Do Oil Shocks Affect Financial Stress? Evidence from Oil-Exporting and -Importing Countries

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ABSTRACT

In recent years, there is increasing attention to examining the relationship between oil prices, financial markets, and the economy. Relatively little is known about the dynamic relationship between structural oil shocks and financial market stress of countries, which are majorly dependent on oil price fluctuations. This paper examines the impact of structural oil shocks (oil supply shocks, global aggregate demand shocks, speculative shocks, and other oil shocks) on the financial stress of major oil-exporting and-importing economies. In this study, we construct a financial stress index and using a structural vector autoregression model, we investigate the effects of oil price shocks on the financial stress of major oil-exporting and importing economies. We find evidence that global demand shocks, followed by speculative demand shocks, have significant impacts on financial stress. Furthermore, the US subprime crisis has a significant bearing on the response of the financial stress index to structural oil shocks. The magnitude of oil price shocks on financial stress has subdued during the post-crisis period.

KEYWORDS

Structural Oil Shocks, Financial Stress Index, Financial Crisis

JEL Code: C32, C51, E44, E60, Q43, Q48

INTRODUCTION

Given the crucial role of oil in the global economy, a considerable body of empirical research has studied the relationship between oil price shocks and macroeconomic variables (Cunado and de Gracia, 2014, Cunado et al., 2015; Dutta et al., 2017; Hoover and Perez, 1994; Hamilton and Herrera, 2004; Kilian, 2009; Kilian and Park, 2009; Kilian and Lee, 2014; Noor and Dutta, 2017).In recent years, the literature in oil has expanded with the focus on the financial market indicators. The literature suggests that oil price shocks not only adversely affect stock returns but also influence the exchange rates, bond markets, and such effects depend on whether the economy is net oil exporter or importer (Aloui et al., 2012; Habib et al., 2016). Also, oil shocks can induce recession in the entire economy and make the financial system vulnerable (Aminu et al., 2018; Engemann et al., 2010; Mork et al., 1994). During the period of the financial crisis, the interlinkage between different segments of financial markets increases (Apostolakis and Papadopoulos, 2015; Silva et al., 2017; Vašíček et al., 2017). Such observation led to a growing concern for the relationship between oil prices and the entire financial system. It is noted that by studying the relationship of oil with one of the segments of the financial markets might ignore the combined effects of the entire financial system during the market downturn

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(Baumeister and Kilian, 2016; Chen et al., 2014; Jouini and Khallouli, 2019; Morana, 2013; Tokic, 2010). Despite the fact that the significance of oil shocks for the entire economy, very little or negligible attention has been paid to the relationship between oil shocks and the overall financial stress of any economy (Balke et al., 2002; Nazlioglu et al., 2015). Moreover, despite the growing concern for the oil price and financial system relationship, it is worth noting that very little empirical evidence has been established with respect to the implication of oil price shocks on the financial stress (Chen et al., 2014) of oil-exporting importing countries.

There are several possible channels like inflationary pressure, economic activity, and investor behavior through which stress in the financial system is influenced by oil shocks (Brown and Yücel, 2002; Chen et al., 2014; Kilian, 2008; Nazlioglu et al., 2015). As oil is a crucial ingredient in the production and manufacturing process; hence, shocks to oil prices affect corporate investment, which leads to declining stock returns (Katircioglu et al., 2015). Furthermore, financial stress through the bank lending channel could influence economic activity, and subsequently, the demand effect could affect oil prices (Cardarelli et al., 2011). An increase in economic growth may encourage higher lending by banks, which raises margin for banks. But, when the economic growth suffers due to higher oil prices, bank performance faces distress not only because of a decline in new lending but also due to the increase in credit default risks of previous loans. This eventually increases non-performing loans (Makri et al., 2014; Idris and Nayan, 2016). The impacts of structural oil shocks could be predisposed to the sovereign risk due to a decline in foreign reserves and, thus, fall in sovereign credit rating. For any economy to be in the normal state, the long-term yield of a government bond stays higher than short-term yield, typically an upward sloping term-spread. However, when term-spread becomes narrow, this shows that investors expect higher depreciation in the long-term returns. This increases the overall credit risk. Oil price shocks can upset the economic environment, increase fear, and credit risk of the country.

Armed with the above argument, we examine the impact of structural oil shocks on the aggregate financial system by constructing the Financial Stress Index and applying a structural vector autoregressive (SVAR) model. This paper offers two essential innovations. (i) It provides insights on how structural oil shocks (oil supply shocks, global aggregate demand shocks, speculative shocks, and other oil shocks) influence aggregate financial stress (ii) It attempts to characterize the patterns of oil shocks and financial stress relationship depending on whether the economy in question is oil-exporting and seven oil-importing countries.

Our results found that the impact of oil price shocks on financial stress is distinct for oil-exporting and importing economies, depending on the underlying cause of the shock. Oil price changes due to global aggregate demand matter most for financial stress. Speculative shock or precautionary demand shock is found to be beneficial and eases financial stress for oil-exporting countries like Canada, Norway, and the UK during the pre-crisis period; however, it acted reverse for the oil-importing countries like Brazil and India during the same period. The effects of speculative shock on FSI are lesser evident in comparison to global aggregate demand shocks. Compared to global aggregate demand shocks and oil speculative demand shocks, oil supply has relatively marginal impact on financial stress. Oil supply shocks increase FSI during the pre-crisis period both for the oil-exporting and oil-importing countries.

We contribute to related literature in the following ways: First, available studies never examine the unique effect of different structural oil shocks on financial stress encompassing multiple segments of the financial system, which is also an important limitation of Nazlioglu et al. (2015) approach. The main novelty of our study is that we provide a profound analysis of the relation between oil price shocks and financial stress by decomposing oil price shocks to different underlying causes like supply shock, aggregate demand shock, speculative shocks, and oil-specific demand shock (Kilian, 2009, 2014). Second, our approach using an FSI, based on a broad set of asset classes like equity, foreign exchange, bonds, and banking sector, offers a comprehensive measure to capture the acuteness of the financial

stress on a continuous scale. Third, unlike previous studies having single country focus (Wan and Kao, 2015; Nazlioglu et al., 2015), our sample selection encompassing major oil exporting and -importing countries provides a unique opportunity for robust assessment of oil shocks and financial stress relationship. Also, this paper belongs to a limited number of studies, which supplement the oil shock and financial stress discussion by comparing the relationship before and after the financial crisis. Four, the results of the impacts of oil price shocks on FSI can offer significant policy implications to manage financial stability at an aggregate level.

The remainder of the article is organized as follows: Section 2 reviews related literature and presents the motivation of the study; Section 3 describes the data and explains the construction of the financial stress index. Section 4 deliberates our empirical approach. Section 5 discusses our main results. Section 6 provides summary and conclusions.

A REVIEW OF LITERATURE

The significant effect of oil prices on macroeconomic variables has been well documented in the existing literature (Hamilton, 1983, 1996; Hoover and Perez, 1994; Hamilton and Herrera, 2004). Subsequently, a large strand of literature has come into existence, which studies the effect of oil price shocks on financial markets (Dutta et al., 2017; Noor and Dutta, 2017).[1] Since stock price at any point in time is equal to the expected present value of discounted future cash flows, oil price fluctuation can affect stock prices directly by affecting future cash flows or indirectly due to a change in the interest rate or expected return used to discount the future cash flows. Jones and Kaul (1996), and Sadorsky (1999) report a negative association between oil price shocks and stock price. Kilian (2009) observed that representing only oil price as the only channel of propagation of oil shocks to macroeconomic variables (like CPI or GDP) might be misleading. The paper found that oil shocks due to global real economic demand have a higher impact on macroeconomic variables as compared to other channels of oil shocks. Also, oil price shocks to other oil market-specific factors have a higher impact on macroeconomic variables as compared to oil supply shocks. In recent years, after the seminal work of Kilian (2009) and Kilian and Lee (2014), a majority of empirical literature has focused on the multiple channels through which oil price shocks influence economic variables. For instance, Bouoiyour et al. (2017) document that demand-side oil shocks seem to have better explanatory power on the economic activities of oil-exporting countries. Park and Ratti (2008) concluded that positive oil price shocks cause positive (negative) returns for the oil-exporting (oil-importing) countries. Apergis and Miller (2009) note that oil price shocks do not matter for stock markets of both oil-importing and oil-exporting countries. Kang and Ratti (2013) suggest that a positive oil-market specific demand shock significantly reduces real stock returns. Kang et al. (2015) conclude that a positive aggregate demand shocks and oil-market specific demand shocks exert adverse effects on the covariance of return. Very recently, Jouini and Khallaouli (2019) observe that stock markets are more sensitive to oil price decreases than to oil price increase.

Similarly, Filis et al. (2011) observe that supply-side shocks do not influence the relationship between oil and stock prices. Güntner et al. (2014) find that global aggregate demand shock consistently raises oil prices for oil-exporting countries, and oil supply shock found to have no significant effects. Overall, there is no robust consensus about the effect of oil price shocks on stock returns. Taken together, the review of related literature suggests that although oil price shock and economic activity relationship has been well documented in related literature, the precise channels through which oil price shocks affect financial system are only partially known. The increasing focus

[1] See for e.g., Aloui et al. (2012), Basher et al. (2012), Bouoiyour et al. (2017), Fang and You (2014), Filis and Chatziantoniou (2014), Güntner et al. (2014), Jones and Kaul (1996), Jung and Park (2011), Kang et al. (2015), Miller and Rati (2009), Park and Rati (2008), Sadorsky (1999), Elder and Serletis (2010) among others.

on oil shocks and financial system relationship may help to shed more light on the energy policy design of major oil-exporting and importing countries (Brown and Yücel, 2002). Therefore, the implication of oil price shock on financial stress qualifies to be an important research question. Despite the growing concern among the market participants to understand the relationship between oil price and financial stability, the evidence to understand the impacts of oil shocks on overall financial stress is scarce.

Most of the literature is concerned about studying the impact of oil shocks on only one financial market. At the same time, the literature has also urged for studying the relationship between oil shocks and overall financial stability (Baumeister and Kilian, 2016; Chen et al., 2014; Jouini and Khallouli, 2019). Yet very little or negligible attention has been paid to the relationship between oil shocks and the overall financial stress of any economy (Balke et al., 2002; Nazlioglu et al., 2015). To overcome this limitation in the literature, we have studied the impact of structural oil shocks on the overall financial system of major oil-importing and exporting economies. To attain this, we have constructed the Financial Stress Index for all the sample countries. This index is introduced by Illing and Liu (2006) for Canada. Balakrishnan et al. (2011) and Cardarelli et al. (2009) have constructed the Financial Stress Index for developing economies. This index combines financial stress in all the major segments of the financial markets, thereby giving an opportunity to study the stress at the aggregate level of the financial system. This index covers bond markets, banking sector, equity markets foreign exchange markets and thereby, this index is better suited for analyzing financial stress in aggregate.[2] In the literature, Çamlıca (2016), Cambón and Esteviz (2016), Chatterjee et al. (2017), Ishrakieh et al. (2020), Louzis and Vouldis (2012), Morales and Estarda (2010) constructed country-specific Financial Stress Indexes for Turkey, Spain, United Kingdom, Lebanon, Greece, Columbia, respectively. In the United States, Kansas State Federal Reserve and Federal Reserve Bank of St. Louis maintains the Financial Stress Index (FSI, hereafter) to keep track of the health of the overall financial system.[3]

Our paper retains its distinctiveness from existing literature due to the following three reasons. First, previous studies offer negligible discussion on the oil price shock and financial stress. Our approach considering FSI permits us to accommodate the entire financial system. Second, our study extends to a sample of oil exporting and importing countries. Given the evidence of a distinctive relationship between oil prices and financial variables in the context of oil exporting and importing countries (Doğrul and Soytas, 2010; Filis et al., 2011; Ju et al., 2016; Kang et al., 2015), it is desirable to examine FSI and oil-price shock in a large sample of countries (including emerging markets) which have different implications for oil price movements.[4] Our study perhaps, the first study that offers this comparative analysis in the context oil-exporters and-importers. Third, unlike the previous study (Nazlioglu et al., 2015), we include FSI in structural VAR with oil-related variables like world oil production, global aggregate demand, oil inventory, and real price oil helps to decompose oil price shocks into different underlying causal forces and identify their effects on FSIs.

DATA

We used monthly data of equity, bond, foreign exchange, and banks for all sample countries. The sample period for each country is different due to the data availability of FSI index. The oil-exporting countries represent a sample period of; Brazil (July 2002- June 2018), Canada (February 1999-June 2018), Norway (February 1999-June 2018), Russia (April 2005-June 2018). The oil-importing countries

[2] The importance of the Financial Stress Index is highlighted by the fact that Federal Reserve Banks maintain St. Louis Financial Stress Index (https://fred.stlouisfed.org/series/STLFSI2) and the Kansas City Financial Stress Index (https://www.kansascityfed.org/research/indicatorsdata/kcfsi).

[3] Kliesen et.al (2012) and Mansour et.al (2018) document a detailed explanation on Financial Stress Index.

[4] For instance, the sharp rise in oil price during 2003-2008 possessed bigger challenges for countries which heavily import oil like India and China. Similarly, the oil price crash during 2014-2015 has created economic stress in the countries which earn their revenues from oil exports like Russia and Canada.

represent a sample period; China (July 2002-June 2018), France (July 2002-June 2018), Germany (July 2003-June 2018), India (July 2003-June 2018), Japan (September 1998-June 2018), UK (September 1998-June 2018), US (July2002-June 2018). The sample period is constrained by the availability of data for making composite FSI.

We have considered eleven major oil-consuming economies in the world. The choice of country is constrained by the fact of available financial market data to construct Financial Stress Index. Then we further classified countries in our samples like Canada, Brazil, Norway, and Russia as oil exporters. Also, economies like China, France, Germany, India, Japan, the UK, and the US as oil importers. The selection of countries, as well as their classification, is based on the net imports information from the US Energy Information Administration (EIA) (Bouoiyour et al., 2017; Wang et al., 2013). For calculating real oil prices, we consider the average monthly West Texas Intermediate (WTI). Consistent with the argument of Kilian (2009) and Güntner (2014), we multiply the nominal WTI price as obtained from the EIA by the country-specific nominal exchange rate (per unit of US dollar) to convert to the domestic oil price of the respective countries. Interestingly, the UK was an oil exporter until 2004; hence, for most of the pre-crisis estimation period, the UK remained in the group of oil-exporting countries. Likewise, until 2006, Brazil was a net oil importer. After the discovery of its "pre-salt" oil reserves on its offshore oil-fields (first explored in 2006) along with the use of biofuels like ethanol, Brazil had made a transition from being a net oil importer to an oil exporter.

While generating FSI, we also take into consideration that the selected countries must have a well-functioning equity and bond markets. We have sourced data related to the banking sector, equity, and bond market data from Thomson Reuters Data-stream. The foreign exchange market data is taken from IMF International Financial Statistics data. Oil market-related data from EIA database. The global real economic activity data is sourced from Kilian Index of Global Economic Activity.

METHODOLOGY

We construct the Financial Stress Index following the approach of Balakrishnan et al. (2011). The FSI used in our analysis consists of five series which are: i) the banking sector, captures the stress in the banking sector by measuring the sensitivity of banking stock returns to market returns, ii) the volatility of equity market returns of benchmark composite index, iii) monthly average return of benchmark equity indexes, iv) exchange rate stress and v) sovereign spread, i.e., the spread between 10-year local bond and US Treasury bond of the same period (Illing and Liu, 2006; Park and Mercado, 2014).[5] Based on the fives indexes, we construct FSI for each country by employing principal component analysis (PCA). The motivation behind using the PCA approach is to accommodate each component of the FSI into a single composite variable by forming linear combinations of each component (Park and Mercado, 2014). The principal component analysis allows extracting the common component from all the five selected series (series i, ii, iii, iv, and v) that constitute the financial stress environment to be linearly combined into a single variable with own weight (W) to each component. The final index (FSI) is constructed using appropriate weights derived from the third principal components to attain the highest variance of the final FSI. The generic specification of our FSI specification can be presented as follows:

$$\text{FSI} = (\text{W1})\text{x}\,(\beta) + (\text{W2})\text{ x }(\sigma_t Stockvolatility) + (\text{W3})\text{ x }(r_t stockreturns) + (\text{W4})\text{ x}(EMSI) + (\text{W5})\text{ x }(Spreads) \quad (1)$$

[5] In the interest of brevity, we do not mention a detailed note about calculation of each of the component of FSI. For details, please see Balakrishnan et al. (2011).

After constructing the FSI we estimate the impact of structural oil shocks on the volatility of the FSI financial stress index of major oil exporting and importing nations using SVAR following Kilian (2009,2014) as follows:

$$A_0 y_t = \alpha + \sum_{i=1}^{12} A_t y_{t-1} + \varepsilon_t \quad (2)$$

Where, is the vector of variables such as four structural oil supply shocks and FSI shocks. The first shock is the shock to global oil production, followed by a shock to global aggregate demand. The third shock is speculative demand shock (increased the oil demand for inventory purposes). The fourth shock is limited to other oil market-specific factors followed by shock to country-wise financial stress (FSI).

Following Kilian (2009, 2014), we consider the following recursive exclusive restrictions:

$$\begin{bmatrix} e_{1t}^{\Delta global\ oil\ production} \\ e_{2t}^{global\ real\ activity} \\ e_{3t}^{\Delta global\ oil\ inventory} \\ e_{4t}^{\Delta real\ oil\ price} \\ e_{5t}^{FSI} \end{bmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{bmatrix} \begin{bmatrix} \varepsilon_{1t}^{oil\ supply\ shock} \\ \varepsilon_{2t}^{global\ demand\ shock} \\ \varepsilon_{3t}^{speculative\ shock} \\ \varepsilon_{4t}^{oilspecific\ shock} \\ \varepsilon_{5t}^{Financial\ stress\ shock} \end{bmatrix}$$

The restrictions in the abovementioned matrices is based on Kilian (2009):

(i) Oil supply does not contemporaneously respond to other shocks in the system within a month except its own shock.

(ii) The global demand shocks as proxied by real economic activity is not affected by the change in the oil price due to oil supply, speculative, or other oil shocks.

(iii) Speculative demand shocks in the short-run are proxied by the level of oil inventories that are influenced by oil supply shocks and global demand shocks (Kilian and Murphy, 2014).

(iv) The other oil market-specific shock is triggered by all demand and supply-side conditions affecting the oil market. The other shock is also considered as an idiosyncratic shock specific to a particular economy.

(v) FSI is supposed to be affected by all the shocks, i.e., supply shock, global aggregate demand shock, speculative shocks, and another oil shock.

RESULTS AND DISCUSSION

PRELIMINARY ANALYSIS

Table 1 reports the descriptive statistics of the FSI index. In the second column of Table 1 (i.e., trade balance), the negative (positive) values denote the corresponding economy is a net oil-exporter (oil-importer) based on the twenty years trade balance data (1998-2017).[6] We report both the mean and median values of FSI as mean values may not be better due to a sudden rise and fall of FSIs, we describe

[6] The trade balance data is sourced from Global Energy Statistical Yearbook 2018 (https://yearbook.enerdata.net/)

the median values of FSI. Descriptive statistics in Table 1 reveals that all oil-exporting countries have a positive median. Among oil-importing economies, except Japan and Germany, all countries have a positive median. This indicates indicating a higher degree of financial stress. Brazil, followed by Russia among the oil-exporting countries, and India among the oil-importing economies, show a high standard deviation in the financial stress. The FSIs of Brazil, Norway, and Russia among oil exporters and China, India, and France among oil importers have positive skewness, which indicates fat tail on the right side. On the other hand, FSIs of Canada, Germany, Japan, the UK, and the US have negative skewness, indicating the presence of a negative fatty tail. FSI series of all other countries, except the US and Germany, have kurtosis larger than three implying they are leptokurtic. The Jarque-Bera test results also indicate non-normality at 1 percent level of significance. The FSI of India is normal, as suggested by their Jarque-Bera test results. We assess the nonstationarity of FSIs by employing Augmented Dickey-Fuller (1979) stationarity test. FSI series of all countries are significant, implying there is no presence of nonstationarity. We do not find any co-integration between oil prices and FSI as oil prices are I(1), and EPU is I(0). We find that not all the FSIs (except Norway) have any unit root and stationary.[7] The oil shock variables, except real economic activity, are also non-stationary.

We report descriptive statistics of components, i.e., stock returns, bank beta, stock market volatility, spread between10-year local bond and US Treasury bond, and exchange rate returns (in USD) in Table 2. Panel (A) and (B) report the summary statistics for oil-exporting and importing countries, respectively. We notice that Brazil has the highest monthly average stock market returns and volatility among the oil-exporting economies. Brazil also has the highest bond yield spread. Among oil-importing countries, India has the highest monthly average stock market returns, and China has the highest stock market volatility. India has the highest bond yield spread.

Figure 1a and 1b present the movement of the computed FSI for each oil-exporting and oil-importing country along with the WTI prices. The pattern of observed time-series movements of FSI and WTI prices presented in Fig.1a and 1b suggest that FSI can closely illustrate the different periods of peak and trough in the oil price movements. For example, the peak in 2008 implies the financial crisis, which is common in all countries. We observe that volatile changes of FSI in 2008 for almost all countries are matched with a surge in oil prices during the same year. A high peak in 2011 in Germany and France indicates the European debt crisis, and a spike in 2015 in China corresponds to financial stress situations in the Chinese economy due to the commodity market crash and economic slowdown.

ANALYSIS OF EFFECTS OF OIL PRICE SHOCKS ON FSI

In this sub-section, we examine the effects of four oil price shocks, i.e., oil supply shock, global aggregate demand shock, and speculative shocks on the FSI of the major oil-exporting and importing economies. We also extend our analysis for two sub-periods, i.e., before and after the US 2008 subprime crisis. The results discussion on oil price shocks and FSI is categorized further into two sub-sections. The first sub-section (section 5.2.1) elaborates on our results for the entire sample period. The second sub-section (section 5.2.2) shows the pre- and post-crisis results for the oil-exporting and importing economies. We present the results in the form of impulse responses and variance

[7] Following Kilian (2009) argument, similar to real economic activity index, FSI series also represents the different phases of business cycles. The Financial Stress Index is an aggregate measure composed by variance-weighted averaging of five individual components. Consequently, it is reasonable to assume that it is stationary. Our assumption does not cause impulse response estimates asymptotically invalid. Also, incorrect differencing may lead to inconsistent estimates.

Table 1. Summary Statistics of the Financial Stress Index (FSI)

Country	Trade (Mt)	Mean ($x10^{-8}$)	Median	Std. Dev	Skew	Kurt	Jarque-Bera	ADF test
Oil Exporting Countries								
Brazil	-5.6	1.76	1.72	0.74	1.80	12.35	804.85 ***	-3.75 ***
Canada	-65.5	0.13	0.160	0.29	-0.27	8.11	256.95 ***	-11.61 ***
Norway	-99.4	0.14	0.131	0.31	0.64	5.56	11.15 ***	-1.71
Russia	-230.5	1.05	1.03	0.68	0.85	5.14	49.62 ***	-3.81 ***
Oil Importing Countries								
China	201.8	0.16	0.094	0.55	0.72	4.34	31.46 ***	-1.57
France	71.6	0.05	0.04	0.33	0.41	4.23	21.60 **	-5.53 **
Germany	99	-1.19	-0.88	1.51	-0.27	2.20	6.96 **	-0.75
India	143.6	0.99	1.00	2.38	0.06	3.34	0.16	-3.08 **
Japan	189.5	-0.41	-0.38	0.42	-0.67	4.03	27.57 ***	-3.54 ***
UK	4.3	0.13	0.12	0.32	-.004	4.14	12.45 **	-12.53 ***
US	481.5	0.37	0.40	0.21	-0.41	2.97	6.42 **	-2.88 ***
Oil Variables								
Oil Production	-	73743.13	73871.10	4763.17	-.013	-0.90	8.35	-0.58
Oil Inventory	-	2.42	2.43	0.08	-0.09	-0.73	5.97	-1.64
Real Economic Activity	-	5.98	-9.04	72.16	0.56	-0.31	14.08	-2.87*
WTI	-	57.54	53.37	29.11	0.34	-0.89	19.14	-2.15

Note: This table reports the descriptive statistics of the FSI index for the four-oil exporting and seven oil importing countries. Dickey-Fuller (1979) stationarity test (ADF) is for testing the stationarity of data. Stationarity tests take the null hypothesis that series is difference stationary. The mean and median value of oil production is in million barrels per month. *** /**/* indicates statistical significance at 1/5/10% respectively.

Table 2. Summary Statistics of the FSI Components
Panel(A) Oil Exporting Countries

Country	Mean	Max	Min	Std. Dev.	Skew	Kurt	J-B Stat
Brazil							
Stock Returns (%)	*0.97*	*16.4*	*-28.4*	*0.067*	*-0.48*	*1.20*	*19.08* **
Bank Beta	*-0.053*	*0.20*	*-0.29*	*0.079*	*0.056*	*0.002*	*0.10*
Stock Market Vol.(%)	*4.40*	*1.40*	*1.30*	*0.017*	*3.58*	*14.62*	*2122.57* ***
Spread	*8.89*	*25.79*	*2.096*	*3.08*	*1.33*	*6.38*	*382.95* ***
Ex. Rate Returns (%)	*0.40*	*28.0*	*-16.0*	*0.05*	*1.094*	*-0.52*	*49.15* ***
Canada							
Stock Returns (%)	*0.40*	*11.0*	*-19.0*	*0.04*	*-1.04*	*6.30*	*148.53* ***
Bank Beta	*0.60*	*1.02*	*0.12*	*0.15*	*-0.06*	*3.59*	*3.63*
Stock Market Vol.(%)	*0.16*	*0.85*	*0.00*	*0.001*	*2.013*	*7.68*	*370****
Spread	*-0.061*	*1.30*	*-0.88*	*0.44*	*0.65*	*3.28*	*17.63* ***
Ex. Rate Returns (%)	*0.0*	*12.0*	*6.0*	*0.019*	*0.755*	*8.24*	*289.25* ***
Norway							
Stock Returns (%)	*1.0*	*14.0*	*-27.0*	*0.06*	*-1.30*	*4.28*	*244.46* ***
Bank Beta	*0.45*	*0.73*	*0.32*	*0.08*	*1.00*	*1.02*	*49.11* ***
Stock Market Vol.(%)	*0.33*	*2.0*	*0.1*	*0.2*	*3.27*	*13.51*	*2197* ****
Spread	*0.20*	*2.39*	*-1.1*	*0.74*	*0.54*	*-0.15*	*11.40*
Ex. Rate Returns (%)	*0.0*	*14.0*	*-6.0*	*0.03*	*0.71*	*2,80*	*95.55* ***
Russia							
Stock Returns (%)	*0.8*	*30.5*	*-36.1*	*0.094*	*-0.262*	*4.658*	*20.04* ***
Bank Beta	*-0.01*	*0.664*	*-0.34*	*0.10*	*1.90*	*14.31*	*945* ***
Stock Market Vol.(%)	*0.80*	*4.00*	*0.30*	*0.005*	*2.49*	*10.65*	*552* ***
Spread	*5.24*	*12.23*	*1.30*	*2.30*	*0.40*	*3.06*	*4.29*
Ex. Rate Returns (%)	*0.60*	*22.5*	*-11.0*	*0.04*	*1.56*	*8.72*	*282* ***

Table 2. Continued
Panel (B) Oil Importing Countries

Country	Mean	Max	Min	Std. Dev.	Skew	Kurt	J-B Stat
China							
Stock Returns (%)	*0.80*	*30.5*	*-36.1*	*0.08*	*-0.544*	*4.77*	*34.73* ***
Bank Beta	*0.472*	*0.722*	*0.292*	*0.08*	*0.008*	*2.871*	*0.133*
Stock Market Vol.(%)	*0.80*	*4.00*	*0.30*	*0.005*	*1.486*	*4.62*	*91.89* ***
Spread	*0.447*	*1.959*	*-2.07*	*1.06*	*-0.53*	*2.29*	*13.22* *
Ex. Rate Returns (%)	*0.0*	*4.0*	*-3.0*	*0.007*	*0.8*	*11.52*	*608.32* ***
France							
Stock Returns (%)	*0.09*	*12.50*	*-19.20*	*0.051*	*-0.584*	*3.87*	*20.57* ***
Bank Beta	*0.634*	*1.12*	*0.37*	*0.13*	*0.99*	*4.79*	*69.57* ***
Stock Market Vol.(%)	*0.2*	*800.0*	*0.0*	*0.001*	*2.09*	*8.23*	*436* ***
Spread	*-0.37*	*1.31*	*-2.18*	*0.78*	*-0.107*	*2.17*	*7.09* **
Ex. Rate Returns (%)	*-0.06*	*8.00*	*-13.00*	*0.02*	*-0.19*	*4.96*	*39.04* ***
Germany							
Stock Returns (%)	*0.8*	*19.3*	*-21.3*	*0.05*	*-0.54*	*5.54*	*58.55* ***
Bank Beta	*1.02*	*1.14*	*0.96*	*0.03*	*1.56*	*6.33*	*159* ***
Stock Market Vol.(%)	*0.20*	*1.10*	*0.10*	*0.001*	*2.82*	*13.10*	*1022* ***
Spread	*-0.72*	*0.73*	*-2.54*	*0.76*	*-0.37*	*2.13*	*10.14* ***
Ex. Rate Returns (%)	*-0.1*	*8.8*	*-13.9*	*0.029*	*-0.267*	*5.00*	*32.82* ***
India							
Stock Returns (%)	*1.40*	*28.0*	*-23.0*	*0.06*	*-0.17*	*5.41*	*44.58* ***
Bank Beta	*0.586*	*0.783*	*0.367*	*0.091*	*-0.31*	*2.72*	*3.58*
Stock Market Vol.(%)	*0.40*	*1.70*	*0.10*	*0.002*	*1.81*	*6.65*	*199.4* ***
Spread	*4.38*	*6.81*	*0.62*	*1.56*	*-0.46*	*2.40*	*9.09*
Ex. Rate Returns (%)	*0.18*	*9.00*	*-7.00*	*0.023*	*0.44*	*4.88*	*32.53* ***

Table 2. Continued
Panel (B) Oil Importing Countries

Country	Mean	Max	Min	Std. Dev.	Skew	Kurt	J-B Stat
Japan							
Stock Returns (%)	*0.10*	*12.34*	*-22.60*	*0.050*	*-0.489*	*4.127*	*22.12 ****
Bank Beta	*0.47*	*0.73*	*0.12*	*0.12*	*-0.571*	*2.800*	*13.33 ***
Stock Market Vol.(%)	*0.25*	*0.92*	*0.10*	*0.000*	*2.48*	*14.17*	*1483 ****
Spread	*-2.52*	*-0.67*	*-4,95*	*0.90*	*-0.22*	*2.64*	*3.28*
Ex. Rate Returns (%)	*0.10*	*9.00*	*-7.00*	*0.02*	*0.44*	*4.88*	*32.53 ****
UK							
Stock Returns (%)	*0.16*	*8.20*	*-13.90*	*0.0395*	*-0.69*	*0.838*	*26.08 ****
Bank Beta	*0.623*	*0.965*	*-*	*0.132*	*-0.55*	*2.440*	*71.43 ****
Stock Market Vol.(%)	*0.16*	*0.80*	*0.06*	*0.0011*	*2.35*	*7.011*	*709.67 ****
Spread	*-0.048*	*1.15*	*-1.022*	*0.65*	*-1.99*	*11.20*	*1409.07 ****
Ex. Rate Returns (%)	*62.58*	*11.20*	*-8.20*	*0.024*	*0.24*	*0.054*	*2.37*
US							
Stock Returns (%)	*0.39*	*10.0*	*-15.0*	*.04*	*-0.69*	*4.49*	*38.02 ****
Bank Beta	*0.4498*	*0.87*	*0.21*	*0.132*	*0.586*	*3.30*	*13.46 ***
Stock Market Vol.(%)	*0.17*	*0.79*	*0.05*	*.001*	*2.21*	*8.30*	*437.58 ***
Spread	*1.40*	*2.81*	*-0.7*	*0.87*	*-0.40*	*2.13*	*12.80 ****
Ex. Rate Returns (%)	*0.03*	*3.50*	*-4.00*	*0.013*	*-0.08*	*3.41*	*1.88*

Notes: The table reports the descriptive statistics of stock returns of country-specific benchmark equity indexes, bank beta of the index of banking companies, the volatility of benchmark equity indexes, spread between 10-year local bond and US Treasury bond, exchange rate returns (in USD).

decompositions, which enable us to analyze the cumulative effects of structural oil shocks on the FSI of each economy.[8]

[8] In cumulative impulse analysis, if an impulse to one variable (for example, shock to oil price) transmits statistically significant response to another variable (for example, FSI) in at least one period then we can extrapolate the response as significant to an H-period or lag ahead horizon (Lütkepohl, 2005).

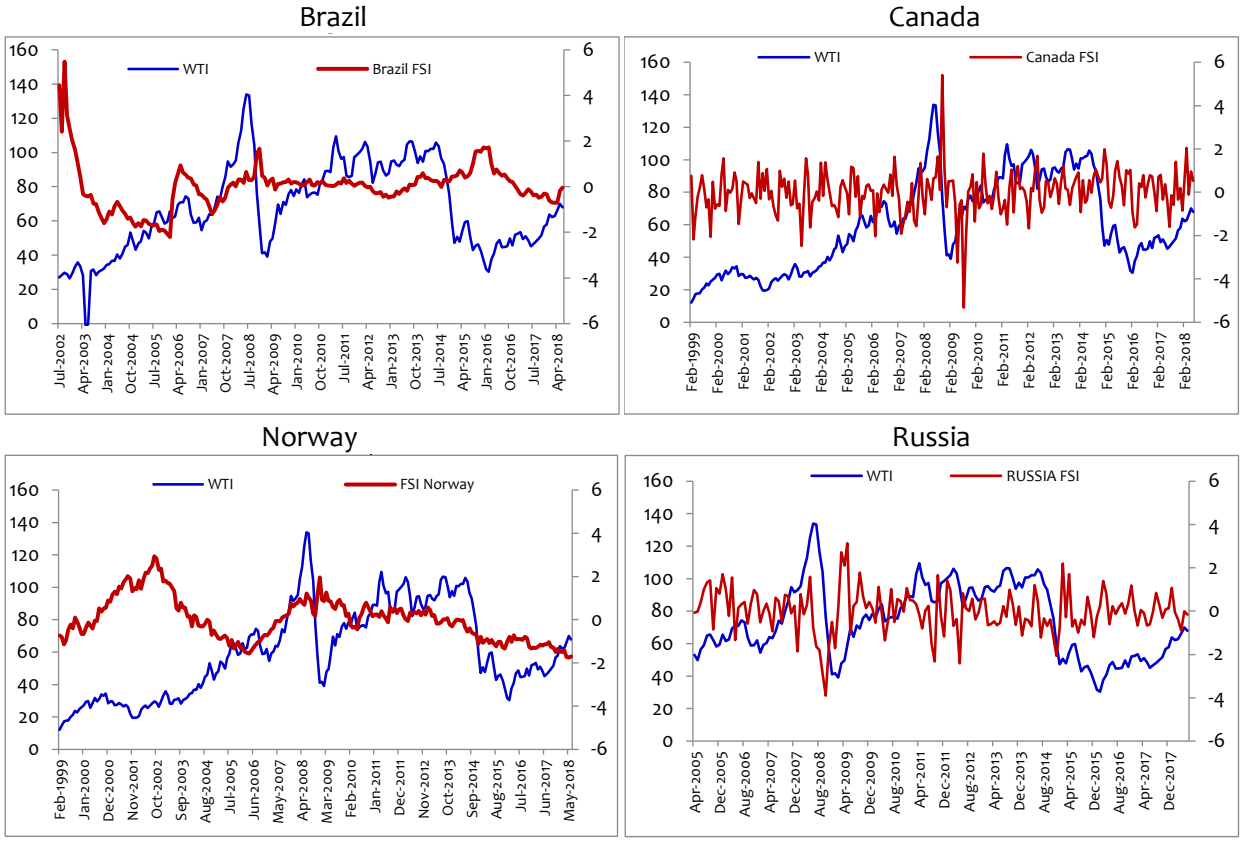

Figure 1a. WTI Price and FSI Dynamics (Full Sample Period): Oil-Exporting Countries

Notes: The above and below figures show the movement of WTI prices with Financial Stress Index (FSI) of each country. Fig 1a and Fig 1b show the time series movement for oil exporting and oil-importing countries, respectively. The left axis (blue line) shows the prices of WTI in $ per barrel and the right axis (red line) presents FSI. The sample period for each country is different due to the data availability of FSI index. The sample period is constrained by the availability of data for making composite FSI.

FULL SAMPLE PERIOD ANALYSIS

Fig. 2.1 reveals that the impulse response of FSI to shocks to oil supply has no significant impact on all the oil-exporting and oil-importing economies except Japan (although for a brief period). The insignificant effect of shocks to oil supply shock on FSI for most of the economies is in line with the findings of Kilian (2009). The reason for the no impact or at best transitory positive impact of oil supply shocks on FSI is because any oil supply disruption from one part of the world is offset by an increase in oil production from other oil-producing economies thereby, making any oil supply disruption very short-lived (Kilian, 2009; Güntner, 2014).

The impulse response of shocks to global aggregate demand (second column of Fig. 2.1 and 2.2) shows insignificant effects on the FSI for most of the oil exporting economies except Brazil and Canada. However, in the case of oil importing economies, the impact of shocks to global aggregate demand on FSI is found to be significant for all the economies except Germany. But in the countries where global demand shocks have significant impact on the FSI, it is found that later responds negatively to shocks to the former irrespective of whether the economy is oil importing or, oil-exporting. This is because global demand signifies an economic boom and growth in real economic activity. During this economic boom, the corporate earnings increase, the equity markets yield good returns with lower volatility, and the sovereign yield spread improves, which ultimately decreases the

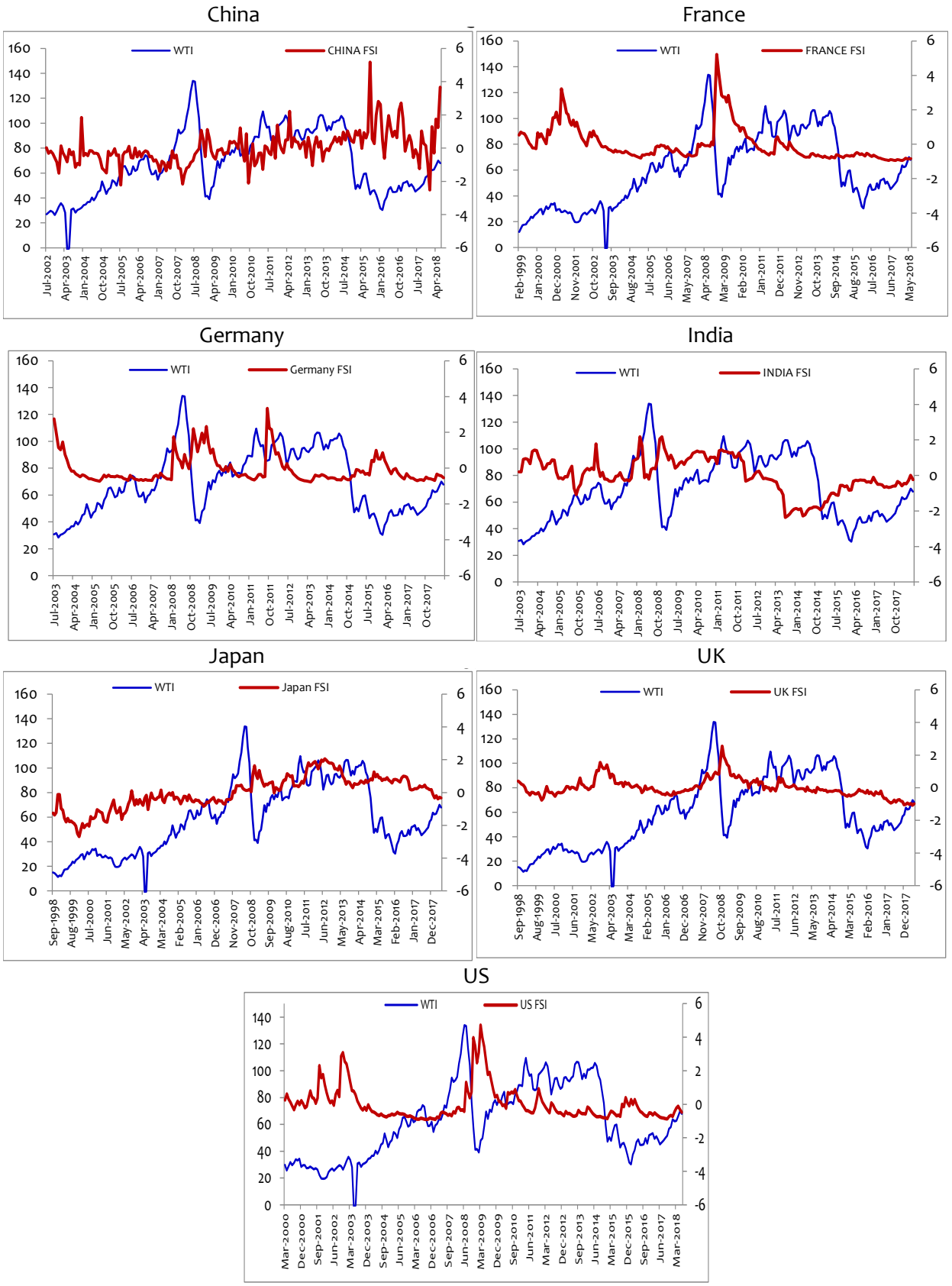

Figure 1b. WTI Price and FSI Dynamics (Full Sample Period): Oil-Importing Countries

financial stress. In most cases, the increase in the real- price of oil due to a positive shock to global aggregate demand is offset by robust economic growth.

The impulse response of shocks to precautionary or speculative demand (third column in Fig. 2.1 and 2.2) has an insignificant impact on FSI, both for oil-exporting and importing countries, except in Canada and India. The FSI decreases for a brief period between second- and fourth month after the shock in Canada. This is due to the fact that when there is uncertainty about the future of oil supply due to geopolitical events[9] and economic uncertainties associated with them Hamilton (2011), oil exporters increase its oil supply to the rest of the world to meet its increased oil demand, which improves its trade balance. For example, Canada (which is oil exporter across the whole-time frame) responds to such events and increases its oil supply to the rest of the world to meet its increased oil demand, which is purely precautionary. This supports the argument that higher oil prices lead to wealth accumulation by oil exporters at the cost of oil importers (Bjørnland, 2009). However, the impact on FSI is very short-lived (i.e., between the second and third periods). The temporary effects of shocks to the speculative demand for oil on the FSI are consistent with the findings of Kang and Ratti (2013), Kilian and Lee (2014), Lorusso and Pireoni (2018) which concluded that the flow demand shock is the primary driver of the real price of oil even during the times of mid-2008 US subprime crisis and Libyan crisis. In case of India, its FSI increase due to shocks to speculative demand for oil. As India is an oil importer, any increase in demand for oil due to speculation and consequent oil price increases can cause inflation. Increase in inflation adversely impacts its FSI. The FSIs of oil exporting economies does not get significantly impacted by other oil market specific shocks. Among oil importer, FSIs of Germany, Japan and USA get significantly impacted by the shocks to other oil market specific shocks.

Furthermore, Table 3 presents the results of variance decompositions representing contributions of each structural oil shocks to the variations of FSI. Panel (A) and Panel (B) presents results for oil exporting and oil-importing countries, respectively. Results in Panel (A) suggest that global demand shocks have the highest contributions to FSI of Russia, followed by Brazil among oil-exporting countries. In Panel (B) for the oil-importing countries like France, India, Japan and China, similar implications can be found for global demand shock. The dependency of the Russian economy on oil exports make it sensitive mainly to the oil supply shocks and other oil specific factors. For instance, the World Bank data for the average oil rents[9] as a percentage of GDP for the past 20 years (1998-2017) is the highest for Russia (9.47 percent) and lowest for Japan (0.01 percent). Given this higher percentage of oil rent to GDP, it is reasonable to assume that any type of oil market shock can result in a significant impact on Russian financial market variables in general and FSI in specific. Among oil-importing countries, China shows the highest effects of supply shocks on FSI.

PRE-CRISIS AND POST-CRISIS PERIOD ANALYSIS

To have a better perspective on our findings in this subsection, we carried out a similar analysis for oil-exporting and importing countries focusing on pre-crisis (until December 2007) and the post-crisis period (July 2009 until June 2018). Fig. 3.1 and 3.2 present the results for oil-exporting countries during the pre-crisis and post-crisis periods. Similarly, Fig. 3.3 and 3.4 exhibit the results for oil-importing countries during pre-and post-crisis, respectively. In Fig. 3.1 and 3.2, we find that the impulse responses to oil supply shock have an insignificant impact on the FSI of the majority of oil-exporting economies except for Russia during pre-crisis. However, during the post-crisis period, except Brazil whose FSI increase, the FSIs of other oil exporting economies remained insulated from the oil supply shocks.

[9] Oil rents are calculated as difference between the price of crude oil and cost of production. Data is from World Bank development indicators website.

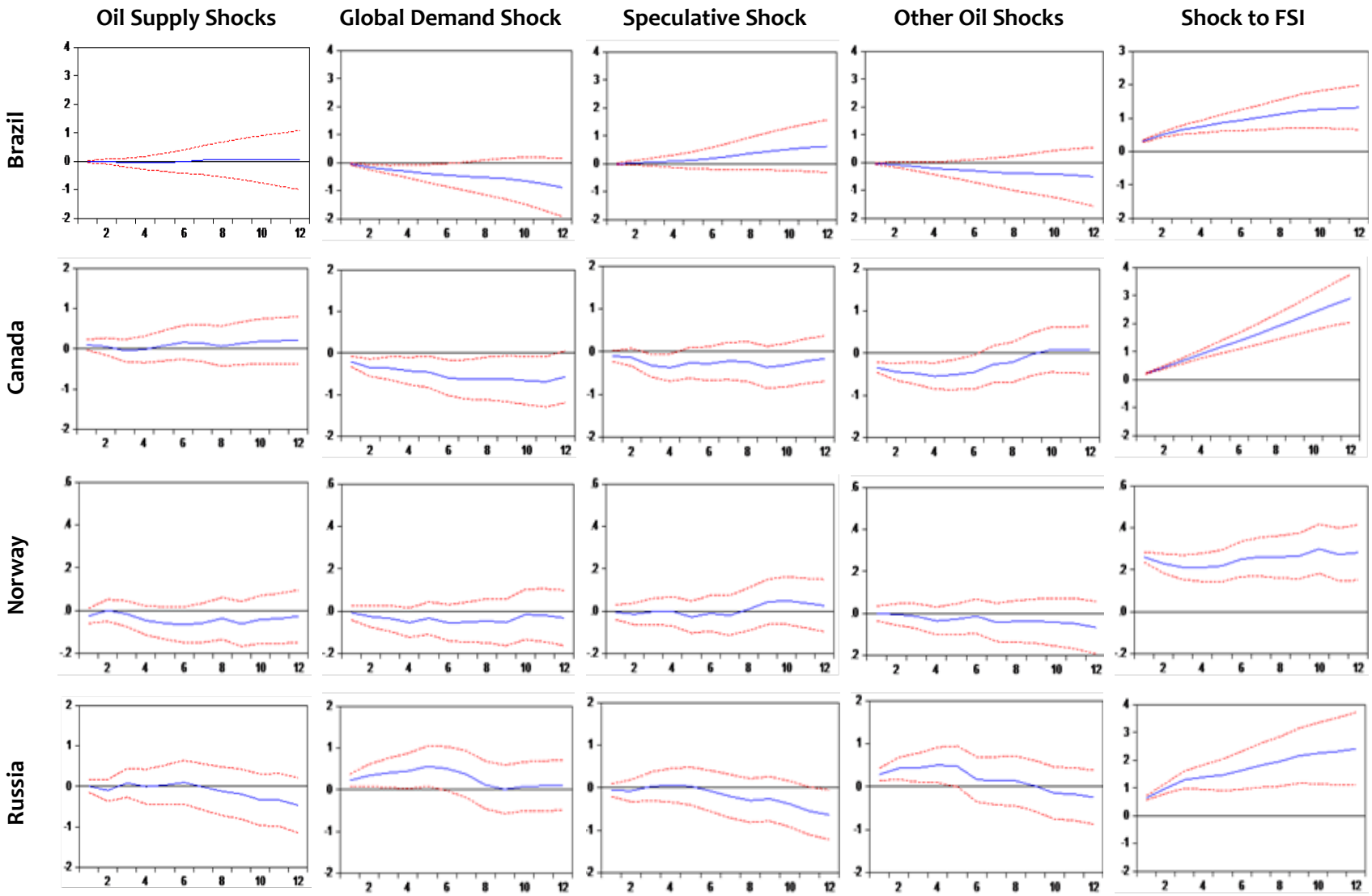

Figure 2.1 Impulse Responses of FSI of Major Oil-Exporting Economies (Full Period)

Notes: This figure shows cumulative responses of FSI of each oil exporting country to structural oil price shocks (oil supply shocks, global aggregate demand shocks, speculative shocks, and other oil shocks) due to underlying causal forces. The red line is the upper and lower ±2 standard error bands.

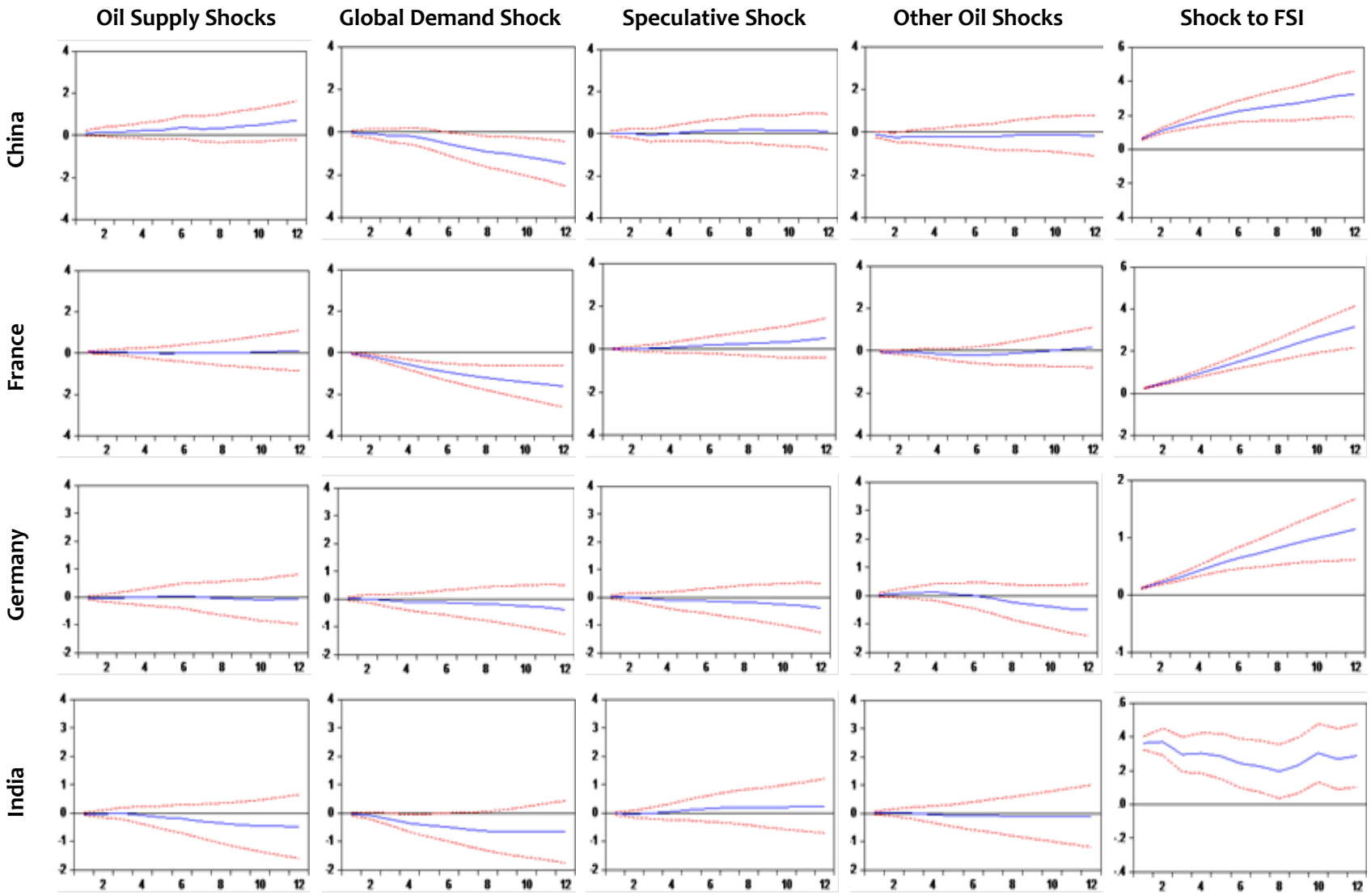

Figure 2.2 Impulse Responses of FSI of Major Oil-Importing Economies(Full Period)

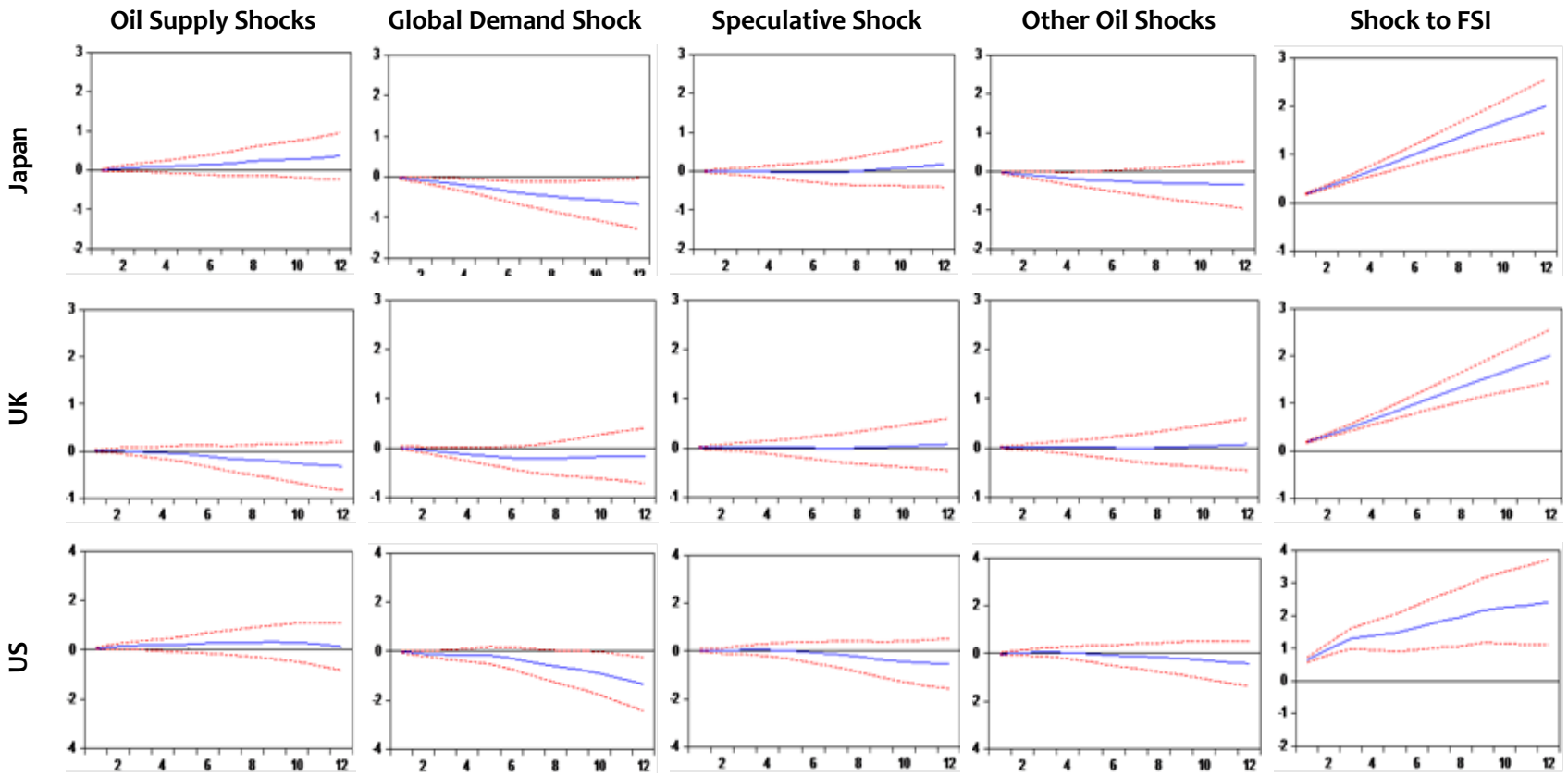

Figure 2.2 Continued

Notes: This figure shows cumulative responses of FSI of each oil importing country to oil price shocks (oil supply shocks, global demand shocks, speculative shocks, and other oil shocks). The red line presents the upper and lower ±2 standard error bands.

Table 3. Forecast Error Variance Decomposition of FSI: Full Period Analysis

Panel (A) Variance Error Decomposition of FSI of Major Oil Exporting Countries

	Full Sample Period				
Countries	**Supply Shock**	**Global Demand Shock**	**Speculative Shock**	**Other Oil Shock**	**FSI Shock**
Brazil	*0.83*	*12.38*	*6.60*	*0.07*	*79.33*
Canada	*4.14*	*8.49*	*7.84*	*10.33*	*69.18*
Norway	*5.14*	*2.40*	*5.11*	*2.14*	*85.19*
Russia	*8.51*	*12.86*	*7.23*	*17.12*	*54.24*

Panel (B) Variance Error Decomposition of FSI of Major Oil Importing Countries

	Full Sample Period				
Countries	**Supply Shock**	**Global Demand Shock**	**Speculative Shock**	**Other Oil Shock**	**FSI Shock**
China	*6.89*	*14.70*	*3.22*	*3.44*	*71.72*
France	*1.05*	*26.95*	*3.48*	*3.85*	*64.65*
Germany	*1.64*	*3.60*	*1.17*	*10.25*	*83.31*
India	*4.21*	*8.38*	*1.91*	*0.75*	*84.73*
Japan	*2.90*	*7.95*	*2.54*	*2.17*	*84.40*
UK	*4.56*	*3.84*	*0.43*	*4.43*	*85.75*
US	*5.55*	*2.76*	*2.45*	*5.73*	*85.75*

Notes: The table above reports variance error decompositions of FSI due to various underlying oil shocks. We report the average forecast error variance decompositions for the lag 12.

The impact of supply shocks to oil on the FSI of Russia during the pre-crisis period (Fig. 3.1) is on account of lower demand for oil from many oil-importing countries due to higher oil prices. The oil price increase hurts the aggregate demands of many emerging countries, which are majorly dependent on high imports (e.g., India) (Cunado and de Gracia, 2005; Valcarcel and Wohar, 2013). Unlike oil-importing countries like China, India, and other Asian economies[10], all oil importing countries do not subsidize retail oil prices to save the consumers from higher oil prices. During post-crisis period, economies around the world were recovering due to measures supported by the central banks across the world. As a result, the demand for oil was growing. Any increase in inflation (due to oil or other factors) was compensated by high growth in the economy (Gagnon, 2016). Hence, during any oil supply shocks, Norway and Russia increased oil production and improved its trade balance which reduced its FSI.

We note that positive shocks to global aggregate demand significantly reduced FSI during the pre-crisis period for the oil-exporting countries like Canada and Russia (Fig. 3.1). In the pre-crisis period, oil exporting economies like Canada and Russia increased their exports during the period of economic boom and higher aggregate demand for oil. This improved their trade balance and GDP, thereby reducing their financial stress. During the post-crisis period, any shocks to global demand have insignificant impact on the FSIs of many oil exporting economies such as Canada and Brazil (Fig. 3.2). One of the reasons, attributed to this result is the steady decline in the crude oil prices from 2014 to 2018. Due to low crude oil prices, their earnings from exports reduced, which adversely affected their trade-balance and increased their financial stress, unlike the pre-crisis period.

The impulse response of shocks to precautionary or speculative demand has a significant impact on the financial stress for oil-exporting countries. During the pre-crisis period (Fig. 3.1), oil exporters like Canada, Norway, and the UK show noticeable negative effects on FSI due to shocks to speculative

[10] Except Japan, Hong Kong, Singapore, and South Korea.

demand. In pre-crisis period, any shocks to oil demand due to speculation, economies like Canada, Norway and the UK increased their exports, improved their trade balance, and reduced their financial stress. However, due to steady fall in the oil prices between 2014 and 2018, reduced their revenue from oil exports, hence the FSI of none of the oil-exporting economies got significantly impacted due to shocks to speculative demand of oil during the post-crisis period.

The shocks to other oil specific factors have significant negative (positive) effects on the financial stress of oil exporters like Canada, and Russia (UK) during the pre-crisis period (Fig. 3.1). During the post-crisis period, only Russia (Fig. 3.2) shows significant negative impacts of shocks on other oil marker specific factors on FSI.

Contrary to oil-exporting countries, shocks to oil supply found to have a positive impact on FSI of many oil-importing countries like Germany, China, and India during the pre-crisis period (Fig. 3.3). The pre-crisis period is paired with high economic growth and higher aggregate demands. However, the same period has also witnessed higher oil prices between 2003 and 2008. The real crude oil price at the NYMEX reached its peak at $147.30 in July 2008.[11] Owing to the higher oil prices, many firms could not invest and produce more despite the higher aggregate demands as the borrowing costs became higher. Also, higher oil demand, coupled with expansionary monetary policy in many economies during the pre-crisis period, causes an inflationary trend as the oil supply remained rigid during the same time. The high inflationary pressure disrupts economic growth and increases financial stress. The finding is consistent with Wan and Kao (2015). However, the result shows oil supply shocks have negative effects on the FSI of the US. The US, owing to its declaration of the Strategic Petroleum Reserve (SPR), could take its advantage by drawing down on its reserves thereby mitigating the impact of higher oil prices and reducing the financial stress. Interestingly, we note a negative response of FSI to shocks to oil supply in Brazil (during the pre-crisis period). Our results for Brazil can be attributed to its shift of focus to bio-fuel productions. In the case of Brazil, the country was on a transformation from being an oil importer to oil exporter and its oil dependence on the foreign economy was on decline. By 2006, Brazil turned in to net oil exporter. As the oil import was on continuous decline during the pre-crisis period, shocks to the oil supply reduce stress on the financial system.

In the post-crisis period, the oil importing economies like US, France, and China, financial stress in these countries increase in response to shock in the oil supply. The disruption of global oil supply can lead to a rise in the real price of oil. Any surge in the real price of oil can increase the financial stress of an economy through multiple channels. Growth in the real price of oil causes depreciation of currency (mainly for oil- importing economies), the rise in sovereign spreads (a measure of increased country credit risk) and increase in stock price volatility with lower returns thus, increasing financial stress (Darby, 1982; Engemann et al., 2010).

We note that shocks to global aggregate demand significantly reduced FSI during the pre-crisis period for oil-importing countries like France, Japan and the US (Fig. 3.3). However, we also witness that, the shock to global demand positively impacts the FSI of Germany and India in the pre-crisis period. The rapid growth of non-oil imports drives the increase of FSI in India, and a steadily rising oil import bill has widened the current account deficit (Acharya, 2008). The high oil prices ($145 per barrel[12]) along with the high taxation in India owing to its federal taxation system on fuel has put pressure on inflation and corporate margins, which in turn increased the financial stress index of India. In the post-crisis period, among oil importing economies, we find the FSI's of only Germany and UK are significantly negatively and positively affected by the socks to global demand during the post-crisis period. Germany being the major European manufacturing powerhouse, earns most of its revenues

[11] See for e.g., Hamilton (2011), Tokic (2010), Kilian and Hicks (2013), Singleton (2014), and recently, Baumeister and Kilian (2016) for an eloquent discussion on the Oil Shock of 2007-08.

[12] The price is seen at https://tradingeconomics.com/commodity/crude-oil (accessed as on December 22, 2018).

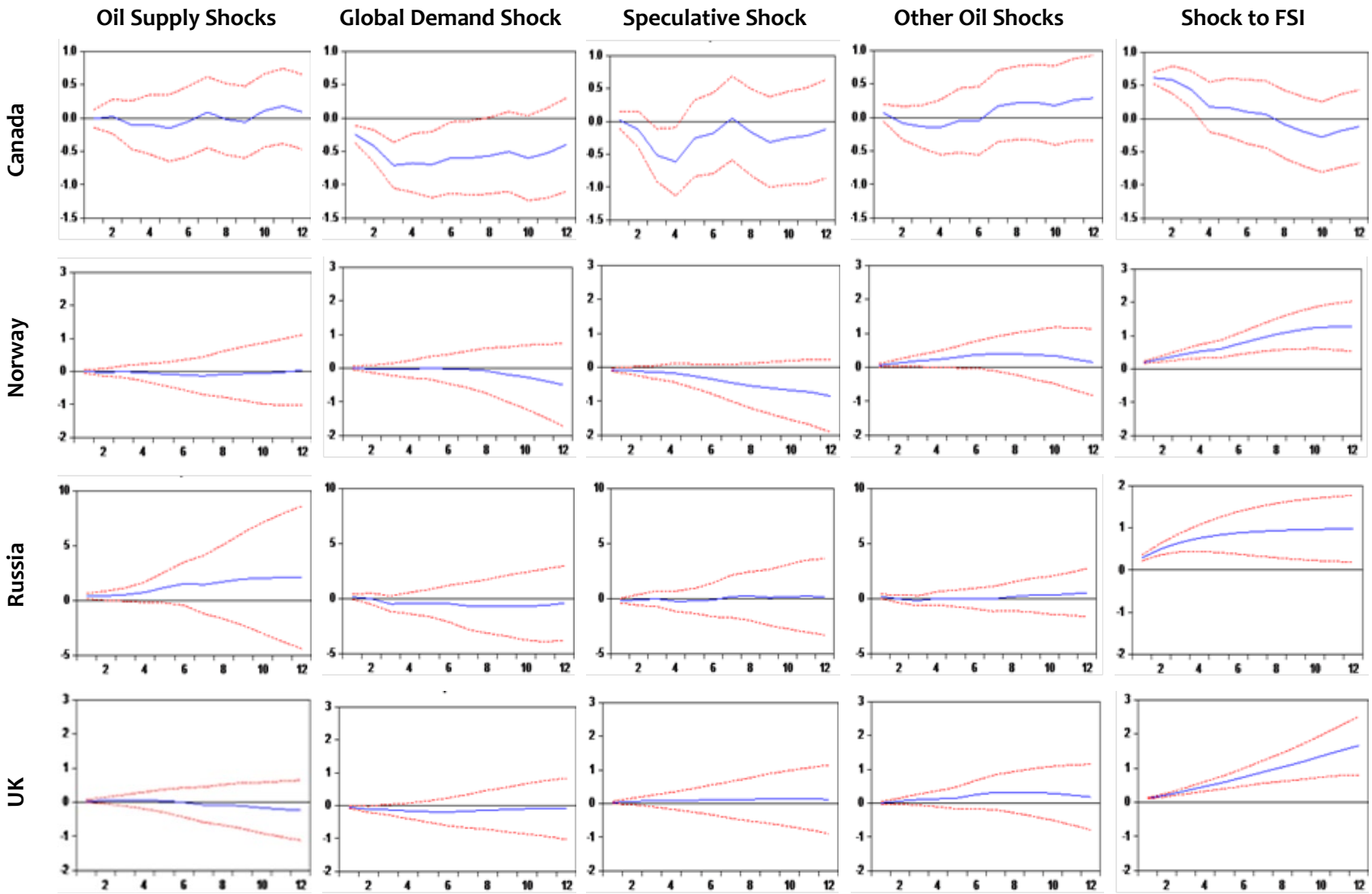

Figure 3.1 Impulse Responses of FSI of Major Oil-Exporting Economies (Pre-Crisis Period)

Notes: This figure shows cumulative responses of FSI of each oil exporting country to oil price shocks (oil supply shocks, global aggregate demand shocks, speculative shocks, and other oil shocks) due to underlying causal forces. The pre-crisis sample period for all the countries is considered until December 2007. The red line is the upper and lower ±2 standard error bands.

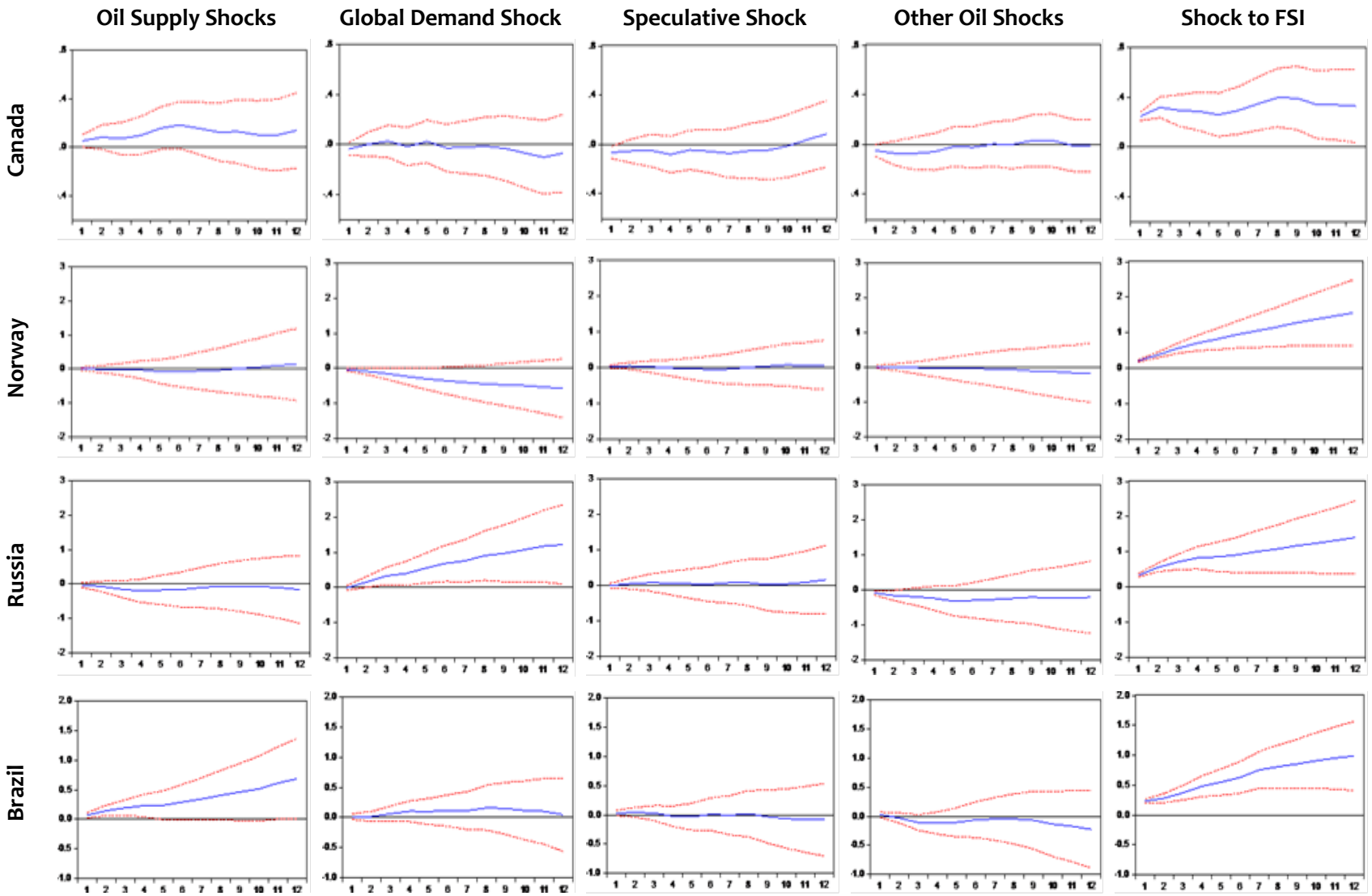

Figure 3.2 Impulse Responses of FSI of Major Oil-Exporting Economies (Post-Crisis Period)

Notes: This figure shows cumulative responses of FSI of each oil importing country to structural oil price shocks. The post-crisis sample period for all the countries is considered between July, 2009 till June, 2018. The red line is the upper and lower ±2 standard error bands.

from exports; hence, any positive shocks to global demand would always increase Germany's sovereign income and reduce financial stress. However, in the case of the UK, there was a confluence of lower growth and high inflation during post-crisis period. The UK being an oil importer, high oil prices owing to high global demand increases inflation subsequently increasing the financial stress.

Similar to the oil-exporting countries, the shocks to precautionary or speculative demand have significant impacts on the financial stress for oil-importing countries. The FSI of oil importers like the Brazil and India increased due to shocks to the oil speculative demand during the pre-crisis period. On the other hand, the reaction of FSI Germany to the oil speculative demand shocks is negative during the same period (Fig. 3.3). The oil importers like Germany and India, exhibit positive impacts of speculative demand shocks on FSI during the post-crisis period (Fig. 3.4). Speculative shocks increase the demand for oil for storage purpose in anticipation of any future uncertain events. This increases the price of oil and puts pressure on the financial condition of oil importing economies like Germany and India. It is also noted that the effects of speculative or precautionary demand on the FSI are lesser in comparison to global aggregate demand.

Our observations in this regard are consistent with the argument of Kilian (2009), and Kilian and Hicks (2013) that the macroeconomic variable responds more to the shifts in the flow of demand. The idea of FSI and global aggregate demand relationship can also be inferred from the argument that episodes of low (high) financial stress represent a high (low) economic activity (Davig and Hakkio, 2010; Park and Mercado, 2014).

During the pre-crisis period, the shocks to other oil specific factors has a significant impact on the financial stress of oil importers like Germany, India France, Brazil and the USA. Except Germany and India, the FSI's of all other affected are positively impacted by shocks to other oil specific factors (Fig. 3.3). However, during the post-crisis period, oil-importing economies like France, and the UK (Fig. 3.4) show significant impacts (negative) of shocks on other oil marker specific factors on FSI during the post-crisis period.

The variance error decomposition results of Table 4 testifies that contributions of each structural shocks to the variation of FSI are higher during the pre-crisis period both for oil-exporting and importing countries. Oil supply shocks contribute the highest to the FSI of Russia during the pre-crisis period among oil exporters. The speculative demand shocks have the highest contributions to the financial stress of Canada during the same period. A similar pattern of higher contributions of oil shocks is observed for oil-importing economies during the pre-crisis period. Global demand shocks play an essential role in the countries like China, France, Germany and India during the pre-crisis period. Speculative demand shocks are found critical in China, and Germany. During the post-crisis period, global demand shocks are found critical in Japan. Also, the contribution of speculative oil shocks in economies like China, France, India and the UK are found to be more prominent during post-crisis period as compared to pre-crisis period. As compared to the pre-crisis period, the contributions to FSI of oil-exporting and importing economies are found due to its own shocks (fifth column) have become more prominent. This is due to an increase in fragility in the financial system during the post-US-Subprime crisis.

Overall, our findings suggest that compared to supply shocks to global aggregate demand are more important. The global aggregate demand shocks reduce the financial stress both in oil-exporting and importing countries. In comparison to the post-crisis period, the effects of oil price shocks are stronger during the pre-crisis period. As oil supply shocks are higher for the oil-importing countries during the pre-crisis period, which could be due to rigid oil supply, hence, any monetary policy to enhance the demand for oil acts adversely on economic growth and increases financial stress during the pre-crisis period. The findings are consistent with the argument of Wan and Kao (2015) mentioned in the literature review section.

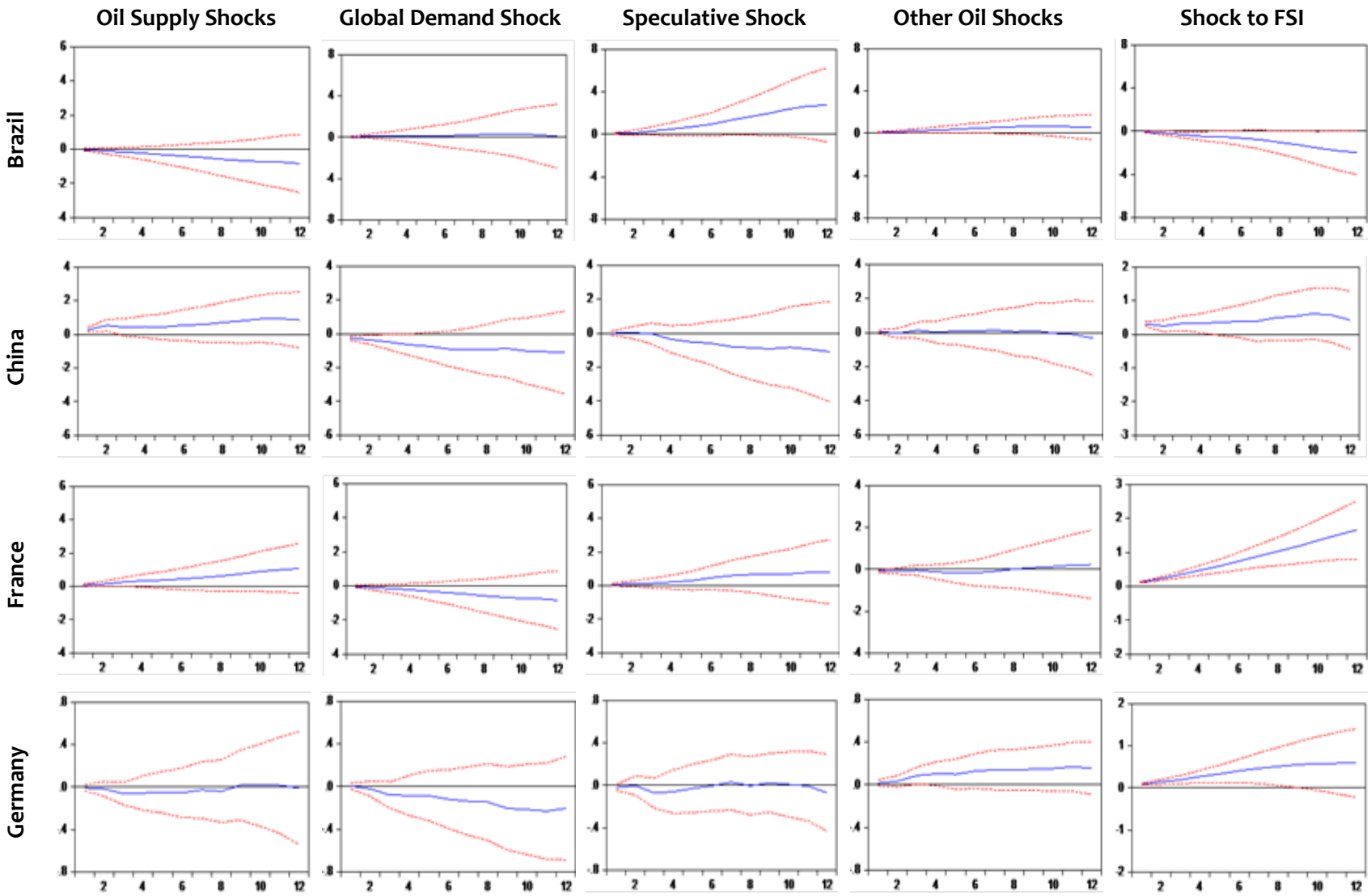

Figure 3.3 Impulse Responses of FSI of Major Oil-Importing Economies (Pre-Crisis Period)

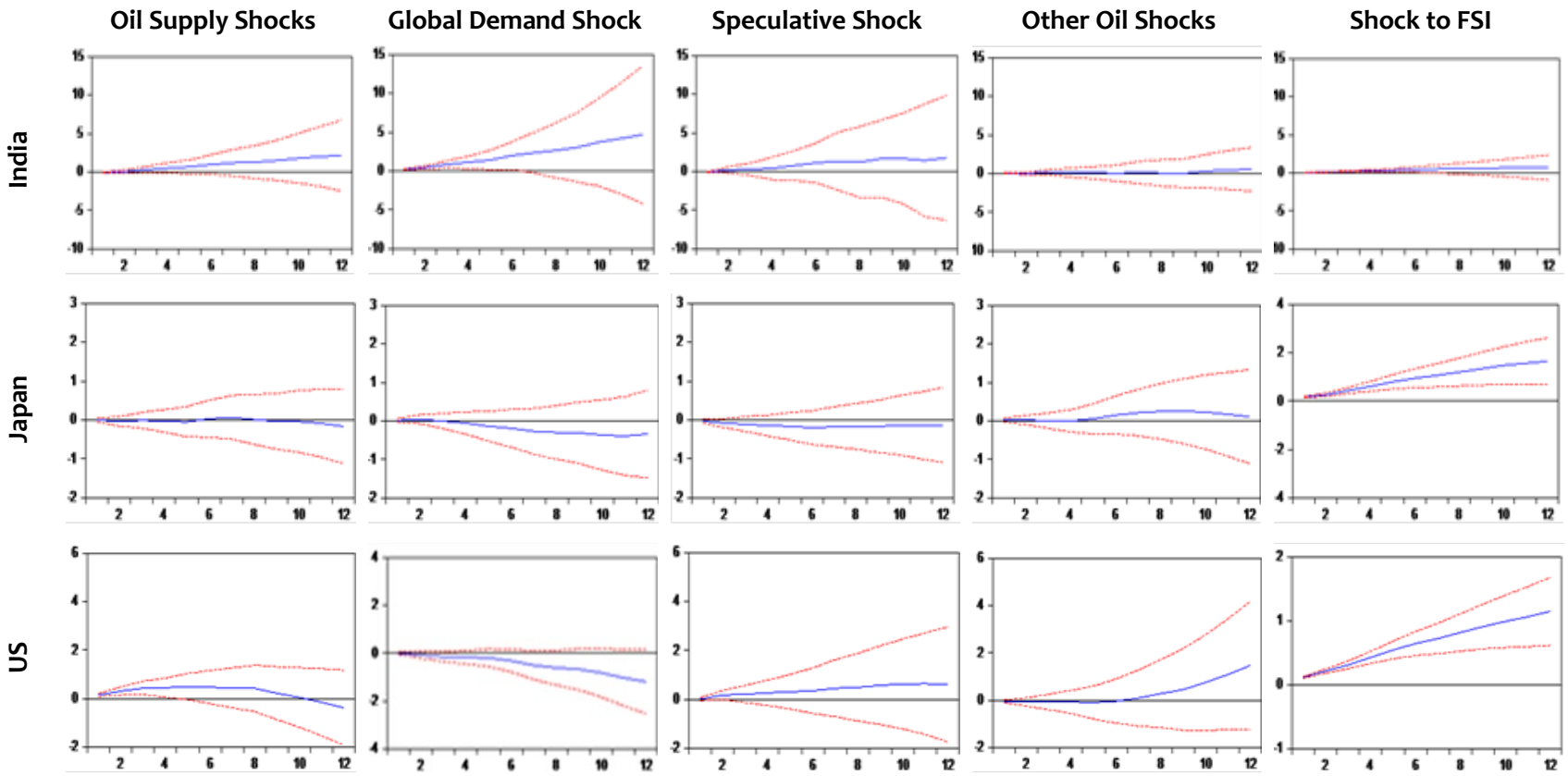

Figure 3.3 Continued

Notes: This figure shows cumulative responses of FSI of each oil importing country to structural oil price shocks. The pre-crisis sample period for all the countries is considered until December 2007. The red line is the upper and lower ±2 standard error bands.

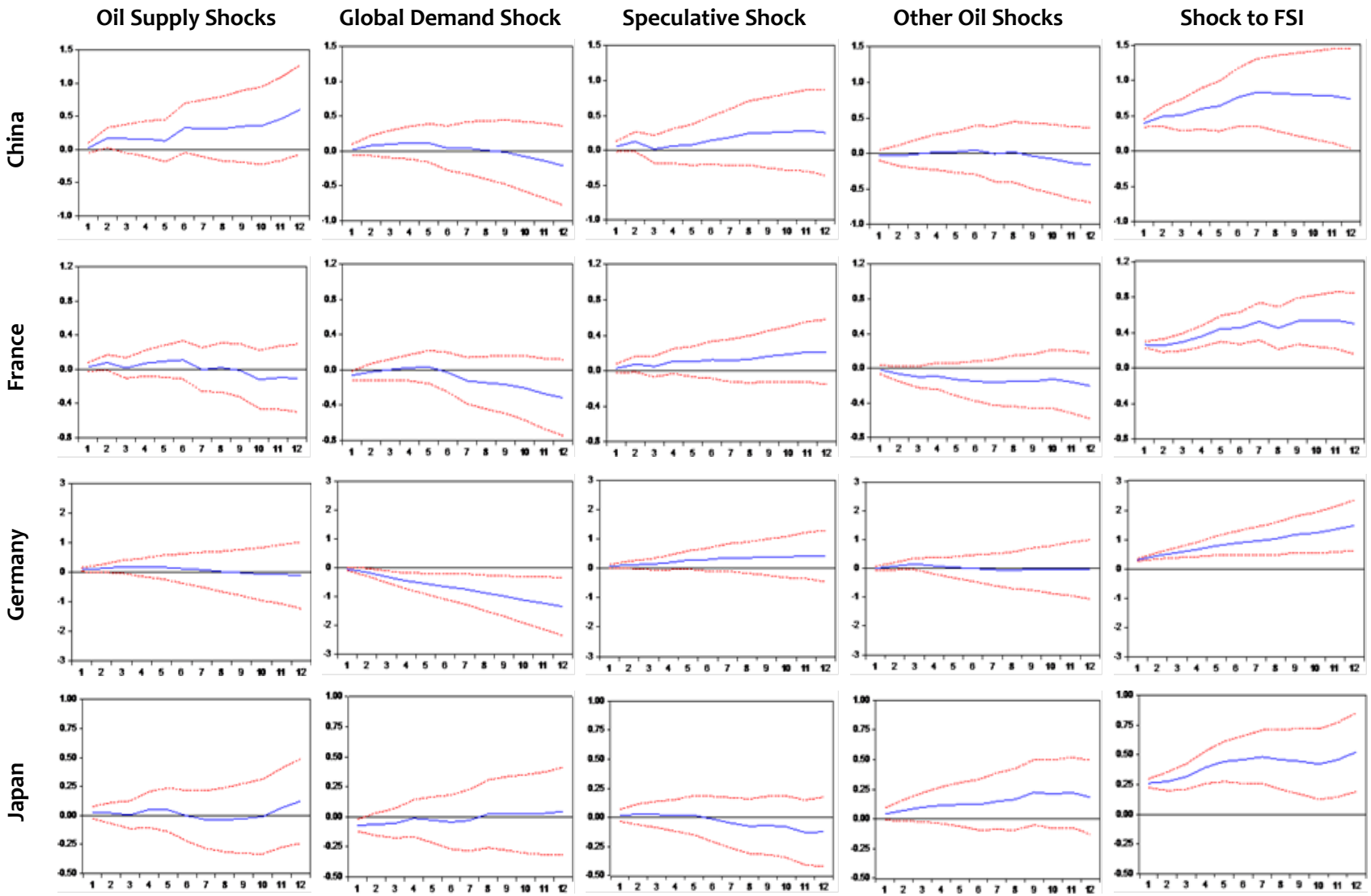

Figure 3.4 Impulse Responses of FSI of Major Oil-Importing Economies (Post-Crisis Period)

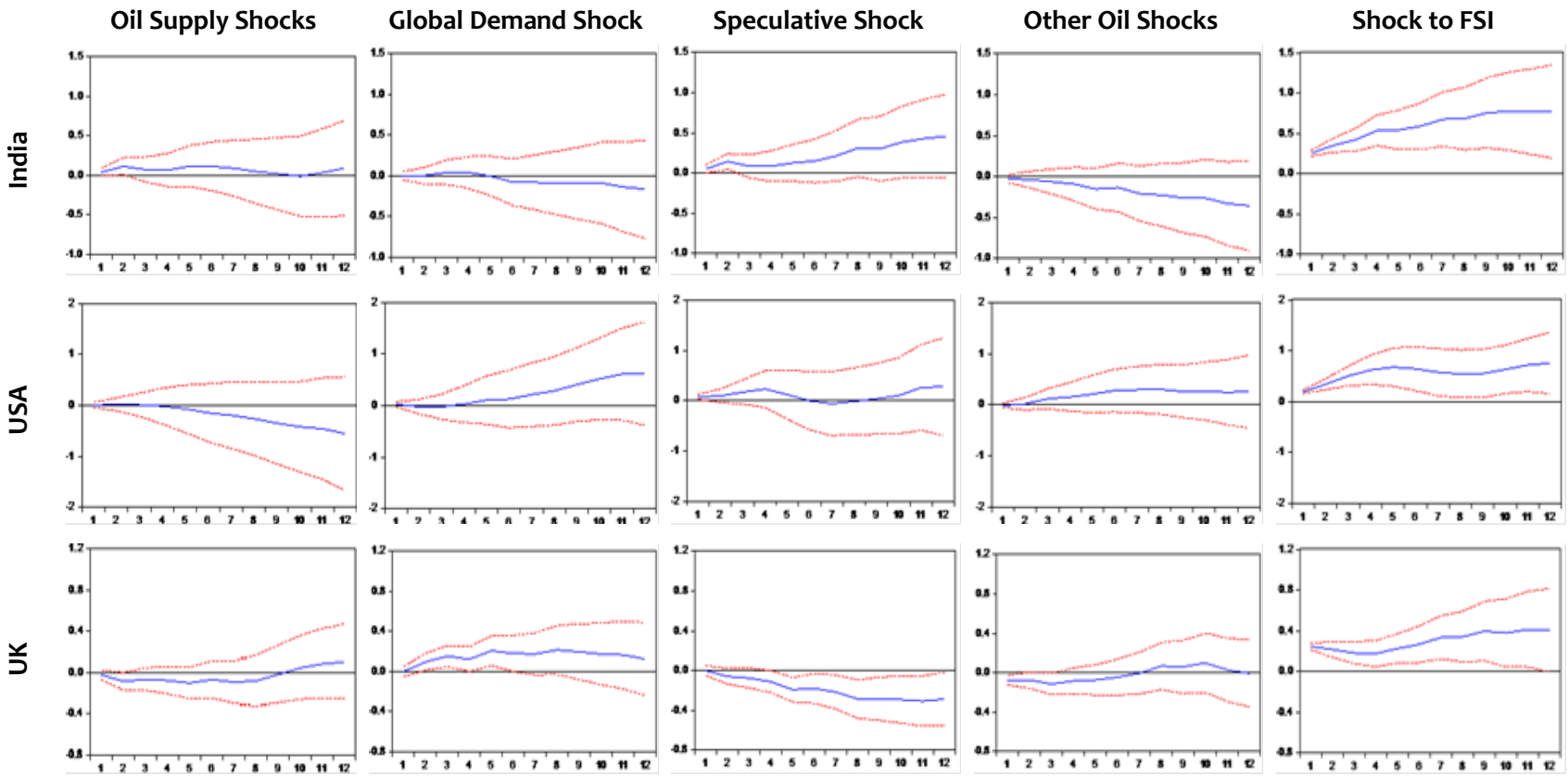

Figure 3.4 Continued

Notes: This figure shows cumulative responses of FSI of each oil importing country to structural oil price shocks. The post-crisis sample period for all the countries is considered between July, 2009 till June, 2018. The red line is the upper and lower ±2 standard error bands.

Table 4. Variance Error Decomposition of FSI: Pre-Crisis and Post-Crisis Period Analysis

Panel (A) Variance Error Decomposition of FSI of Major Oil Exporting Countries

	Shocks during Pre-Crisis Period					Shocks During Post-Crisis Period				
Countries	Supply Shock	Global Demand Shock	Speculative Shock	Other Oil Shock	FSI Shock	Supply Shock	Global Demand Shock	Speculative Shock	Other Oil Shock	FSI Shock
Brazil	36.26	9.29	9.80	13.73	30.89	5.01	2.74	15.67	7.83	66.60
Canada	9.05	13.59	26.17	7.20	43.94	10.63	13.05	7.75	11.88	56.66
Norway	2.22	8.68	10.90	12.31	65.87	11.20	0.80	2.51	6.35	79.90
Russia	45.77	16.55	9.85	26.86	1.31	10.55	2.97	8.20	11.65	66.60

Panel (B) Variance Error Decomposition of FSI of Major Oil Importing Countries

	Shocks during Pre-Crisis Period					Shocks During Post-Crisis Period				
Countries	Supply Shock	Global Demand Shock	Speculative Shock	Other Oil Shock	FSI Shock	Supply Shock	Global Demand Shock	Speculative Shock	Other Oil Shock	FSI Shock
China	10.75	13.71	17.56	8.01	49.92	23.17	3.33	11.43	5.80	56.25
France	13.40	9.90	7.89	9.08	59.70	3.85	4.83	9.31	6.15	75.83
Germany	10.09	44.39	15.04	10.11	20.48	9.39	4.42	6.28	6.51	73.39
India	6.58	17.69	2.14	18.77	54.8	3.81	0.09	25.94	1.90	67.41
Japan	8.03	3.24	6.63	2.42	79.94	4.93	17.68	0.05	13.09	63.77
UK	8.35	2.52	0.08	12.80	75.48	2.99	5.04	8.13	36.41	47.41
US	35.07	4.04	3.37	33.11	24.40	12.79	5.24	6.79	28.63	55.04

Notes: The pre-crisis sample period for all the countries is considered until December 2007. The post-crisis period for all the countries is from July 2009 until June 2018.

IMPLICATIONS

Our study has a novelty in providing a separate treatment to oil importing and oil exporting countries during pre-crisis and post-crisis periods. One of the most noticeable features observed in our results is the effect of oil supply shocks is very transient in nature (short-lived) as the supply shortage from one side of the part of the world is compensated by another part of the world. This observation indicates that the oil supply shocks may not have a long-lasting impact on the inflation and exchange rates in economies that imports oil. The policymakers in central banks may not be required to actively change the interest rates or perform exchange rate intervention to ensure macroeconomic and financial stability.

Our study concludes that oil shocks due to higher global real aggregate demand significantly impact an economy's financial stress. Oil shocks due to aggregate demand emanate when the demand for economic output is higher than the global oil supply. This leads to an increase in oil prices, eventually passing to the Consumer Price Index. Managing forward-looking inflation expectations beyond a certain level is critical as economic agents with higher inflation expectations would require more nominal wages to keep their real wages constant. This phenomenon will start a price-wage spiral, where increases in wages will force the companies to increase the price of their output to keep their margin constant. When the economy is growing beyond its full employment level, the central banks should opt for contractionary monetary policy to avoid the oil shocks due to global real aggregate demand. The policy of central banks should be such that the increase in oil prices should not negatively offset economic growth. However, the impact of oil demand shocks is favorable to the oil-exporting economies due to increased foreign reserves accumulation.

Oil exporters like Canada, Norway, and the UK have witnessed the negative impact of a speculative demand shock on the FSI, while oil importers like Japan and the US have shown an increase in the FSI due to speculative demand shocks. The speculative oil demand increases the oil import bills and, thus, the stress on the financial condition. Speculative demand comes from the stockpiling of oil to ensure energy security. However, the stockpiling can be counter-productive as it may increase trade deficits, adversely affecting the exchange rates, causing inflation. Supply shocks may not have a long-lasting impact on an economy's macroeconomic and financial stability. The strategy of stockpiling in anticipation of supply shock should be done so that the trade deficit and the exchange rate are not adversely impacted.

The above-mentioned policy implications underline the importance of studying the oil shocks in a structurally dis-integrated manner to efficiently manage financial and macroeconomic stability in the event of shocks in the oil market.

CONCLUSIONS

The key findings can be summarised in the following points: (i) The impact of oil price shocks is different on the financial stress of each country, contingent on the underlying cause of the shock. (ii) Oil supply has no or marginal impacts on financial stress. The shocks to oil supply may not always be helpful. The country which migrates to an alternate source of oil can remain immune to oil supply shocks. The higher oil price can offset the beneficial effects of higher aggregate demand. The effects of aggregate demand shocks are more visible for the oil-importers than the oil-exporters both during pre- and post-crisis periods. (iii) The aggregate demand shocks reduce the financial stress; however, this phenomenon sometime does not follow, this could be because aggregate demand is not able to lessen the financial stress as the changes in oil prices driven by global demand offsets economic activity. (iv) Speculative demand shocks do not affect FSI for most of the economies. But few oil-exporters like Canada, Norway and the UK have witnessed the negative impact of a speculative demand shock on FSI while few oil-importers like India has received positive contributions from speculative demand shocks on their FSI during pre-crisis period. During the post-crisis period oil shocks impacted oil importing countries like Germany and the UK. Oil shocks due to oil supply and speculative shocks adversely affected the FSI of UK. The FSIs of oil importing economies such as Germany, India and China have been positively impacted by oil supply and speculative shocks. However, global aggregate demand shocks negatively impacted the FSI of Germany. This can be attributed to robust growth during the post-crisis period. Oil price changes due to other oil shocks are useful to reduce financial stress if it is led by higher aggregate demand.

Attention to an aggregate financial stress index can help policymakers and investors to forecast economic conditions and accordingly adopt stabilization schemes or hedging mechanisms to mitigate the adverse effect of oil price shocks. Our main findings would help the policymakers and investors to understand how any change in the underlying reason of oil price shocks can create overall stress to any economy, and how the influence of oil price shock is different for oil-exporting and- importing countries. The implications of oil shocks, thus, cannot be ignored (Hoover and Perez, 1994; Hamilton and Herrera, 2004). The understanding of the interaction between oil price shocks and Financial Stress also helps to gauge the macroeconomic movements as the financial stress is the manifestation of the anticipations financial market participants about the fundamental deterioration in the real sector environment (Cardarelli et al., 2011).

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