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MACROECONOMIC RESPONSES OF EMERGING MARKET ECONOMIES TO OIL PRICE SHOCKS: ANALYSIS BY REGION AND RESOURCE PROFILE

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Macroeconomic Responses of Emerging Market Economies to Oil Price Shocks: Analysis by Region and Resource Profile

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Abstract:

This study employs a vector autoregressive (VAR) model to analyse how oil price shocks affect macroeconomic fundamentals in emerging economies. Findings from existing literature remain inconclusive how macroeconomic variables fare towards shocks, especially in emerging economies. The objective of our study is to uncover if analysis by region (Latin America and the Caribbean, East Asia and the Pacific, Europe, and Central Asia) and resource intensity of economies (oil exporters, oil importers, minerals exporters, and less resource intensive). Our unique approach forms part of our contribution to the literature. We find that Latin America and the Caribbean are least affected by oil price shocks, while in East Asia and the Pacific the response of inflation and interest rate to oil price shocks is positive, and output growth is negative. Our analysis by resource endowment fails to show oil price shocks' ability to explain huge variations in macroeconomic variables in oil importing economies. Further sensitivity analysis using US interest rates as an alternative source of external shocks to emerging economies establishes a significant response of interest rate responses to US interest rate in Europe and Central Asia, and in inflation in Latin America and the Caribbean. We also find that regardless of resource endowment, the response of output growth and capital to a positive US interest rate shock is negative and significant in EMs. Our results are persuasive that resource intensity and regional factors impact the responsiveness of emerging economies to oil price shocks, thus laying a basis for policy debate.

JEL: F44, E37, C11, E32
Keywords: Emerging market economies, Oil price shocks, Output growth, Panel VAR

1. Introduction and motivation

Oil price shocks are of interest to economists because of the significance of oil price movements to policymakers when assessing economic topics such as potential economic growth, unemployment, CPI, trade (Oladosu et al., 2018; Köse and Ünal, 2020), and the potential impact on international investment decisions (Valenti et al., 2020). Existing studies report different responses to the aftermath of the global financial crisis for emerging economies in Asia, Eastern and Central Europe, sub-Saharan Africa, and commodity exporters like Mexico and Colombia from Latin America (Upper, 2016; Christensen and Upper, 2017). Monetary policy shock transmission have also been reported to exhibit regional differentials in Canada and ASEAN economies in studies by Georgopoulos (2009) and Basnet and Upadhyaya (2015) respectively. Our goal is to bring analysis of the regional differentials in the transmission of oil price shocks to countries in different geographical regions and with varying resource endowments as, to the best of our knowledge, it is an area that has not received sufficient attention yet.

Analysing regional responses to oil price shocks would be informative to the key stakeholders. Exporters and importers are stakeholders and are more affected in short and medium term perspective when taking business decisions. Exporters and importers should respond to oil price shocks in a timely manner to meet supply/demand balance and related risks (Schmitt-Grohé and Uribe, 2003; Céspedes and Velasco, 2012). Policy makers and investors are stakeholders who are more affected in the medium and long term. Often due to legislative procedures, policy makers work in longer-time horizon to evaluate further policy and legislation changes prior to adjustments linked to oil price shocks. On the other hand, monetary policy makers may aim to counteract the oil price shocks with short-term measures (Blanchard and Gali, 2007; Bernanke et al., 2004) that might be felt with a considerable delay, though (Hamilton and Herrera, 2004). Assessing medium and long-term market risks is important for investors when they make decisions to account for the oil price shocks (Ferderer, 1996). This would also open a further area for research on underlying regional characteristics, especially among emerging markets, that may lead to differences in the response to those shocks.

Apart from the need to understand if regional differentials exist in the transmission of oil price shocks, emerging economies represent more important group from a research perspective than advanced economies because emerging economies are basically commodity exporters and more fragile than advanced economies. A key issue is that if advanced economies experience shocks they can transmit them to emerging economies while emerging economies are small to transmit shocks to advanced economies.

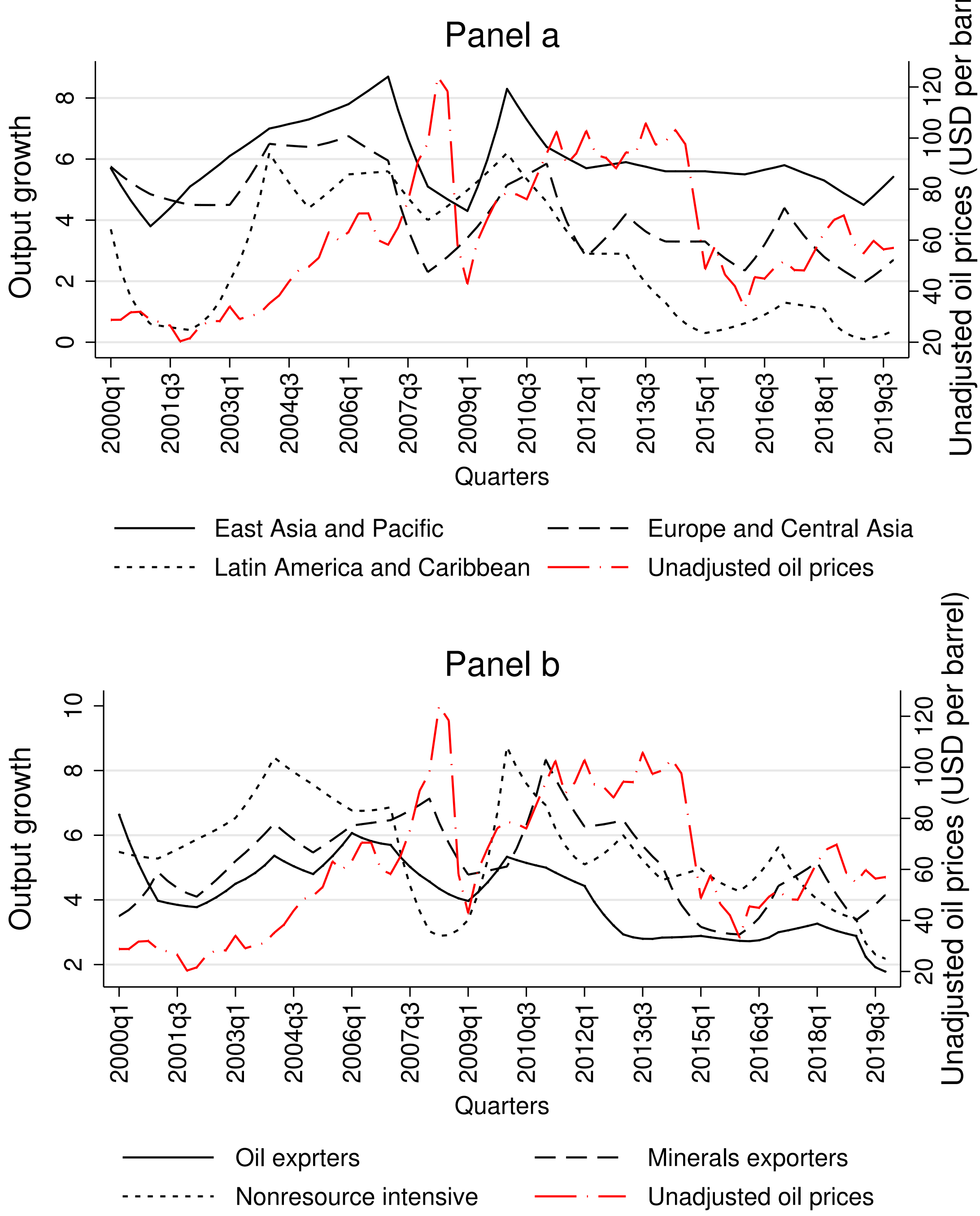
Therefore, shocks to global commodity prices are key to business cycle in emerging economies with the resulting impact being dependent on the composition of exports. That is, demand-side shocks benefit oil exporters and exacerbate global imbalances while supply-side shocks benefit oil importers when prices fall (Jibril et al., 2020). As shown in Figure 1 over the period 2000:Q1 to 2019:Q4, movements in oil prices exhibits a strong and positive co-movement with real GDP in East Asia/the Pacific and Latin America/the Caribbean. A clear difference in trend lines is noted across the regions and when economies are categorized using significant exports. real GDP in economies that are neither oil exporters nor mineral exporters, as seen in Panel b, is adversely affected by a rise in oil prices. In contrast, oil exporters realize an real GDP that is larger than that of mineral exporters.

Our study investigates the dynamic responses of macroeconomic variables to oil price shocks and whether regional differences and the intensity of natural resources impact the observed responses. We employ a panel VAR framework with data originating in emerging economies from Latin America, Europe, and Asia.

Existing studies extensively analyze the effect of oil price shocks on the movement of stock markets (Köse and Ünal, 2020), the terms of trade volatility (Jibril et al., 2020), and exchange rates (Turhan et al., 2013), along with other macro variables. Others have examined whether the relationship between oil prices and macro variables is linear or nonlinear, especially after 1981, when nominal prices fell, and after 1985, when the market collapsed and wide swings followed (Escobari and Sharma (2020)). The existing literature on oil price shocks applies different econometric methodologies to analyze shocks stemming from the demand side and supply side, e.g. VAR analysis (Burbidge and Harrison, 1984; Jiménez-Rodríguez and Sánchez, 2005), Markov chain switching (Basher et al., 2016), Granger causality (Cunado and De Gracia, 2005), and panel data analysis (Behmiri and Manso, 2013; Turhan et al., 2013). Notably, the focus of most of the previous studies has been on advanced economies leaving much to be covered in developing economies.

In this respect, we enrich the literature by showing that Latin America and the Caribbean

Figure 1: Business cycle and oil price movement



Source: Bank for International Settlements (BIS), World Integrated Trade Systems (WITS), The International Financial Statistics (IFS).

are the least affected by oil price shocks, while in East Asia and the Pacific the response of CPI and the interest rate to oil price shocks is positive and real GDP is negative. Our analysis of resource endowment fails to show oil price shocks' ability to explain huge variations in macroeconomic variables in oil-importing economies. In mineral-exporting and less-resource-intensive economies, one standard deviation in oil prices can explain about 2 percent of the variation in consumption in the short run. In the medium run, oil price shocks can account for about a 5-percent movement in interest rates in mineral-exporting countries and more than 2 percent of variation in real GDP in oil- and mineral-exporting economies. However, in mineral-intensive economies, real GDP has a negative and short-lived response to oil price shocks. In contrast, a negative and persistent response is experienced in less-resource-intensive economies. Arguably, this indicates that a rise in oil prices impacts domestic prices and real GDP in oil-importing countries while this impact could be dampened in oil-importing economies that export minerals. The channel through which the dampening can take place is a boom in commodity prices as producers increase production for export, creating high employment.

We also acknowledge that in addition to the categorization of economies according to resource endowment and regional differences, there could be other underlying factors behind patterns in the asymmetric effects of the impact of oil price shocks on the trade balance and real economic activity as reported by Jibril et al. (2020). When analysing emerging economies, our results establish that differences depend not only on regions but also resources endowment.

The next section summarizes the literature review. The remainder of this study is organized as follows: section three presents the stylized facts, section four describes the data and methodology, section five presents results and discussion, and the last section concludes.

2. Literature review

In this section, we focus on empirical evidence and theoretical aspects. Our study investigates the macroeconomic responses of emerging economies to oil price shocks by region and resource endowment. The existing studies focus largely on analyzing the effects of oil price shocks on the movement of stock markets, the terms of trade volatility and exchange rates, and other macro variables, while reviewing factors such as regional differences and resource endowment that can potentially bear relevance for the findings conveyed.Unlike existing studies, we contribute to the literature by demonstrating that differences in VAR results in emerging economies depend not only on regions but also resources endowment.

2.1. Role of oil prices

Oil plays a vital role in a nation's economy. Therefore, fluctuations in oil prices are likely to be correlated to macroeconomic movements in a country. An increase in oil prices is believed to be one of the most severe supply shocks that can hit the world economy. Oil price shocks receive significant consideration due to the presumed impact on other macroeconomic activities. For instance, oil price shocks were shown to Granger-cause GDP per capita in net-oil-importing countries (Gershon et al., 2019) and dynamic effects of oil price shocks (demand and supply) was evidenced with respect to macro variables such as GDP and CPI (Kilian and Park, 2009). There also exist a theoretical relationship between exchange rates, interest rates, and oil price movements (Kilian and Zhou, 2019). Further, Davis and Haltiwanger (2001) credits oil prices for the natural unemployment rate effect. In real business cycle (RBC) models, oil price shocks can reduce technological shocks (Davis, 1986) and because of their impact on uncertainty, oil price shocks can depress irreversible investments (Ferderer, 1996).

Earlier studies by Lee et al. (1995) and Hamilton (1996) found that oil prices and macroeconomic variables retain an asymmetric relationship. In the same vein, Akay and Uyar (2016) reports a non-linear relationship between crude oil prices and macroeconomic variables using partial response functions estimated from a non-parametric model. Furthermore, Ferderer (1996) and Jiménez-Rodríguez and Sánchez (2005) highlight the existence of linear and non-linear relationships between oil prices and macroeconomic variables that exist from a theoretical point of view. For instance, when price increases, aggregate demand is likely to fall as income gets redistributed between net oil exporters and net oil importers. Besides, total supply reduces following a rise in oil prices as firms purchase less oil, consequently lowering capital and labor productivity. If real wages fall due to a decline in factor productivity, the worker can voluntarily withdraw labor supply, thus compounding the effect. A non-linear impact is achieved when the sectoral reallocation occurs as irreversible investments get depressed by oil price uncertainty (Ferderer, 1996).

Other areas that empirical studies have brought into focus include the impact of oil prices on financial markets and firm returns (Kocaarslan and Soytas, 2019; Sharma et al., 2018), exchange rates and CPI (Turhan et al., 2013), real GDP and other macro variables (Behmiri and Manso, 2013; Cunado and De Gracia, 2005), unemployment (Davis and Haltiwanger, 2001), sectoral allocation (Ferderer, 1996), the combined effect of policy reactions (Bernanke et al., 1997), and industrial production (Burbidge and Harrison, 1984).

2.2. Macroeconomic impact

Economics researchers have maintained a keen interest in the relationship between oil price shocks and economic activity. Using a vector autoregressive (VAR) model with seven variables, Burbidge and Harrison (1984) analyzed industrial production responses to oil price shocks using data from January 1961 to June 1982. In OECD countries, the GDP response to the oil price shock from 1972:Q3 to 2001:Q4 is analyzed by Jiménez-Rodríguez and Sánchez (2005) using a seven-factor VAR model. From their multivariate VAR, Jiménez-Rodríguez and Sánchez (2005) reports that an increase in oil prices generates an impact of higher magnitude than a decline in oil prices. In addition, the existence of a non-linear relationship between real GDP and oil prices is established. Analysis of a different variable also establishes a non-linear relationship between oil price shocks and stock prices, as reported by Escobari and Sharma (2020).

A related study by Behmiri and Manso (2013) examined Granger causality between the crude oil price and economic growth in oil-importing and oil-exporting countries using data from Sub-Saharan Africa from 1985 to 2011. In oil-importing regions, a bi-directional causality relationship is reported between crude oil consumption and economic growth. In contrast, a uni-directional causality relationship from crude oil consumption to real GDP is reported in oil-exporting regions. The Granger causality framework between oil prices and macroeconomic factors (economic activity and consumer price indexes) has been previously applied by Cunado and De Gracia (2005) from 1975:Q1 to 2002:Q2. In the short run, the results suggest a significant effect of oil prices on CPI and economic activity, and the level of significance rises when oil price shocks are defined in the domestic currency. An asymmetric relationship between oil prices and the macroeconomy is found in some Asian economies.

Jibril et al. (2020) uses a sample of oil-exporting and oil-importing economies to examine how the asymmetric effects of oil price shocks impact the trade balance and real economic activity. Although the type and source of the shock is beyond the scope of our study, it is worth highlighting that global oil expansions and the sources of shocks are also important in establishing asymmetric patterns as reported by Jibril et al. (2020). For an oil-exporting economy such as Canada, Delpachitra et al. (2020) demonstrates that changes in the dollar value due to adjustments in the US monetary policy affects oil prices, thus impacting other economies through oil price shocks. A meta-analysis regression can be applied in order to control for potential sources of variations in reported results such as data, the methodology used, and other factors. This methodology is applied by Oladosu et al. (2018) in the analysis of the oil price elasticity of the GDP for the US economy. Oladosu et al. finds a negative US GDP elasticity that has a small magnitude.

In addition to oil prices, commodity prices also transmit trade shocks from the rest of the world to small open economies (SOEs). The trade channel affects SOEs through the export value. Exports further impact a country's foreign borrowing capacity because exports act as collateral in international economics Arellano (2008). A fall in exports, just like GDP, results in a rise in a country's risk premium as default risk rises (Schmitt-Grohé and Uribe, 2003). This is notably the reason why the movement of prices remains critical in the emerging economies literature, as pointed out by Céspedes and Velasco (2012). Economies that are not endowed with oil reserves export commodities and import oil. Therefore, oil importers that are also net commodity exporters experience business cycle swings following fluctuations in commodity prices. High commodity prices are associated with a lower country spread, where the spread is taken as the difference between a country's interest rate and the world interest rate. According to Drechsel and Tenreyro (2018), commodity prices and spreads in emerging economies jointly show a positive effect on GDP and prices in net commodity-exporting economies. In the credit market, Kinda (2016) investigates the relationship between commodity price movements and credit markets using panel data for commodity-exporting countries and argues there exists an adverse effect.

2.3. Policy interventions

The last decade witnessed economic fluctuations in many economies. Oil price shocks are linked to the witnessed economic fluctuations. Although oil price shocks are known to have substantial macroeconomic effects, the last decade recorded a reduced impact of oil price shocks on CPI and economic activity. According to Blanchard and Gali (2007), monetary policy interventions reduced the effects of oil price shocks on CPI and economic activity. The debates surrounding the recessions that were preceded by oil price shocks have attempted to establish whether they were caused by oil price increases or tight monetary policies. Others attempted to disentangle the effect of oil price shocks from monetary policy interventions.

In search of answers to these intriguing concerns, Bernanke et al. (2004) applied a VAR analysis and established that a 10-percent increase in oil prices is associated with a 150-basis-point increase in the fund rate and a 0.7-percent decline in peak real GDP. A counter-factual analysis by BGW (where interest rates are held constant) further established that had interest rates remained constant after oil price shocks were experienced, while real GDP fall by a half.

According to Nazlioglu et al. (2019), controlling for structural breaks is essential in analyzing oil price shocks and policy intervention. Through a study examining causal relationships between oil prices and monetary policy in emerging economies, Nazlioglu et al. found that results are improved when structural breaks are accounted for in the analysis of causal linkages between oil prices and monetary policy. However, the findings on oil price shocks and monetary policy intervention have remained inconclusive.

Findings on oil price shocks and monetary policy intervention have never been conclusive, though. Such inconclusive findings relate to monetary policy intervention's ability to restore macro-stability after oil price shocks in oil-importing advanced economies such as Japan. An early study byBernanke et al. (1997) suggested using monetary policy to eliminate the economic swing when oil price shocks hit an economy. At the same time, Hamilton and Herrera (2004) argues that the effect of monetary policy intervention is low because oil price shocks are felt after three to four quarters.

2.4. Direct and indirect effects

Oil price shocks are divided into demand-side and supply-side shocks. Baumeister and Hamilton (2019) report supply shocks as being more disruptive to the global economic activity than demand shocks. While the type of shock matters, macroeconomic fundamentals of any economy hit by oil price shocks are also argued to have a counter impact that determines the net effect of the shock (Kilian and Park, 2009; Holm-Hadulla and Hubrich, 2017; Kilian and Zhou, 2019). Consumption and investment are affected by demand-side effects. A positive indirect effect is passed to the consumption of the existence of a positive relationship with disposable income. As the shock persists, the magnitude of this effect gets stronger. On the other hand, an increase in oil prices can adversely affect investment when costs for firms become high. Apart from that, changes in oil prices indirectly affect real activity through exchange rates and CPI (Jiménez-Rodríguez and Sánchez, 2005). Other indirect effects may be realized as a combination of oil price shocks and the reaction to policies such as monetary policy as argued by Bernanke et al. (1997) and Cunado and De Gracia (2005).

2.5. Impact on exchange rate and financial markets

Using daily data from emerging market economies, Turhan et al. (2013) investigates the role that oil prices play in explaining the dynamics of emerging economies exchange-rate movement. Over the sample period 2003-2010, the currencies of the sampled emerging economies were reported to have appreciated against the US dollar when oil prices increased, and appreciation became more pronounced after 2008.

Although the main focus of this study is not financial markets and returns, it is worth highlighting the impact of oil price movements on other sectors of the economy to underscore the significance of these shocks. For instance, studies have been undertaken on the relationships between oil price shocks and financial markets considering industrialized nations like Canada, the United Kingdom, Japan, and the United States. Kocaarslan and Soytas (2019) did research in the US, where an examination of stock prices and oil prices were the main variables under consideration. The researchers found a correlation between returns and oil prices with a relatively lagged effect between 1947 and 1991. Sharma et al. (2018) tested whether oil shocks and the international stock market's reaction can easily be justified by changes in cash or expected cash returns.

The emphasis on the economic implication of oil price shocks is also echoed in a different study on stock exchanges in Iran, Kazakhstan, and Russia. Results obtained from an SVAR analysis establishes that stock exchanges from these three countries are impacted more by negative oil price shocks than positive shocks Köse and Ünal (2020). There remain divergent arguments in the literature, with some studies linking stock price movements to oil price shocks while others report a weak correlation. Still, on the asymmetric effect of oil prices on stock prices, Escobari and Sharma (2020) examines the effect of oil price movement on stock prices using a Markov switching technique and fails to link stock price movement to either positive or negative oil price shocks. Escobari and Sharma, however, finds that it is only economic recession that has a statistically significant effect on stock prices.

Moreover, the fundamentals of the crude oil market affect investment decisions through the crude oil futures risk premium. Based on SVAR results, Valenti et al. (2020) finds that real oil prices and the risk premium indicate a negative relationship. In addition, a shock component to oil price speculation has larger explanatory power on expected future returns due to the risk premium factor.

3. Methodology

Our study investigates the macroeconomic responses of emerging market economies to oil price shocks using a panel VAR model with a GMM framework as developed by Arellano and Honoré (2001), following the earlier work of Sims (1980). In the case of our study, a PVAR model with a GMM framework is suitable because the sources of cross-sectional dynamic heterogeneity can be easily accounted for. Second, the endogenous system is appropriate in the case of endogeneity among variables. Moreover, a PVAR model can capture the time variation in the shocks and coefficients.

Following Ouyang and Li (2018), our study takes a PVAR model specified as follows:

$$Y_{i,t} = A_o + \mu_i + \sum_{j=1}^{p} A_j Y_{i,t-j} + \epsilon_{i,t} \ , \tag{1}$$

where $Y_{i,t}$ is a vector of dependent variables for each country i, A_j is a vector of estimated coefficients, μ_i denotes fixed-effects between different cross-sectional units, and $\epsilon_{i,t}$ are idiosyncratic errors. The variables $Y_{i,t}$ included in the model are ordered as: oil price, real GDP, interest rate, CPI, consumption, capital, real exchange rate, and export. In order to minimize sensitivity of the impulse responses the variable ordering we employ generalized VAR doing the estimation stage. This approach ensures that generalized impulse responses are not sensitive to variables ordering (Wooldridge (2015)).

This study estimates a non-stationary VAR to avoid the dangers of inconsistency that arise from the imposition of incorrect co-integration restriction (see Sims et al. (1990)). However, this approach can lead to a loss of efficiency. This study follows Hamilton (1994) by allowing the model to implicitly determine any potential co-integrating relationships.

Our choice of using non-stationary variables prevents information loss in the data-generating process, plus is appropriate when the data are cointegrated. Sims et al. (1990) and Toda and Yamamoto (1995) also support the argument we are following that differencing data for stationarity in VAR analysis is not required if the data is cointegrated. A summary of unit root tests for our set of variables are presented in Appendix Table A2 and shows that all variables are non-stationary.

4. Data

We use quarterly data on oil prices and relevant macroeconomic variables for emerging economies from Latin America, Europe, and Asia over the sample period 2000:Q1 to 2019:Q4. In our study we use data reported by respective countries or from other sources such as the World Bank, Bank for International Settlements (BIS), World Integrated Trade Systems (WITS), International Monetary Fund (IMF), and UN COMTRADE. The application of quarterly data is motivated by the argument of Hamilton and Herrera (2004) that the impact of oil price shocks is felt after three to four quarters. It also provides a window for evaluating whether a monetary policy intervention is effective since interest rates are included in the list of variables.

The variables used are oil prices, the global interest rate (proxied by the US three-month treasury bill rate), real GDP, treasury bill rates, CPI (year 2010=100), gross capital formation, exports, and the real exchange rate (year 2010=100). In countries where treasury bill rates are missing, we replace them with a monetary policy-related rate, a deposit rate, or a savings rate. The use of treasury bill rates is common in previous studies. For instance, Yang and Hamori (2014) use the US three-month treasury bill rate as a proxy for the federal fund rate (FED) when analyzing the spillover effect of US monetary policy to ASEAN stock markets, Kucharčuková et al. (2016) use the three-month Euro-area bond rate when analyzing the spillover of monetary policy outside the Euro area, and Rohit and Dash (2019) use T-bill, money market, and certificate of deposit rates when analyzing the dynamics of monetary policy spillover. See Table A1 in the Appendix.

The choice of variables included in this study is motivated by the evidence in the existing literature analyzing the effect of the key macro variables: the impact of oil price shock on business cycle (Oladosu et al., 2018; Köse and Ünal, 2020), the impact of oil price shock on domestic price levels and consumption (Kilian and Park, 2009; Holm-Hadulla and Hubrich, 2017; Kilian and Zhou, 2019), impact of oil price movement on investment decisions (Kilian and Zhou, 2019; Valenti et al., 2020). CPI is to account for the cost-push implication of oil price shock and interest rate accounts for the dynamic response of monetary authority to the inflationary effect of oil price shock (Nazlioglu et al., 2019; Blanchard and Gali, 2007; Hamilton and Herrera, 2004). Further, we include an exchange rate, that either be a channel through which shocks are amplified or it can act as a shock absorber-ending of the impact of oil price on exchange rate was brought by Turhan et al. (2013) and Jiménez-Rodríguez and Sánchez (2005). We also account for the impact of oil prices on trade and include exports in the model. It is expected that in oil importing economies high oil prices raise production costs and reducing the competitiveness of exports, while in oil exporting economies high oil prices raise exports' value (Jibril et al., 2020). A changes in investment decisions impact capital accumulation and due to the potential impact of oil price movement on investment advocated by Valenti et al. (2020), we also include capital into . Gross capital formation, also referred to as gross domestic investment, is fixed assets of a given economy plus changes in inventory as per the World Bank definition. By including more variables than is usual in existing studies, we minimize omitted variable bias. As shown in Model 5 in Table A3, the model is correctly specified with the impact of oil price on real GDP being downward estimated with the expected sign compared to Models 1 - 4. Including few variables in the model cause an upward estimation of real macroeconomic variables as it emerges from theoretical review by Jones et al. (2004) and Kilian and Park (2009).

There are 28 countries, 6 from East Asia and Pacific, 12 from Europe and Central Asia, and 10 from Latin America and the Caribbean. If oil or metal and ore exports comprise a substantial portion of total exports, then a country is categorized either as an oil exporter or mineral exporter, respectively. The sample has 10 mineral exporters, 8 oil exporters, and 10 less-resource-endowed economies. Summary statistics are shown in Table 1.

Next, Table 2 reports the existing correlations between domestic business cycle variables and potential sources of external shocks (oil prices and US interest rates). Rolling standard deviations for each region and resource category over a window from the preceding quarter to three quarters preceding is provided. Specifically, Table 2 shows that oil price deviation has a positive relationship with interest rate deviations in Europe and Cen-

Table 1: Summary statistics

	Log(GDP)	Log(C)	Log(K)	Log(X)	Interest rate	CPI	Real exchange
Mean	10.398	9.940	8.861	9.306	8.093	0.255	120.723
P75	11.551	11.005	10.002	10.654	9.800	0.029	135.979
Sd	1.979	1.938	2.005	1.927	8.725	1.012	31.440
Min	5.745	5.725	3.481	4.488	-0.063	-1.801	72.032
Max	16.529	15.959	15.440	15.115	107.157	8.589	304.642
N	1818	1818	1818	1818	1954	1872	1728

Note: C is consumption, K is capital, G is government expenditure, X is exports.

tral Asia, but an inverse relationship with interest rates and inflation deviations in East Asia and the Pacific and Latin America and the Caribbean. The relationship between oil price deviation and real GDP is negatively correlated only in Europe and Central Asia. When the economies are grouped according to resource endowment, it is only the interest rate and CPI deviations that positively correlate with oil price deviation in mineral-exporting and less-resource-endowed economies. The relationship between global interest rate changes and other variables also varies by region and resource profile. This underscores the importance of analyzing economies by region and resource endowment, as this study does.

Table 2: Correlation coefficients of standard deviations

	Corr(r^*,r)	Corr(r^*,y)	Corr(r^*, π)	Corr(p^*,r)	Corr(p^*,y)	Corr(p^*,π)
Region						
East Asia and Pacific	0.094	-0.273	0.296	-0.418	0.001	-0.096
Europe and Central Asia	-0.224	0.427	0.294	0.042	-0.238	-0.172
Latin America and Caribbean	-0.024	-0.105	0.279	-0.071	0.288	-0.109
Resource profiles						
Oil exporters	0.251	0.437	0.324	-0.166	-0.154	-0.378
Minerals	-0.421	0.111	-0.509	0.181	-0.712	-0.075
Less resources	0.338	-0.127	0.268	-0.285	-0.056	0.332

Note: r^* is global interest rates, r is domestic interest rates, y is real GDP, π is CPI, and p^* is adjusted oil prices.

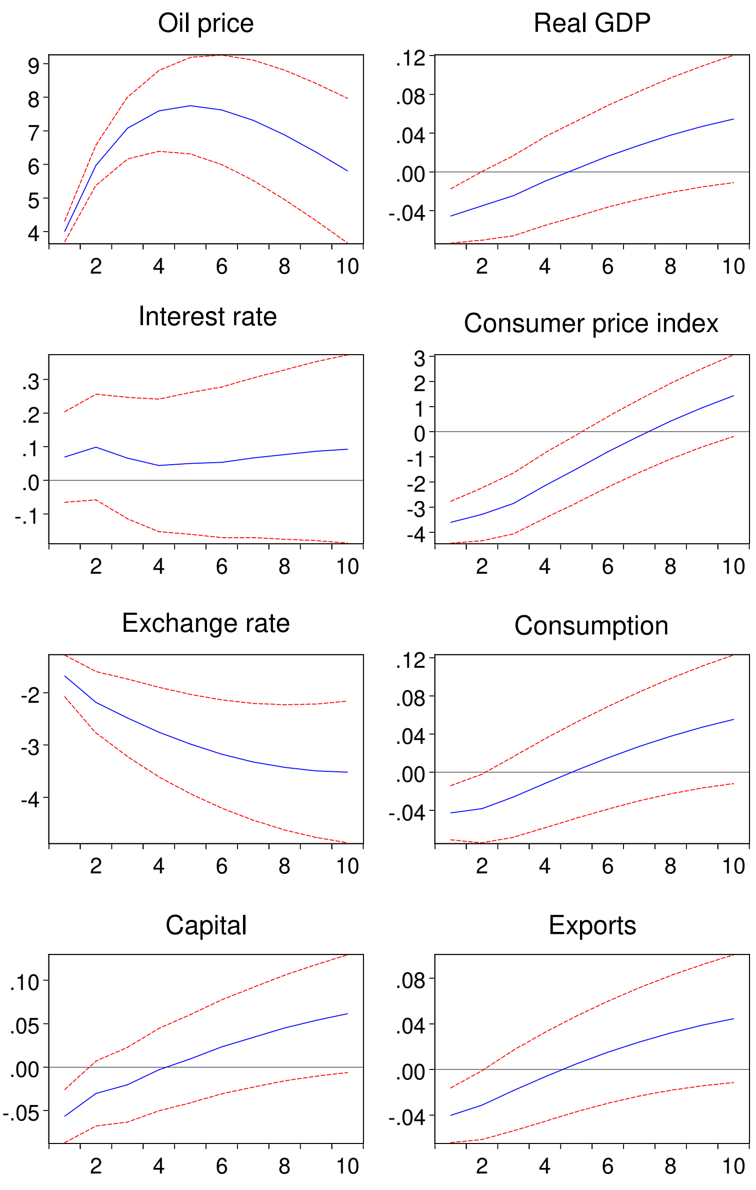
5. Empirical results

We assess the dynamics of the oil price shocks based on the impulse responses estimated using a generalized VAR model (specification 1). The standard error for the innovations are ±2 and the red lines mark the upper and lower bounds at 95 percent confidence level. The innovations are ±2 and the red lines mark the upper and lower bounds at 95 percent confidence level. Further, as an complimentary assessment of analysis we derived Error

Variance Decompositions (EVDs) from Impulse Response Functions (IRFs) and they are represented in the Appendix.

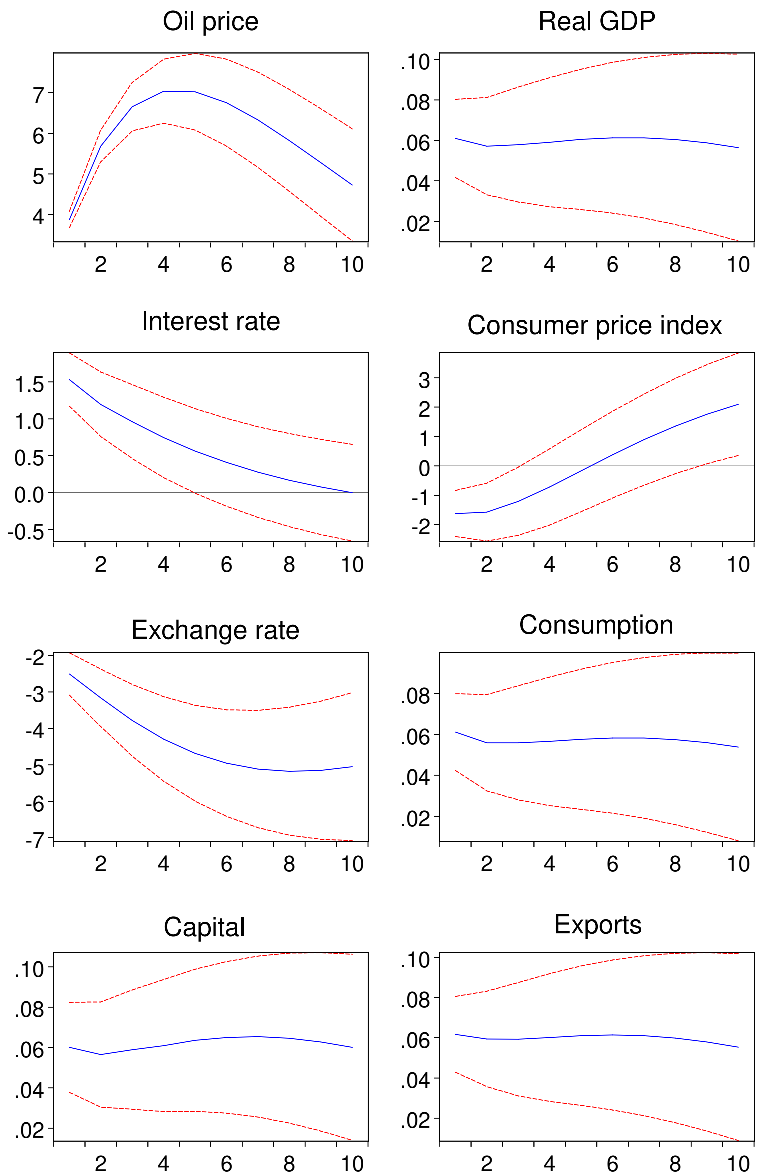
5.1. *Regions*

Figure 2: Response to oil price shocks with ±2 standard error: East Asia and the Pacific



First we represent our Results across the regions. EVDs by regions are presented in Appendix Appendix D.1. Figure 2 (presented in Appendix Table A4) shows that oil price shocks exhibit a positive impact on CPI and interest rates, while in the short run, real GDP is negative in East Asia and the Pacific. As oil prices push domestic price levels up, consump-

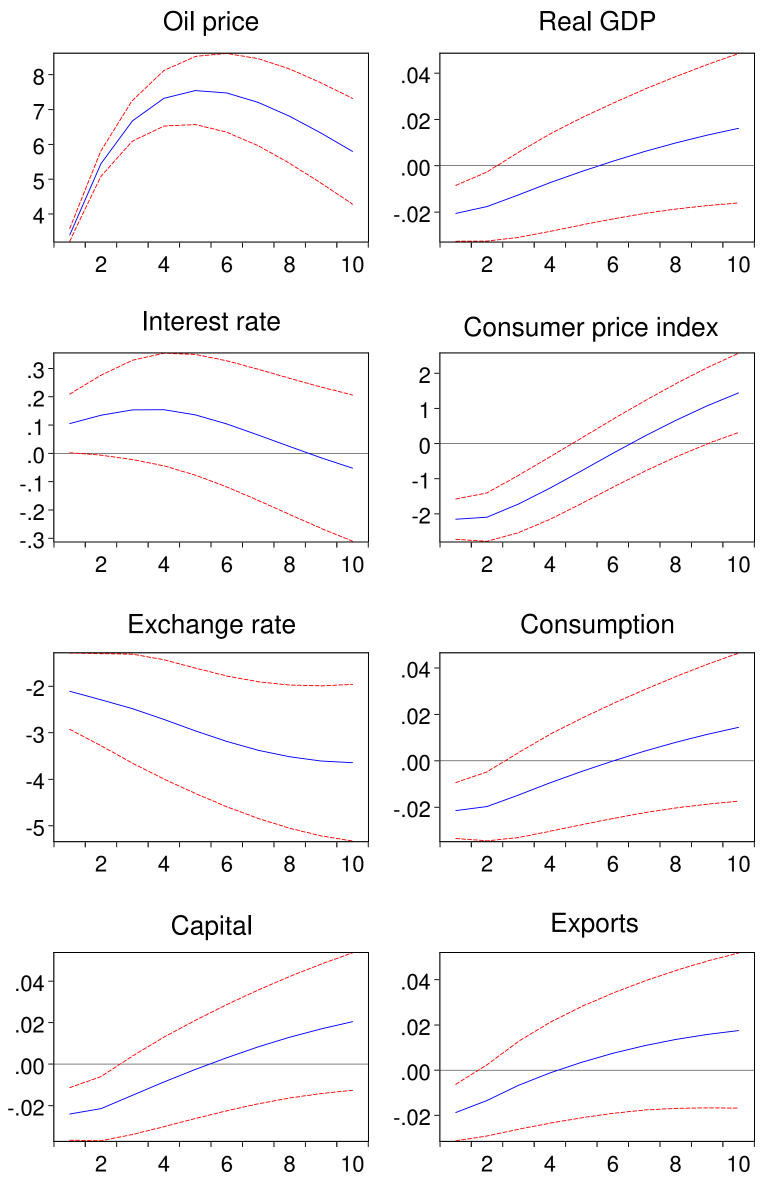
Figure 3: Response to oil price shocks with ±2 standard error: Europe and Central Asia



tion records a negative and significant response. Capital, exports, and the real exchange rate also display a substantial negative response. In Europe and Central Asia, monetary authorities maintain low CPI by raising interest rates to counter positive oil price shocks (Figure 3, Appendix Table A5). A positive and significant response of consumption, capital, and exports to oil price shocks is realized while the real exchange rate appreciates.

Comparatively, a positive oil price shock has a contractionary effect in East Asia and the Pacific while Europe and Central Asia experience a boom. Real exchange appreciation, due to oil price boom, result to a decline in aggregate exports in East Asia and the Pacific but

Figure 4: Response to oil price shocks with ±2 standard error: Latin America and the Caribbean



an increase in Europe and Central Asia. This implies that Europe and Central Asia is more oil-driven than East Asia and the Pacific. Therefore, policy-makers in East Asia and the Pacific should be concerned with real exchange appreciation following a positive oil shock to mitigate loss in non-oil export market. Latin America and the Caribbean economies are the least affected by oil price shocks where real GDP, consumption, capital, and exports fall in the short-run but increases steadily after period 3 (Figure 4, Appendix Table A6). Initial fall in capital in East Asia and the Pacific, and Latin America and the Caribbean is an indication of the adverse impact of oil price uncertainty on investment. The findings confirm the negative relationship between investment and oil prices as earlier reported by Elder and Serletis (2010), Tang et al. (2010) and Melek et al. (2018). However, the response of capital to oil prices in Europe and Central Asia does not support the inverse relationship between oil price shock and investment as reported by previous studies.

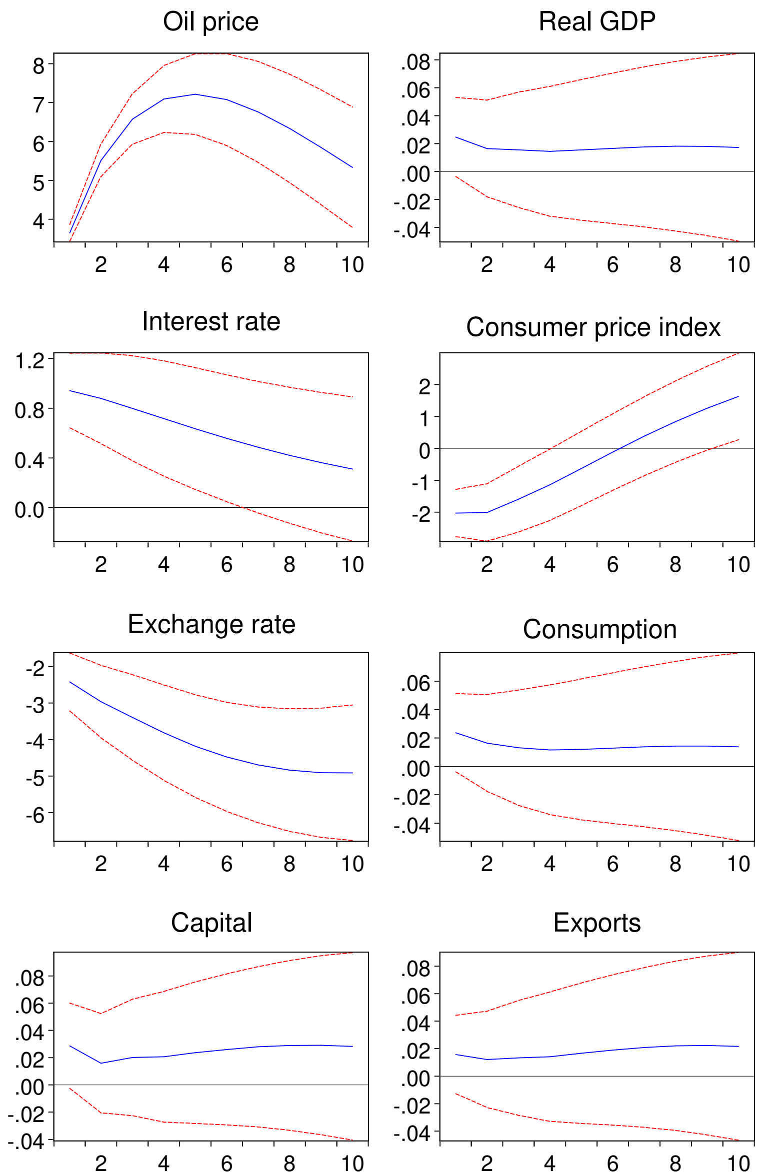
In the medium run (4 period), one standard deviation in oil prices can explain more than 3 percent of the variation in consumption and interest rates in Latin America and the Caribbean (Figure 4 and presented in Appendix Table A6). About 2 percent of interest rate movements in Europe and Central Asia can be explained by oil price shocks in the short run. In contrast, in the medium run, oil price shocks can account for 1 percent for capital, 2 percent for real GDP , and more than 4 percent for interest rates (Figure 3, Appendix Table A5). Further, EVDs (presented in Appendix Table A4) in Figure 2 shows that in East Asia and the Pacific oil price shocks can account for about 2 percent of the variation in real GDP and consumption and in the medium run they can account for 4 and 10 percent of the variation in consumption and real GDP, respectively.

5.2. Resource endowment

While Behmiri and Manso (2013) analyze and report differences in the causality effect of oil consumption and real GDP in oil-exporting compared to oil-importing regions, our study establish significant variations in regional responses to oil price shocks. Our finding thus raise another question as to whether the observed variations is likely due to other underlying factors such as resources endowment. To investigate this possibility, we categorize the sample economies according to their resource endowment as mineral exporters, oil exporters, and less-resource endowed economies. In the following subsection we present our results across the different resource endowed counties.

Real exchange appreciates in all the resource categories implying the dominant effect of other domestic macro economic factors on exchange rate over oil price shocks. In mineral-endowed economies, as shown in Figure 5 and presented in Appendix Table A7, macro variables except CPI have a positive and statistically significant response to oil price shock. For the policy makers, it is evident that oil importers that are mineral-endowed economies are cushioned by mineral exports. To tame the inflationary effect of oil prices, monetary authorities in resource-endowed economies maintain high interest rates. For the oil-exporting economies, it is shown in Figure 6 that CPI is low and monetary authorities maintain low

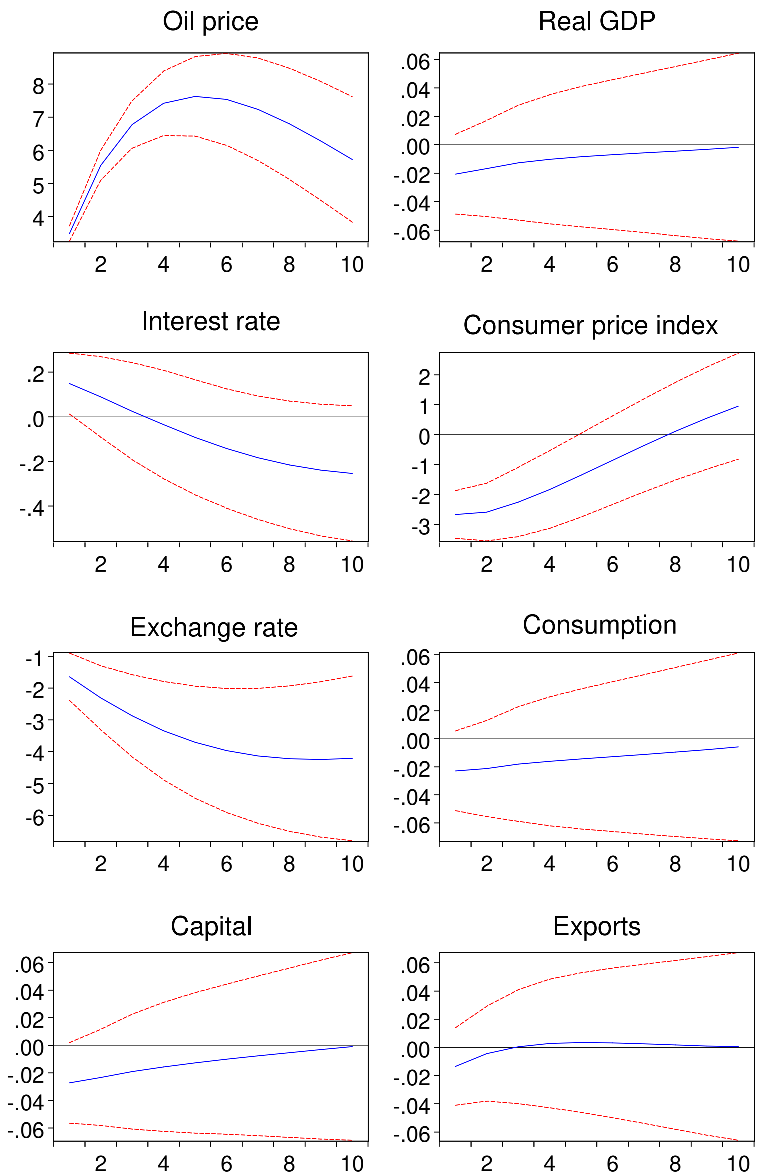
Figure 5: Response to oil price shocks with ±2 standard error: Mineral-endowed



interest rates. The observed dynamic response of monetary authorities to the inflationary effect of oil price shock is consistent with Nazlioglu et al. (2019), Blanchard and Gali (2007) and Hamilton and Herrera (2004). Surprisingly, CPI is negative in less resource-intensive economies (Figure 7, Appendix Table A9). This contradicts Cunado and De Gracia (2005) because an increase in oil prices is expected to raise production cost and domestic prices for the oil importers.

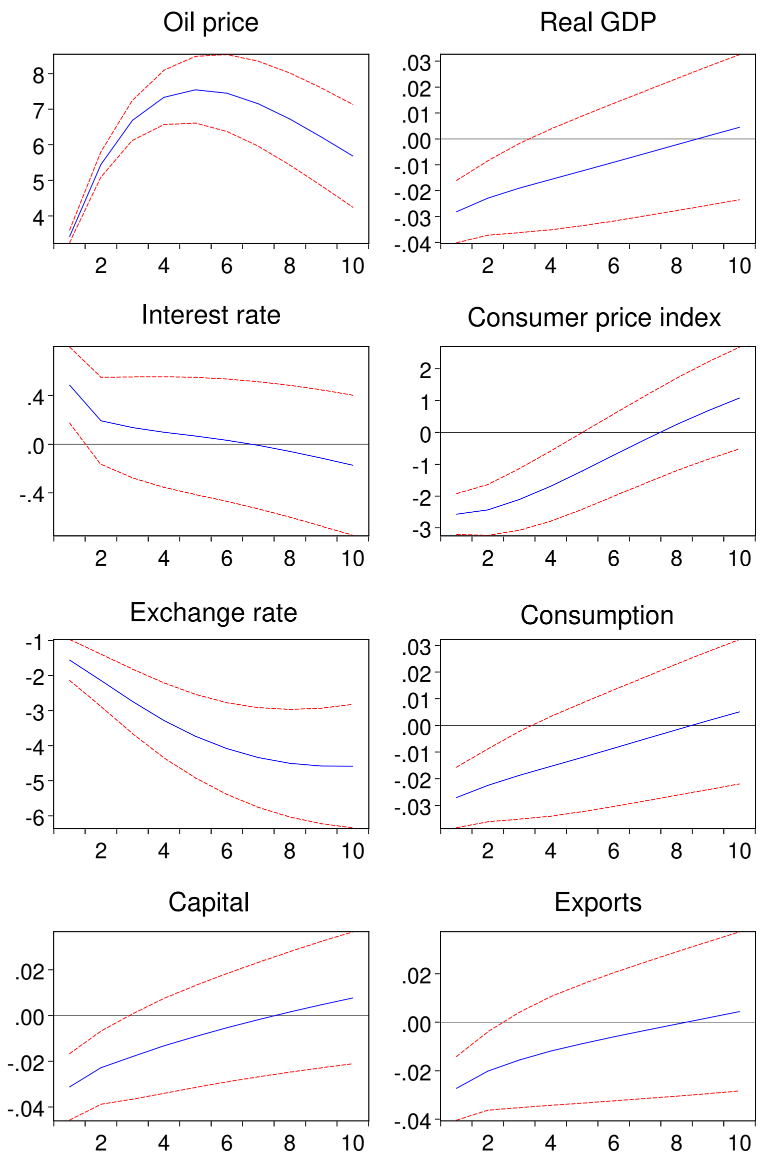
We also establish in Figure 7 and 6 initial adverse effect of oil price shock on capital, consumption and exports in oil-exporting and less-resource intensive economies result to

Figure 6: Response to oil price shocks with ±2 standard error: Oil-exporting



a fall in real GDP up to the fourth period. Results presented by other studies examining the impact of oil price shock on investment (Valenti et al., 2020; Kocaarslan and Soytas, 2019; Ferderer, 1996), real GDP (Gershon et al., 2019; Jiménez-Rodríguez and Sánchez, 2005), and trade balance (Arellano, 2008) validates our findings. A likely difference in the behavior of policy makers is observed through low interest rates by oil-exporting and less-resource intensive economies as an intervention to cause real exchange depreciation that can increase the competitiveness of domestic exports. Overall, adjustment in the macro economic variables coincide with the results previously reported by Jibril et al. (2020) that

Figure 7: Response to oil price shocks with ±2 standard error: Less-resource-endowed



demand-side shocks benefit oil exporters and exacerbate global imbalances while supply-side shocks benefit oil importers when prices fall. It has also come out throughout the analysis that macroeconomic fundamentals have a counter impact in response to oil price shocks. The counter impact determines the net effect of the shock as Kilian and Park (2009), Holm-Hadulla and Hubrich (2017) and Kilian and Zhou (2019) also reported.

The EVDs in Figure 6 and presented in Appendix Table A8 indicate that oil price shocks have a marginal impact on consumption in the short run in oil-exporting economies. However, in mineral-exporting and less-resource-intensive economies one standard deviation in oil prices can explain about a 2-percent variation in consumption in the short run. In the medium run, oil price shocks can account for about 5 percent of the movement in interest rates in mineral-exporting countries and more than 2 percent of the variation in real GDP in oil- and mineral-exporting economies (shown in Figure 5, Appendix Table A7).

6. Conclusion

We analyze the economic impact of oil price shocks and find that dynamic responses of macroeconomic variables in emerging economies to external shocks vary across regions and by resources endowment. A positive oil price shock has a contractionary effect in East Asia and the Pacific while Europe and Central Asia experience a boom. Real exchange appreciation due to oil price shock results in a decline in aggregate exports in East Asia and the Pacific but an increase in Europe and Central Asia. This implies that Europe and Central Asia are more oil-driven than East Asia and the Pacific. Therefore, policy-makers in East Asia and the Pacific should be seriously concerned with real exchange appreciation following a positive oil shock to mitigate loss in non-oil export market. Suitable foreign exchange arrangement(s) might be of help.

Analysis by resource-endowment further reveals that in mineral-exporting and less-resource-intensive economies, oil prices can explain large variation in consumption in the short run. In the medium run, real GDP and interest rates are largely driven by oil price shocks in mineral-exporting countries while only real GDP exhibits substantial oil price shock-driven response in oil exporting economies. However, in mineral-intensive economies, real GDP has a negative and short-lived response to oil price shocks while a negative and persistent response is experienced in less-resource-intensive economies. This is an indication that mineral exports cushion oil-importing economies from oil price shocks. Policy makers in mineral-intensive economies should not misuse the short-lived response, though, as a cushioning effect might quickly vanish during the periods of distress. Recent years can serve as an example. Persistent response experienced in less-resource-intensive economies should serve as an imperative for policy makers to economically diversify and aim at increasing resource efficiency.

The findings of this study contribute to the literature by showing that external shocks grown out of the oil prices fluctuations do affect regions differently. The response of macroeconomic variables to external shocks also differs for countries by resource classification. These findings give an insight for future research to examine what are the specific regional differentials and how they impact the transmission of oil price shocks. For policy making, our findings underscore the need to customize policy responses to oil price shocks depending on resource-endowments as a ”uniform-policy cannot fit all” economies.

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Appendix

Appendix A. Countries used in the analysis

Table A1: List by region, resource profile, and interest rate

Country name	Region	Resource profile	Type of interest rate available
Thailand	East Asia and Pacific	none	Treasury bill rates
Malaysia	East Asia and Pacific	none	Treasury bill rates
Brunei Darussalam	East Asia and Pacific	oil	Deposit rate
Philippines	East Asia and Pacific	none	Deposit rate
Mongolia	East Asia and Pacific	minerals	Deposit rate
Indonesia	East Asia and Pacific	oil	Deposit rate
Turkey	Europe and Central Asia	none	Monetary policy related
Georgia	Europe and Central Asia	minerals	Deposit rate
Kazakhstan	Europe and Central Asia	minerals	Treasury bill rates
Romania	Europe and Central Asia	none	Monetary policy related
Albania	Europe and Central Asia	minerals	Treasury bill rates
Russian Federation	Europe and Central Asia	oil	Monetary policy related
Armenia	Europe and Central Asia	minerals	Treasury bill rates
Azerbaijan	Europe and Central Asia	oil	Treasury bill rates
Poland	Europe and Central Asia	none	Treasury bill rates
Ukraine	Europe and Central Asia	none	Deposit rate
Hungary	Europe and Central Asia	none	Treasury bill rates
Bosnia and Herzegovina	Europe and Central Asia	minerals	Deposit rate
Bolivia	Latin America and Caribbean	minerals	Treasury bill rates
Brazil	Latin America and Caribbean	minerals	Treasury bill rates
Colombia	Latin America and Caribbean	oil	Monetary policy related
Chile	Latin America and Caribbean	minerals	Monetary policy related
Paraguay	Latin America and Caribbean	oil	Deposit rate
Costa Rica	Latin America and Caribbean	none	Deposit rate
Guatemala	Latin America and Caribbean	none	Deposit rate
Ecuador	Latin America and Caribbean	oil	Savings rate
Peru	Latin America and Caribbean	minerals	Deposit rate
Mexico	Latin America and Caribbean	oil	Treasury bill rates

Appendix B. Unit Root Test

Table A2: Unit root tests

Variable	Test	t-calculated	t-critical		Decision
			5%	10%	
Real GDP	ADF	-0.64	-1.95	-1.62	Do not reject
	KPSS	0.77	0.15	0.12	Reject
Interest rate	ADF	-5.97	-1.95	-1.62	Reject
	KPSS	0.15	0.15	0.12	Reject
CPI	ADF	-1.36	-1.95	-1.62	Do not reject
	KPSS	0.05	0.15	0.12	Reject
Real exchange rate	ADF	-0.81	-1.95	-1.62	Do not reject
	KPSS	0.14	0.15	0.12	Reject
Consumption	ADF	-0.67	-1.95	-1.62	Do not reject
	KPSS	0.74	0.15	0.12	Reject
Capital	ADF	-0.79	-1.95	-1.62	Do not reject
	KPSS	0.76	0.15	0.12	Reject

ADF denotes Augmented Dickey-Fuller (with no drift and trend) and KPSS denotes Kwiatkowski-Phillips-Schmidt-Shin.

ADF H_0 : *Data series contain unit root*

$KPSS\ H_0$: *Data series has no unit root*

$Note:\ Reject\ H_0\ if\ t-calculated\ >\ t-critical$

Appendix C. Omitted variable bias test

Table A3: Regression analysis (Dependent variable: Output)

	(1)	(2)	(3)	(4)	(5)
Interest rate	-0.066*	-0.059*	-0.001	-0.000	0.003*
	(0.0107)	(0.0102)	(0.000723)	(0.000428)	(0.000464)
Inflation	-0.003	0.000	-0.000	0.000	-0.001
	(0.0358)	(0.0250)	(0.00306)	(0.00210)	(0.00222)
Log(Oil price)	0.039**	0.003	0.004	0.002	-0.004*
	(0.109)	(0.180)	(0.0158)	(0.0172)	(0.0129)
Real exchange		-0.065	-0.001	-0.000	-0.006
		(0.00418)	(0.000303)	(0.000390)	(0.000381)
Log(Consumption)			1.013***	0.802***	0.631***
			(0.0123)	(0.0219)	(0.0344)
Log(Capital)				0.202***	0.174***
				(0.0195)	(0.0277)
Log(Exports)					0.212***
					(0.0455)
N	1756	1756	1756	1756	1756

Note: Standardized beta coefficients are reported; Standard errors in parentheses; $*p < 0.05, **p < 0.01, ***p < 0.001$

Appendix D. Forecast Error Variance Decomposition

Appendix D.1. Analysis by regions

Table A4: East Asia and Pacific

Period	Oil price	Real GDP	Interest rate	CPI	Exchange rate	Consumption	Capital	Exports
1	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	97.29	0.57	0.79	1.11	0.03	0.05	0.05	0.11
3	95.90	0.85	1.17	1.75	0.07	0.10	0.05	0.11
4	95.18	0.95	1.43	1.91	0.08	0.26	0.03	0.17
5	95.00	0.92	1.52	1.82	0.07	0.42	0.03	0.22
6	94.96	0.84	1.55	1.64	0.05	0.62	0.05	0.28
7	94.98	0.76	1.54	1.44	0.05	0.81	0.08	0.35
8	94.99	0.67	1.50	1.27	0.05	0.99	0.11	0.41
9	94.96	0.61	1.46	1.15	0.06	1.14	0.14	0.47
10	94.88	0.57	1.42	1.08	0.08	1.28	0.17	0.53

Table A5: Europe and Central Asia

Period	Oil price	Real GDP	Interest rate	CPI	Exchange rate	Consumption	Capital	Exports
1	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	96.28	0.34	2.23	0.47	0.01	0.30	0.25	0.11
3	93.22	0.68	4.21	0.60	0.12	0.55	0.41	0.21
4	90.90	0.93	5.70	0.55	0.29	0.75	0.58	0.29
5	89.09	1.14	6.83	0.45	0.49	0.90	0.74	0.37
6	87.58	1.31	7.69	0.36	0.71	1.02	0.89	0.44
7	86.25	1.48	8.36	0.32	0.94	1.12	1.02	0.50
8	85.03	1.63	8.87	0.37	1.19	1.20	1.15	0.56
9	83.85	1.77	9.25	0.53	1.44	1.26	1.27	0.62
10	82.68	1.91	9.53	0.81	1.70	1.31	1.38	0.67

Table A6: Latin America and the Carribean

Period	Oil price	Real GDP	Interest rate	CPI	Exchange rate	Consumption	Capital	Exports
1	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	97.89	0.41	1.18	0.23	0.11	0.01	0.07	0.10
3	96.23	0.64	2.43	0.24	0.20	0.01	0.09	0.17
4	95.12	0.74	3.38	0.17	0.26	0.01	0.09	0.23
5	94.35	0.77	4.06	0.12	0.31	0.01	0.08	0.30
6	93.78	0.77	4.54	0.12	0.36	0.01	0.08	0.36
7	93.34	0.74	4.87	0.18	0.39	0.01	0.07	0.40
8	92.96	0.71	5.09	0.29	0.44	0.01	0.07	0.44
9	92.62	0.67	5.24	0.45	0.48	0.02	0.07	0.46
10	92.29	0.64	5.32	0.65	0.53	0.02	0.06	0.48

Appendix D.2. Analysis by resources

Table A7: Mineral-Exporting Countries

Period	Oil price	Real GDP	Interest rate	CPI	Exchange rate	Consumption	Capital	Exports
1	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	96.46	0.04	2.47	0.80	0.05	0.10	0.07	0.01
3	93.89	0.07	4.60	1.02	0.06	0.29	0.06	0.02
4	92.30	0.09	6.07	0.92	0.04	0.50	0.06	0.03
5	91.25	0.10	7.10	0.74	0.03	0.71	0.05	0.03
6	90.49	0.11	7.81	0.58	0.04	0.90	0.05	0.03
7	89.87	0.13	8.30	0.50	0.06	1.07	0.04	0.03
8	89.31	0.14	8.64	0.53	0.11	1.21	0.04	0.03
9	88.78	0.15	8.86	0.65	0.17	1.33	0.03	0.03
10	88.25	0.16	8.99	0.87	0.25	1.42	0.03	0.03

Table A8: Oil-Exporting Countries

Period	Oil price	Real GDP	Interest rate	CPI	Exchange rate	Consumption	Capital	Exports
1	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	98.07	0.04	1.14	0.59	0.00	0.00	0.14	0.02
3	96.67	0.04	2.34	0.70	0.01	0.00	0.23	0.02
4	95.71	0.02	3.28	0.62	0.05	0.00	0.30	0.02
5	94.98	0.02	4.02	0.48	0.11	0.00	0.36	0.02
6	94.38	0.03	4.58	0.38	0.19	0.00	0.41	0.03
7	93.83	0.05	5.02	0.33	0.28	0.00	0.45	0.04
8	93.30	0.08	5.35	0.35	0.38	0.00	0.48	0.05
9	92.78	0.12	5.60	0.45	0.47	0.00	0.49	0.08
10	92.25	0.17	5.78	0.63	0.57	0.00	0.50	0.10

Table A9: Less-Resource-Intensive Countries

Period	Oil price	Real GDP	Interest rate	CPI	Exchange rate	Consumption	Capital	Exports
1	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	97.91	0.68	0.26	0.82	0.00	0.07	0.02	0.23
3	96.82	0.96	0.50	1.30	0.01	0.09	0.05	0.26
4	96.31	1.04	0.66	1.52	0.06	0.08	0.08	0.25
5	96.08	1.02	0.77	1.57	0.14	0.07	0.11	0.23
6	95.99	0.95	0.85	1.52	0.28	0.07	0.15	0.21
7	95.94	0.86	0.91	1.41	0.45	0.06	0.19	0.19
8	95.87	0.77	0.96	1.28	0.67	0.05	0.22	0.17
9	95.74	0.69	1.01	1.16	0.93	0.05	0.26	0.16
10	95.53	0.64	1.05	1.07	1.22	0.05	0.30	0.15

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