown that inflation moderately affects interest rates, explaining 18% of its long-run variance, while the reverse influence is insignificant.

Variable	Step	Oil Supply	Oil Demand	Oil Specific	US Rate	DLnCPI	Rate3M	LnFX	LnREXP	TBY	DLnRER	DLnREER
DLnCPI	1	0.09	0.30	7.46	0.00	92.15	0.00	0.00	0.00	0.00	0.00	0.00
	6	1.29	4.39	19.82	4.01	61.80	1.20	1.70	0.68	10.41	3.21	8.90
	12	1.14	12.10	18.69	5.09	53.80	1.96	1.47	0.60	12.79	2.98	7.78
	18	1.09	16.65	17.80	5.01	50.70	1.98	1.41	0.57	12.13	2.80	7.36
	24	1.09	18.47	17.39	5.14	49.38	1.94	1.38	0.56	11.85	2.71	7.19
Rate3M	1	0.00	0.42	2.56	1.56	1.27	94.18	0.00				
	6	0.29	3.73	18.36	0.76	18.87	56.32	1.68				
	12	0.22	9.74	26.78	3.73	22.13	36.09	1.31				
	18	0.20	16.77	26.82	6.26	19.34	29.49	1.11				
	24	0.18	21.81	25.67	6.82	17.57	26.78	1.17				
LnFX	1	0.01	0.73	0.87	0.00	3.03	1.26	94.10				
	6	0.33	0.62	1.54	0.22	2.73	6.80	87.75				
	12	0.43	0.44	3.82	1.43	4.65	7.22	82.02				
	18	0.62	0.38	5.91	4.18	5.25	6.74	76.93				
	24	0.81	0.29	7.96	7.32	5.24	6.21	72.17				
LnREXP	1	0.00	1.21	0.00	0.17	0.14			98.17		0.30	
	6	0.07	8.07	4.81	2.69	1.57			82.28		0.51	
	12	0.05	10.20	7.15	3.40	1.56			77.26		0.39	
	18	0.04	11.68	8.58	3.16	1.58			74.63		0.35	
	24	0.03	12.92	9.63	2.69	1.59			72.83		0.32	
TBY	1	0.01	0.06	0.52	1.05	2.07				93.64		2.66
	6	0.34	12.86	4.11	5.59	2.70				73.04		1.35
	12	0.38	27.92	4.10	4.70	2.73				58.93		1.24
	18	0.44	32.46	3.85	4.69	2.57				54.82		1.17
	24	0.48	33.26	3.96	5.20	2.51				53.45		1.14
DLnRER	1	0.00	0.30	0.13	0.01	4.17			0.00		95.39	
	6	0.88	4.01	2.18	3.25	12.81			3.75		73.12	
	12	0.93	7.11	3.09	3.45	12.62			3.58		69.22	
	18	0.91	8.84	3.31	3.38	12.36			3.52		67.69	
	24	0.90	9.81	3.35	3.34	12.21			3.49		66.89	
DLnREER	1	0.07	0.04	3.39	1.62	8.84				0.00		86.03
	6	2.66	0.18	5.01	2.61	8.69				1.90		78.94
	12	3.03	0.48	7.00	2.56	8.50				2.07		76.35
	18	3.00	0.95	7.71	2.57	8.39				2.06		75.31
	24	2.99	1.27	8.00	2.58	8.33				2.05		74.79

Note: variance decomposition of DLnCPI w.r.t foreign shocks is averaged over models I, II, and III. The top row represents structural shocks, while each row in the first column is the decomposed variable.

Table 3: Variance decomposition of models I, II, and III.

5.2. Historical variance decomposition

The preceding subsection answered the question of the variance contribution in a forecasting context. We now turn to explore and contrast how these shocks explain the dynamics of Vietnam's inflation, interest rates and trade balance in the following selected periods of interest: the two inflationary episodes of 2007:06 – 2009:12 and 2010:01 – 2012:06, and the years of deteriorated trade-balance-over-output in 2007:01 – 2011:12. Figures 5, 6 and 7 present the contributions of the structural oil price and risk-premium shocks to their trajectories (oil supply shocks are omitted due to their extremely limited impacts on the domestic variables, as also found in Table 3). The bars represent actual data, while the black solid lines depict the benchmark projection implied by the model in the absence of shocks. In turn, the different dashed lines correspond to the sum of two components: the benchmark projection and the stochastic accumulation accruing from each respective structural shock.

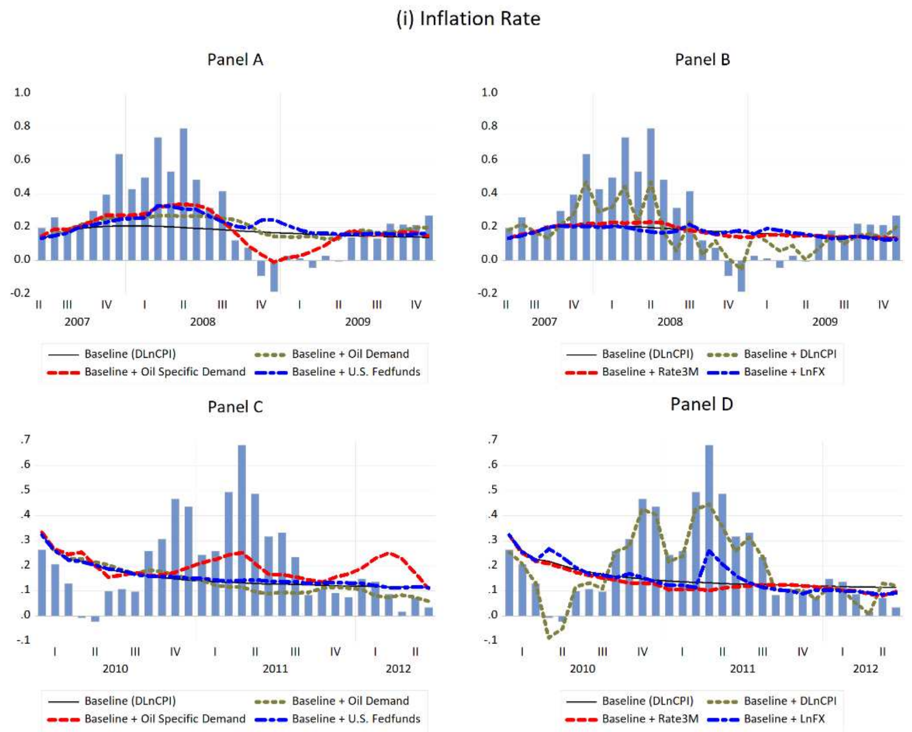

Figure 5: Historical variance decomposition of VN inflation rate.

Figure 5 shows that all three types of foreign shocks produced strong impacts on the VN inflation rate during the first inflationary episode, 2007:06 – 2008:06, but only the global demand oil and oil-specific demand shocks kept their strong influence in 2010:06 – 2011:09. The fall in inflation between 2008:09 and 2009:05 is mostly explained by oil-specific demand and autonomous inflation shocks. Given, in addition, the low impact of nominal interest rates (Panels B and D), one is bound to conclude that Vietnam's monetary policy was largely inefficient in the first inflationary episode, and it was thanks to domestic aggregate demand and oil price declines due to non-fundamental innovations that inflation pulled down subsequently. In sharp contrast, shocks to oil-specific demand were the only foreign factor that accelerated inflation in the second inflationary period. This may be explained by the socio-economic and political tensions around the world that caused the rise in precautionary oil demand between 2011 and 2014 (Lorusso and Pieroni, 2018).

Panel D of Figure 5 also shows that VN aggregate demand was a major force driving inflation in 2010 – 2011 for the reasons mentioned in Bhattacharya (2014), namely, movements in nominal effective exchange rates, real output growth, and credit expansion. Actually, in mid-2011 the nominal VND/USD exchange rate had a considerable impact on VN consumer prices, but it is clear that the impact was short-lived.

Turning to interest rate dynamics, Figure 6 shows that the benchmark projections (black lines) exhibit an opposite influence on the movements of interest rates in the past two periods. A slight upward trend between 2007 and 2009, while a downward line is observed in the period 2010 – 2012. Similarly to Figure 5, we find that oil-specific demand and inflation shocks strongly affected interest rates, even though the latter were capped at 13.5% for sixteen months between 2010:12 and 2012:03. Panel D suggests that autonomous interest rate shocks considerably reduced the combined effects of oil-specific, inflation, and nominal exchange shocks that would have raised the interest rate to above 14% had it not been capped.

Figure 7 shows the base projection from 2007:01 to 2011:12, which is remarkably close to the long-run trade-balance deficit of -2.5% of GDP, as highlighted by Pham *et al.* (2019). Panel A shows that the U.S. monetary policy implemented in the aftermath of the GFC helped improve the VN trade balance, but oil price shock due to global demand worsened it notably in most of the assessed months. Finally, we observe that the trade balance was driven essentially by shocks *per se,* while the rest of domestic shocks had limited impacts on it.

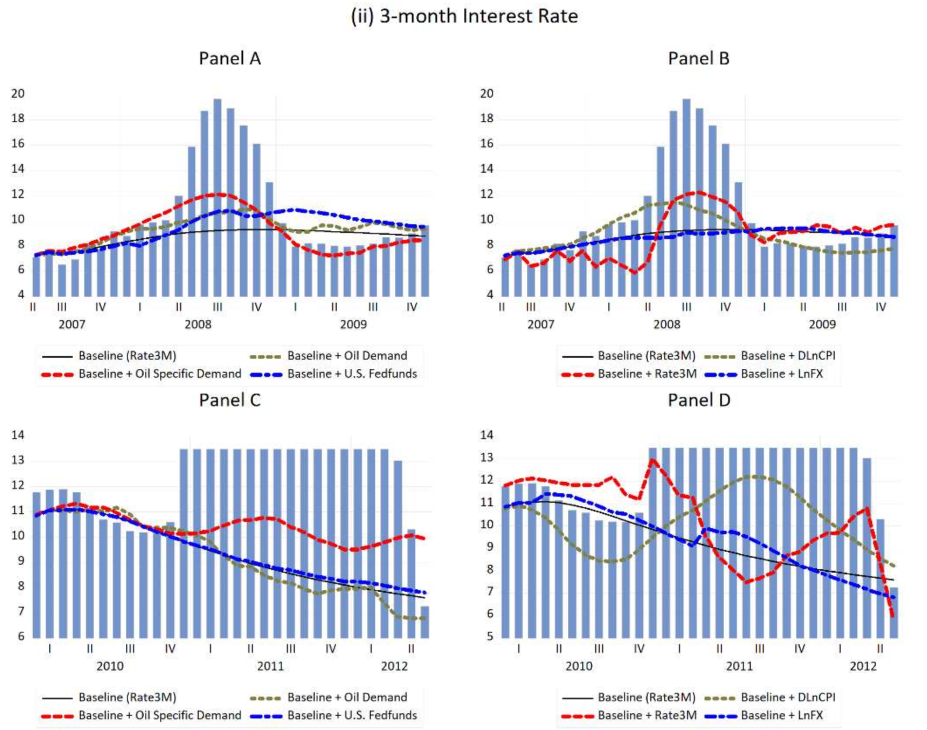

Figure 6: Historical variance decomposition of the VN 3-month interbank interest rate.

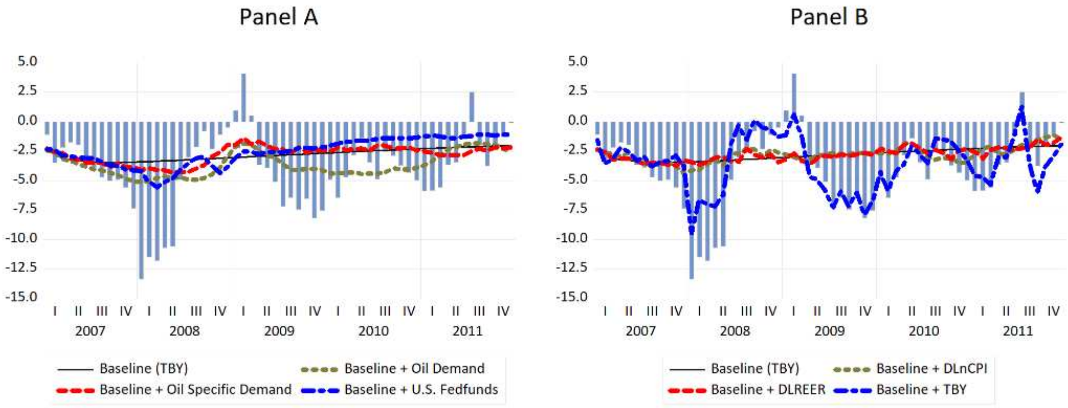

Figure 7: Historical variance decomposition of trade-balance-over-output.

6. Conclusions

Vietnam is known to be a small open country in the process of completing its transition to a free-market economy. It is less known, however, that it was a net exporter of crude oil until 2009, at the same time that it had to import up to 70% of the gasoline consumed domestically and most cracked petroleum products. In spite of the long-time planned and expected oil refineries, only Dung Quat started to be in operation in 2009 and could not counterbalance the growing need of oil imports. Given this twofold exposition (to trade in general, and to oil prices in particular), Vietnam's economic prospects crucially depend on the ability to manage the consequences of potential global shocks. This paper provided a step forward in the understanding of the mechanisms through which such shocks may condition Vietnam's economic performance.

To conduct the analysis, we followed Kilian's (2009) framework and examined the macroeconomic consequences of different oil price shocks: (1) oil supply shocks; (ii) oil demand shocks reflecting changes in the level of global economic activity (also called global demand oil shocks); and (3) oil-specific demand shocks, which are also referred to as precautionary, speculative or non-fundamental demand shocks.

Under Kilian's (2009) baseline model, our analysis yielded a first important insight for Vietnam's economy, namely that its CPI and RER are fairly responsive to both types of oil demand shocks (and not to the supply-side shock). In particular, the recovery of inflation to oil-specific demand shocks, whose impact clearly dyes down within one-year, is much faster than to global demand oil shocks. The persistence of the latter implies that one standard deviation of such shock raises VN CPI by 3.6% per annum and reduces the RER by 13.1% per annum in the same 24-month horizon. This leads to a strong appreciation of the VND against the U.S. Dollar. A first important result is, therefore, the harm of global demand oil price shocks in terms of inflation and international price-competitiveness.

Models I and II allow a deeper evaluation on the way oil price and risk-premium shocks affect competitiveness in Vietnam. First, the little influence from oil supply disruptions is confirmed both from the IRFs of the RER and the REER, which display similar responses. Second, the harm in terms of international price-competitiveness is also confirmed when oil price shocks arise either from global demand or speculative activities. Impulses in both cases strengthen the VND during at least a year, thereby leading to cheaper foreign goods for VN households.

Amid this general appraisal, Kilian's (2009) expanded setting allows the identification of idiosyncratic responses of RER and REER when the economy is hit by global demand oil price shocks. On the one hand, the RER and the REER react in opposite ways to such noises. On the other hand, the impact on the REER varies depending on the nature of the demand-side perturbation. A global demand oil price shock significantly raises VN's REER after eleven months, causing a loss in trade competitiveness (exports become more expensive, imports become cheaper, or both since Vietnam is at the same time an oil exporter and an oil importing economy). In contrast, an oil-specific demand shock decreases REER growth rate by about 0.3 percent per month initially and quickly overshoots to reach a peak of 0.15% in the fourth month. This indicates that in case of an oil-specific shock the VN economy may start losing its relative competitive advantage in one quarter. Of course, REER responses were examined together with TBY's ones and we saw that oil price increases actually impair Vietnam's trade balance, and of course, the current account.

Turning to risk-premium shocks, we uncovered remarkable effects of the U.S. Federal Fund rate because of the strong tie between the two respective currencies. In model I with the RER, we disclosed the strong impact of risk-premium shocks on Vietnam's inflation rate due to VND pegging to the US dollar. In contrast, in the multilateral setting brought by the REER, we found short-lived price responses. This is the outcome of international competition beyond the pegging of VND and the US dollar. Inflation responds more quickly to risk-premium shocks because in the multilateral trade context there is more penetration of imported goods and services in the worse currency scenario brought by such shocks. For the same reason, Vietnam's trade balance reacts positively to an increase in the exogenous risk premium, since that type of shock depreciates the VND in the following ten months so that exports are enhanced, and imports restrained.

Model 3 allowed us to assess how reactive the monetary policy is to oil price and risk-premium shocks. It is in this case that we found significant impacts of oil ~~supply~~ demand shocks on the 3-month interest rate and the nominal VND/USD exchange rates during the first two months after the shock. The possibility of quickly increasing oil imports may be the reason why this response, although significant, tends to be short-lived.

We also found that the 3-month interest rate (and/or short-term interest rates) has been greatly sensitive to both types of oil demand shocks and to changes in international financial risk.

Given the lack of inflation sensitivity to supply-side oil price shocks delivered by Kilian's (2009) baseline model, the significant monetary policy response to these shocks in the first two months after the shock was a new result requiring some interpretation. Especially in a context in which inflation on one side, and the monetary policy response on the other, showed a detachment (moving, respectively, upwards and downwards) consistent with the so-called "price puzzle" (Castelnuovo and Surico, 2006). This may be revealing of a conservative implementation of the monetary policy in Vietnam in recent decades, which would be consistent with Bhattacharya's (2014) assessment of Vietnam's persistently higher inflation vis-à-vis other Asian emerging economies. We therefore conclude that Vietnam's authorities were quite conservative in their reaction to international demand shocks and failed to counteract the inflationary pressures brought from that shocks. In this context, Bhattacharya's (2014) call for a forward-looking monetary policy in Vietnam is also endorsed by our analysis.

As our variance decomposition analysis showed, this is likely to have had adverse effects on competitiveness on account of the essential role played by both types of demand-side oil price shocks in the long-run variations of several VN macroeconomic indicators, most particularly on the trade balance.

In a context in which inflationary periods are mainly driven by the effects of oil price shocks, we have confirmed that it is likely that Vietnam's monetary policy was to some extent inefficient in the first inflationary period (2007-2009). However, in the second period (2010-2012) domestic aggregate demand and oil price declines due to non-fundamental innovations pulled down Vietnam's inflation rate and counterbalanced the impact of global demand oil price shocks for precautionary reasons. As shown by Lorusso and Pieroni (2018), a set of socio-economic and political tensions around the world from 2011 to 2014 resulted in a rising precautionary demand for oil. This was the only foreign driver of inflation in

Vietnam in those years, but it is a key example of how global shocks may affect domestic macroeconomic performance thereby asking for an appropriate policy response.

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Appendix

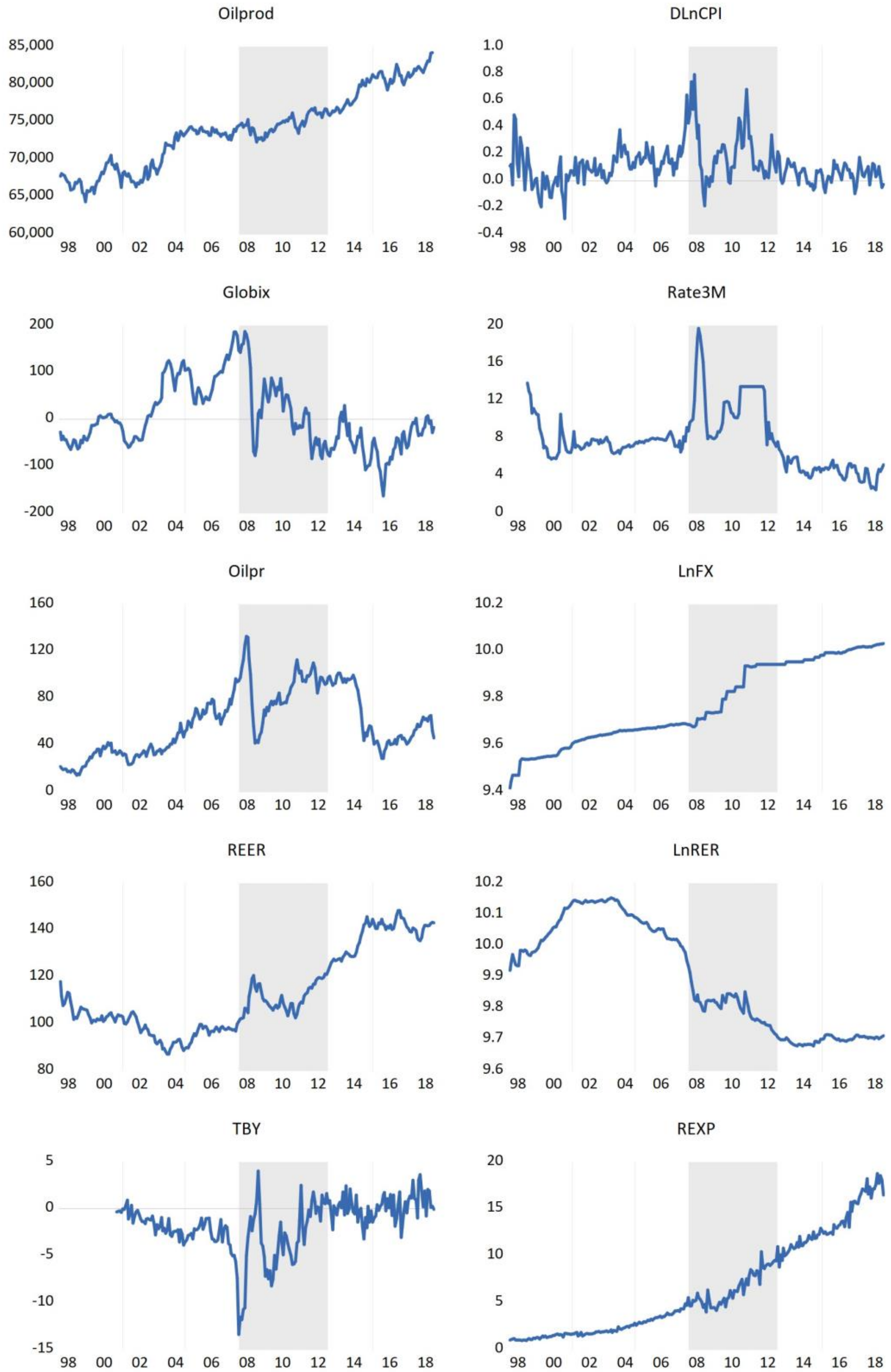


Figure A.1: Global prices and Vietnam's macroeconomic indicators, 1998 – 2018.

	Stability	Information criteria				
Model	Largest root	p	FPE	AIC	SC	HQ
Baseline	0.97035	0	10.40853	16.53201	16.60204	16.56019
		1	0.012608	9.815951	**10.23612***	**9.985019***
		2	0.011602	9.732562	10.50287	10.04252
		3	**0.011231***	**9.699457***	10.81991	10.1503
Model I	0.99623	0	7.460511	21.87476	21.9728	21.91421
		1	2.37E-06	6.912553	7.69687	7.228146
		2	9.20E-07	5.96498	**7.435575***	**6.556717***
		3	**8.65e-07***	**5.901157***	8.05803	6.769038
Model II	0.95522	0	72.95096	24.15493	24.26801	24.20066
		1	0.000505	12.27318	**13.17785***	12.63906
		2	**0.000261***	**11.61174***	13.30799	**12.29776***
		3	0.000301	11.75056	14.23839	12.75672
Model III	0.99140	0	0.825113	19.6729	19.7769	19.71484
		1	8.91E-09	1.329123	**2.161094***	1.664648
		2	**4.65e-09***	**0.678190***	2.238136	1.307300*
		3	5.09E-09	0.765657	3.053577	1.688352

Figure A.1: VAR order selection.

Correlation Probability	DLnOilpd	LnOilpr	Globix	DLnCPI	Rate3m	DLnRER	DLnREER	DLnREXP	TBY
DLnOilpd	1.000000 -----								
LnOilpr	0.024619 0.7203	1.000000 -----							
Globix	0.055407 0.4200	0.266420 0.0001	1.000000 -----						
DLnCPI	0.004056 0.9530	0.428292 0.0000	0.521264 0.0000	1.000000 -----					
Rate3M	-0.073691 0.2832	0.434138 0.0000	0.340182 0.0000	0.424267 0.0000	1.000000 -----				
DLnRER	-0.063261 0.3571	-0.210418 0.0020	-0.235422 0.0005	-0.438477 0.0000	-0.165433 0.0154	1.000000 -----			
DLnREER	0.069859 0.3091	0.210527 0.0020	0.081512 0.2351	0.242466 0.0003	0.139802 0.0410	-0.353575 0.0000	1.000000 -----		
DLnREXP	0.055455 0.4196	0.043316 0.5285	0.064389 0.3486	0.073961 0.2814	-0.007027 0.9186	0.085658 0.2120	0.003776 0.9562	1.000000 -----	
TBY	-0.043473 0.5270	-0.282740 0.0000	-0.648303 0.0000	-0.619260 0.0000	-0.394005 0.0000	0.258300 0.0001	-0.002675 0.9690	0.034144 0.6194	1.000000 -----

Table A.2: Correlation matrix (p-values are below the correlation coefficients).

Complementary material designed for an Online Appendix

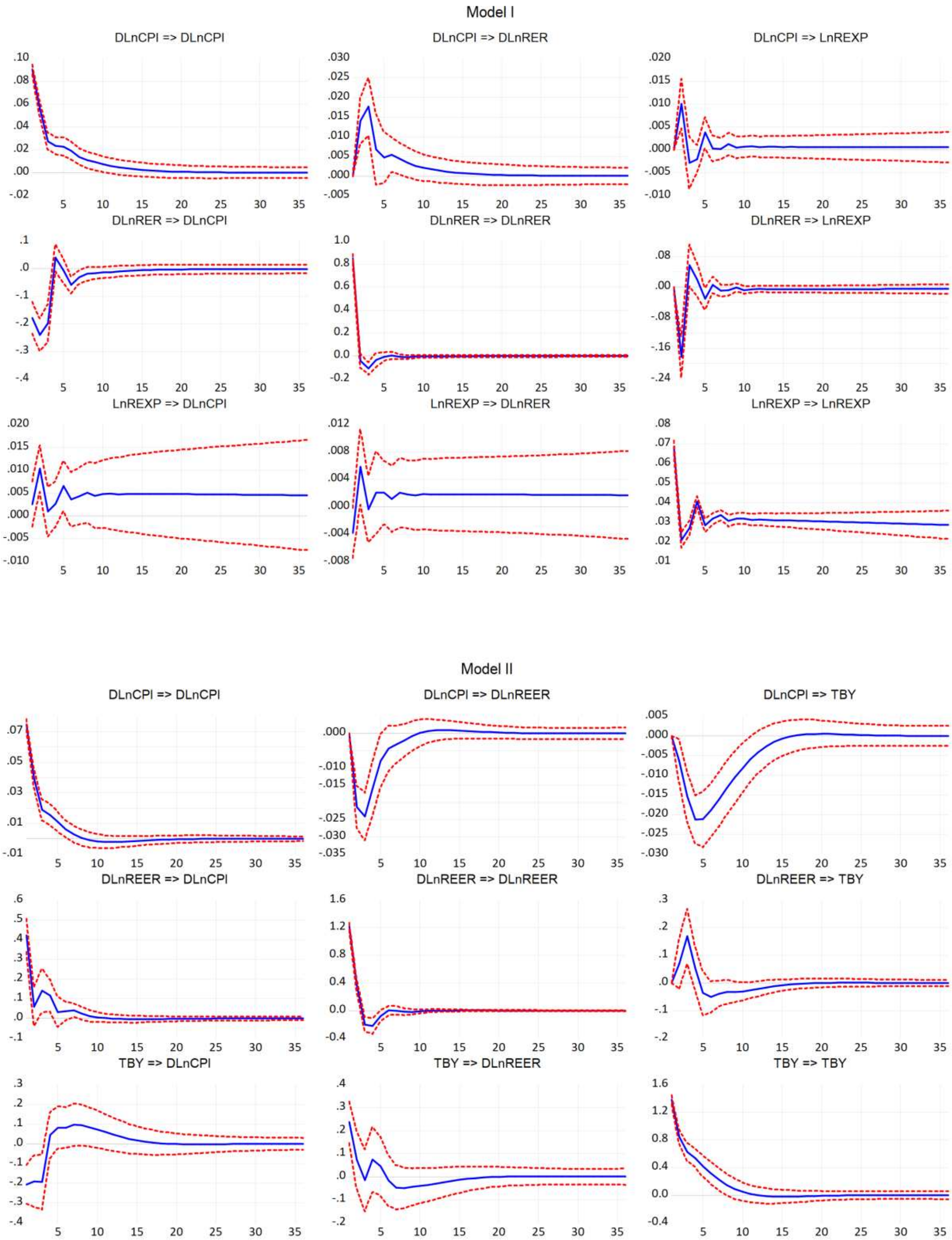


Figure A.3: Impulse - response functions w.r.t domestic structural shocks.

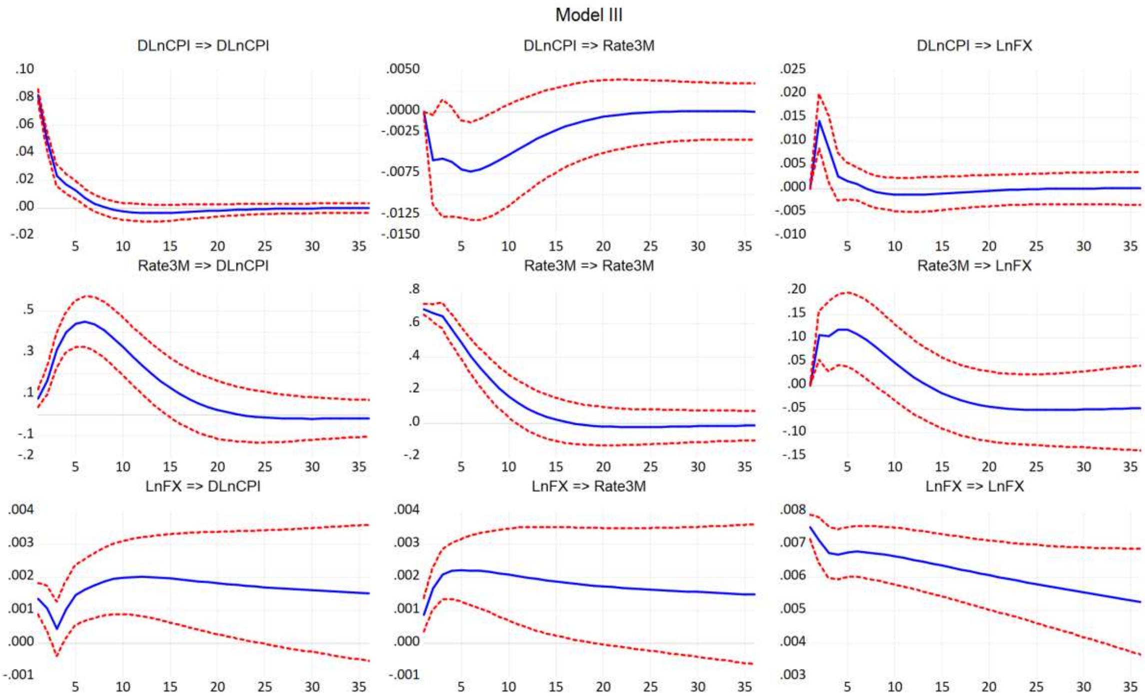


Figure A.3 (continue): Impulse - response functions w.r.t domestic structural shocks.

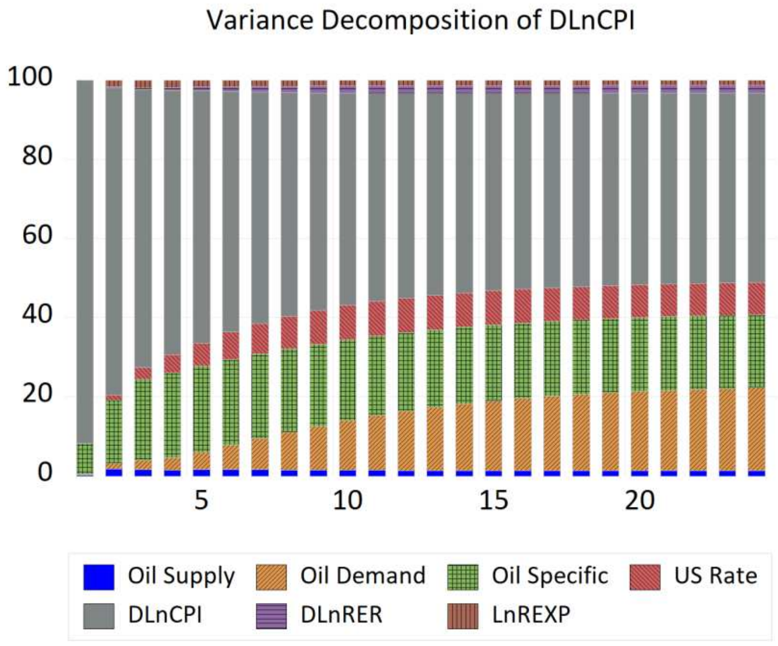
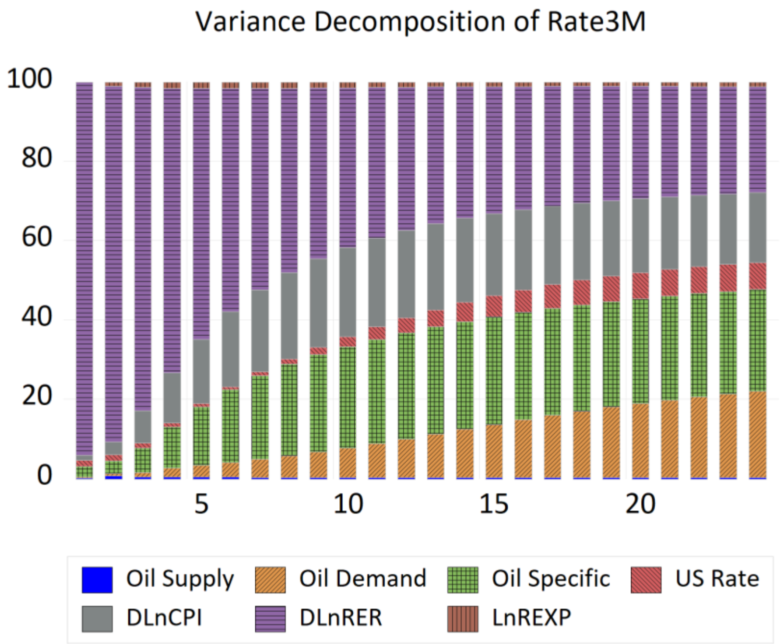


Figure A.4: variance decomposition of selected variables



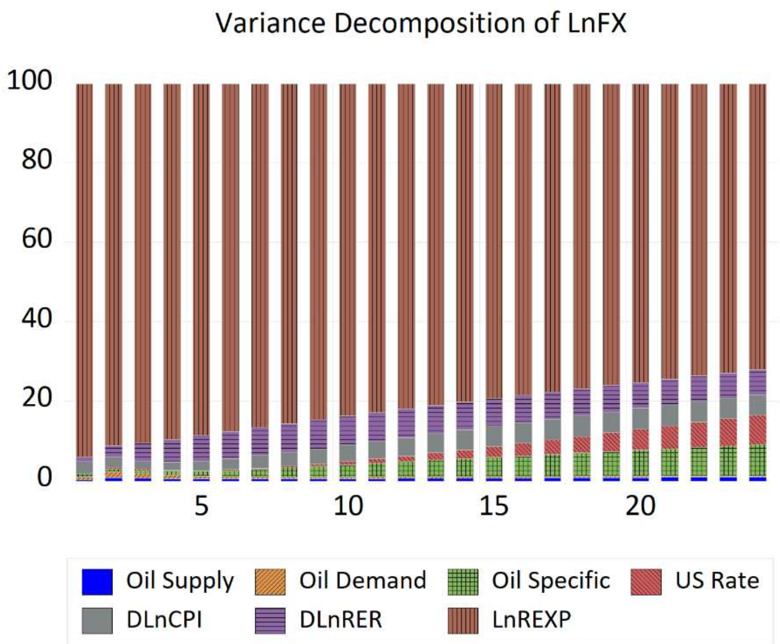
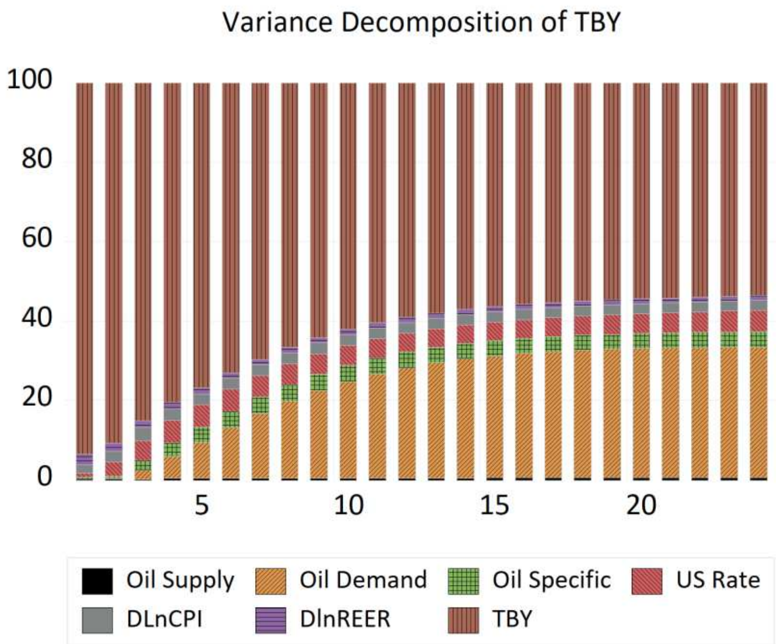


Figure A.4 (continue)



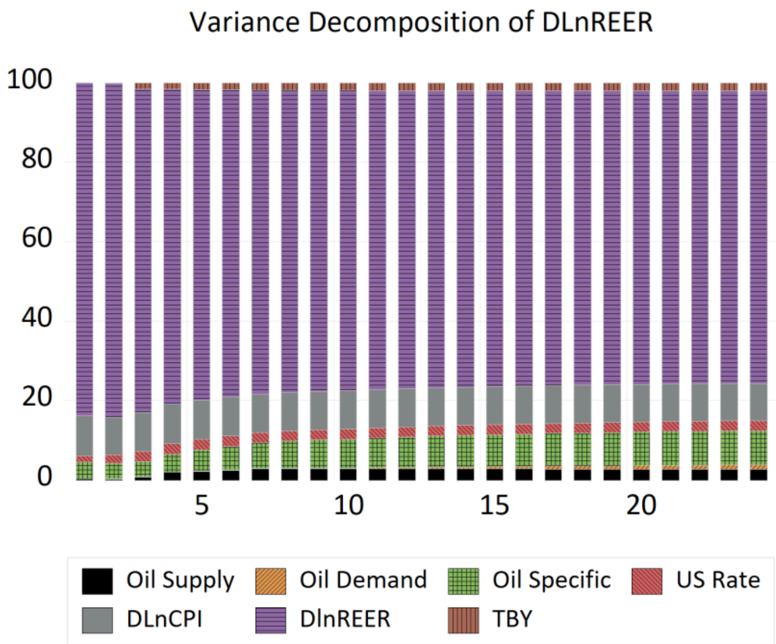


Figure A.4 (continue)