TESTING MONETARY POLICY TRILEMMA FOR MIDDLE EASTERN ECONOMIES
UNDER A BAYESIAN PANEL VAR SPECIFICATION

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ABSTRACT

Purpose: This research aims to investigate the presence of monetary policy trilemma in the Middle Eastern region and evaluate the spillover effects of US monetary policy on the region.

Theoretical framework: Middle Eastern economies follow the dollar pegged exchange rate policy with open capital account and this poses a question about the autonomy of the monetary policy stance adopted by the regional central banks. In this context, current research considers variables such as domestic interbank interest rate, domestic liquidity, oil price and federal fund rate to test the monetary policy trilemma in the region.

Design/methodology/approach: To investigate the presence of monetary policy trilemma in the Middle Eastern region, this research employs the time-varying Bayesian panel vector autoregression approach and selects a panel of five Middle Eastern countries which include Saudi Arabia, United Arab Emirates, Qatar, Oman and Kuwait while considering the monthly data for the sample period 2009m10 until 2021m12.

Findings: This research finds that a positive shock in US federal fund rate increases the domestic interest rates in the Middle Eastern economies. In addition, this research finds a negative relationship between oil price shocks and domestic interest rates. Whereas a positive shock in US federal fund rates induces a reduction in the oil price.

Research, Practical & Social implications: Current research provides insights for policy makers to determine the autonomy of domestic monetary policy stance to achieve its broader macroeconomic objectives.

Originality/value: This research is unique as it examines the monetary policy trilemma while considering oil price as a control variable in the system under a time-varying Bayesian panel vector autoregression specification.

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TESTE DO TRILEMA DA POLÍTICA MONETÁRIA PARA ECONOMIAS DO ORIENTE MÉDIO SOB UMA ESPECIFICAÇÃO BAYESIANA DE PAINEL VAR

RESUMO

Objetivo: Esta pesquisa tem como objetivo investigar a presença do trilema da política monetária na região do Oriente Médio e avaliar os efeitos indiretos da política monetária dos EUA na região.

Estrutura teórica: As economias do Oriente Médio seguem a política de taxa de câmbio atrelada ao dólar com conta de capital aberta, o que coloca uma questão sobre a autonomia da postura da política monetária adotada pelos bancos centrais regionais. Nesse contexto, a presente pesquisa considera variáveis como a taxa de juros interbancária doméstica, a liquidez doméstica, o preço do petróleo e a taxa de fundos federais para testar o trilema da política monetária na região.

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Testing Monetary Policy Trilemma for Middle Eastern Economies Under a Bayesian Panel VAR Specification

Projeto/metodologia/abordagem: Para investigar a presença do trilema da política monetária na região do Oriente Médio, esta pesquisa emprega a abordagem de autorregressão vetorial de painel bayesiano variável no tempo e seleciona um painel de cinco países do Oriente Médio, que inclui Arábia Saudita, Emirados Árabes Unidos, Catar, Omã e Kuwait, considerando os dados mensais para o período da amostra de 2009m10 a 2021m12.

Conclusões: Esta pesquisa conclui que um choque positivo na taxa de fundos federais dos EUA aumenta as taxas de juros domésticas nas economias do Oriente Médio. Além disso, esta pesquisa encontrou uma relação negativa entre os choques no preço do petróleo e as taxas de juros domésticas. Por outro lado, um choque positivo nas taxas de fundos federais dos EUA induz a uma redução no preço do petróleo.

Implicações sociais, práticas e de pesquisa: A pesquisa atual fornece insights para que os formuladores de políticas determinem a autonomia da postura da política monetária doméstica para atingir seus objetivos macroeconômicos mais amplos.

Originalidade/valor: Esta pesquisa é única, pois examina o trilema da política monetária ao considerar o preço do petróleo como uma variável de controle no sistema sob uma especificação de autorregressão vetorial de painel bayesiano variável no tempo.


COMPROBACIÓN DEL TRILEMA DE LA POLÍTICA MONETARIA EN LAS ECONOMÍAS DE ORIENTE MÉDIO CON UNA ESPECIFICACIÓN BAYESIANA DE PANEL VAR

RESUMEN

Objetivo: Este estudio pretende investigar la presencia del trilema de la política monetaria en la región de Oriente Medio y evaluar los efectos indirectos de la política monetaria estadounidense en la región.

Marco teórico: Las economías de Oriente Medio siguen la política de tipo de cambio vinculado al dólar con cuenta de capital abierta, lo que plantea un interrogante sobre la autonomía de la orientación de la política monetaria adoptada por los bancos centrales regionales. En este contexto, la presente investigación considera variables como el tipo de interés interbancario nacional, la liquidez nacional, el precio del petróleo y el tipo de los fondos federales para poner a prueba el trilema de la política monetaria en la región.

Diseño/metodología/enfoque: Para investigar la presencia del trilema de la política monetaria en la región de Oriente Medio, esta investigación emplea el enfoque Bayesiano de autorregresión vectorial de panel variable en el tiempo y selecciona un panel de cinco países de Oriente Medio, que incluye Arabia Saudí, EAU, Qatar, Omán y Kuwait, considerando datos mensuales para el periodo de muestra de 2009m10 a 2021m12.

Conclusiones: Esta investigación concluye que una perturbación positiva del tipo de los fondos federales de EE.UU. aumenta los tipos de interés nacionales en las economías de Oriente Medio. Además, esta investigación encontró una relación negativa entre los shocks del precio del petróleo y los tipos de interés domésticos. Por otra parte, una perturbación positiva de los tipos de los fondos federales estadounidenses induce una reducción de los precios del petróleo.

Repercusiones sociales, prácticas y para la investigación: La presente investigación aporta ideas a los responsables políticos para determinar la autonomía de la orientación de la política monetaria nacional a fin de alcanzar sus objetivos macroeconómicos más amplios.

Originalidad/valor: Esta investigación es única en el sentido de que examina el trilema de la política monetaria considerando el precio del petróleo como variable de control en el sistema bajo una especificación Bayesiana de autoregresión vectorial de panel variable en el tiempo.

Palabras clave: Política Monetaria, Trilema, Precios del Petróleo, Oriente Medio, Estados Unidos.

INTRODUCTION

Countries in the Middle East are more sensitive to any change in the US monetary policy as these economies have pegged their currencies to the US dollar. However, these economies are trapped in ‘monetary policy trilemma’ with open capital account and pegged exchange rate regimes. The spillover of any change in the stance of US monetary policy affects the policies of regional central banks in Middle East. The conventional Mundell- Fleming trilemma also
known as the impossible or inconsistent trinity implies that a country cannot simultaneously maintain capital mobility, fixed exchange rate and an independent monetary policy (Froyen & Guender, 2022). For instance, if a country having fixed exchange rate and perfect capital mobility, adopts a contractionary monetary policy to reduce inflation, this will result into higher capital inflows and demand for domestic currency will increase which in turn compels the central bank to sell domestic currency for maintaining the stable exchange rate. Therefore, if a country follows the fixed exchange rate regime with an independent monetary policy, then it can’t allow capital mobility across borders. Whereas if country allows capital mobility with fixed exchange rate then it needs to compromise on monetary autonomy. And finally, if country wants to have independent monetary policy with capital mobility, then it should adopt a flexible exchange rate regime. This historic Mundell’s and Fleming’s analysis is based on the Keynesian model of simple open economy with a single interest bearing asset category.

The Middle Eastern economies are classic case as they keep a pegged exchange rate regime with cross border capital flows and consequently any change in US monetary policy stance transmits to regional monetary policy stance in Middle East. Earlier studies find that an increase of 150 basis points in federal fund rate reduced the non-oil economic activity in Middle Eastern countries by 1.5 % with a time lag of 2 years (Prasad and Khamis, 2011). In this context, current research aims to examine the spillover effects of US monetary policy to the domestic monetary policy of selected Middle Eastern countries while using time varying Bayesian panel vector autoregression model. This paper is unique as it relates the size of US monetary policy spillover with oil price level as changes in oil prices are the key factor to influence the international transmission of US monetary policy. In addition, changes in oil prices can significantly alter the growth effect of monetary policy in these oil-based economies, especially role of monetary policy is constrained in the higher oil price regime with added liquidity in the economy. Therefore, this research adds to existing literature through the specification of Bayesian panel VAR model while specifying oil price as among other variables in the transmission channel for the selected sample of Middle Eastern countries. Whereas we select US real interest rate as a stance measure of US monetary policy. Earlier Olumuyiwa et al. (2019) analyse the spillovers of US monetary policy on GCC countries through its transmission in the regional output growth. However, current research analyses the impact of the fluctuation in the US monetary policy on the regional monetary sector indicators such as market interest rate and domestic banking sector liquidity while incorporating oil price volatility in the model specification. In addition, this research adopts Bayesian panel vector autoregression to

determine the spillover effects, while considering oil prices through a panel regression approach.

This research finds that a positive shock in the Federal Fund rate induces a short-term positive shock in the domestic interest rates of Middle Eastern Economies which confirms the presence of monetary policy trilemma in the region. The estimated results also reveal the impact of oil price fluctuations on the monetary policy anchors of both US and Middle Eastern economies.

Middle Eastern countries are commonly known as oil-based economies as oil constitutes major part of fiscal revenues and foreign exchange earnings. Oil contributes around 62% of total regional exports (World Bank, 2021) and average contribution of oil revenues to GDP remained 23% from 1970 until 2019 (World Bank, 2021). In this context, fiscal policy mainly depends on oil price dynamics. Higher oil price volatility complicates the conduct of monetary policy in these oil-based economies as oil price induced fluctuations mainly disturb the liquidity position of the regional banking sector. Higher oil prices cause large fiscal and trade surplus and therefore increase in liquidity whereas lower oil prices reduce the liquidity in the banking system of domestic banking sector. Moreover, since the regional economies follow a US dollar-pegged exchange rate system, therefore these economies resort to align their monetary policy stance with the stance of US monetary policy. Consequently, domestic policy rates in these Middle Eastern economies follow the changes in Federal Fund rate in the USA.

Mainly, a central bank manages the liquidity position in the banking system with the purpose to align short term interest rates to its policy rate and constrains commercial banks actions which may deviate from policy objectives through limiting imbalances in the system. Nevertheless, banks maintain specific level of liquidity for payment and precautionary purposes, however this extra provision of liquidity may translate into lower market interest rate with expanded credit. Whereas tight liquidity situation leads to higher lending rates which in turn reduce the credit expansion with a potential negative impact on economic growth. Henceforth, oil price led liquidity changes can obstruct monetary policy implantation and can lead an undesired divergence between lending rates and policy rates. For instance, an increase in liquidity because of higher oil prices enables banks to supply more loanable funds through interbank market and this in turns lowers the cost of funding for banks, causing lower lending rates for borrowers. These oil price led liquidity swings have constrained the pass through of policy rates to short term interbank lending rates in some of the Middle Eastern countries (IMF, 2017). In case of low oil prices and consequently lower liquidity, interbank rates may increase
more than policy rates and banks will charge higher lending rates, reducing demand for loans as well as economic growth. Nevertheless, monetary authorities in the region conduct open market operations and use other standing facilities to manage short term liquidity requirements whereas structural liquidity conditions are administered through long term government bonds, liquidity, reserve requirements and macroprudential instruments (Parsad and Khmis, 2011). However, these operations have limited impact on domestic interest rates due to the openness of capital accounts of the economies in the region and indigenous interest rates swiftly follow the patterns of US nominal interest rates. Moreover, in these economies interbank rates are considered as better indicators of monetary policy stance than policy rates because central banks mostly rely on direct instruments to conduct monetary policy. Though, fluctuations in interbank rates are difficult to be distinguished either caused by policy interventions or instigated by market dynamics (Bova, 2012). In Middle Eastern countries, as the currency pegging to US dollar restricts the autonomy of monetary policy, therefore these economies rely on prudential regulations, fiscal policy and other types of policy options to generate a balance between economic growth and price stability. Though this US dollar pegged exchange rate policy enabled the regional economies to keep inflationary expectations at lower levels.

Henceforth, current research aims to evaluates the autonomy of regional monetary policy through the examination of co movements between the interbank interest rates of Middle eastern economies and Federal Fund rate. In addition, this research assesses the structure of domestic banking sector and examines the degree of passthrough from policy rates to domestic lending and deposit rates. In this context, to determine the passthrough of US interest rates to Middle Eastern interest rates, this research considers monthly data of 3 months domestic banks rate for each country in the sample. Furthermore, empirical research suggests Federal Fund rate as a better indicator of monetary policy stance (Goodfriend 1993, Bernanke and Blinder 1992, Laurent 1988, and McCallum 1983). The rest of the paper is organized as follows: Section 2 elaborates the related literature, section 3 explains the data and methodology, section 4 discusses the empirical results and finally section 5 concludes and presents policy insights.

**LITERATURE REVIEW**

Earlier, there are many studies available to examine the transmission of US monetary policy shocks on different economies while considering the impact on domestic capital markets, output growth and changes in risk premium of domestic securities. However, there is dearth of literature to investigate the Mundell Fleming trilemma. Since in the presence of easy
international capital mobility and large volume of trade with pegged exchange rate, it is hard to ensure the autonomy of domestic monetary policy in oil exporting countries. This trilemma is based on the classic assumption of perfect capital market having capital mobility, no arbitrage income and global interest rate parity that ensure the same bond yield in the world. In case of fixed exchange rate and international mobility of capital, domestic monetary authorities maintain interest rates that can help to achieve domestic macroeconomic targets of price stability and economic growth. However, according to Mundell-Fleming approach a flexible exchange rate reduces the inflow of speculative capital and provides more independence to domestic central bank to employ interest rate policy for achieving its macroeconomic objectives (Rey, 2015). Therefore, most of the earlier literature related to Mundell Fleming trilemma focuses on analysing the domestic country’ interest rate behaviour with the core country rate across exchange rate regimes. For instance, studies such as Obstfeld et al. (2019), Klein and Shambaugh (2015), Goldberg (2013) and Obstfeld et al. (2005) suggest weak correlation between short term interest rates of domestic country and base country under floating exchange rate as compared to fixed exchange rate. Similarly, Kim (2001) evaluates the transmission of US monetary policy to non-US G6 countries and finds positive spillover effect on the output of these countries which emerged through world capital market. As monetary expansion in US reduces the world lower real interest rate which in turn enhances the world aggregate demand for goods and services for both US and non-US countries in the sample (Svensson & Wijnbergen, 1989; Obstfeld & Rogoff, 1995; Fahad & Abdurrazaq, 2022; Galoyan & Hovsepyan, 2023). The interest rate channel of international transmission is further confirmed by Takáts and Vela (2014) who suggest that any change in the monetary policy of developed countries causes a subsequent change in the monetary policy of emerging market economies under a flexible exchange rate. In addition, transmission of monetary policy is also influenced by the oil price shocks. Since any change in oil price affects the domestic consumer price indices as well as the wage rates. In this case, monetary authorities need to adopt some additional policy options to reduce inflation in the economy (Adjemian & Paries, 2008). An increase in oil price raises the domestic interest rate through inflation rate channel and a contractionary monetary policy is required to offset this effect (Cologni and Manera, 2008). In this context current research aims to examine the transmission of US monetary policy to oil exporting countries while incorporating oil price channel under a time varying vector autoregression specification. Earlier, Burakov (2017) investigates the Mundell Fleming trilemma, using oil price channel for Russia (an oil exporting country) while considering flexible exchange rate regime and employs
a linear specification of vector error correction model. This research finds little evidence of MF trilemma as a positive shock in US federal fund rate leads to lower oil price and that in turn increases the Russian policy rate. Whereas Olumuyiwa et al (2018) evaluate the spillovers of US monetary to Gulf Cooperation Council (GCC) countries monetary policy while using oil price as an additional factor. This research employs panel vector autoregression (fixed effect) specification and finds that oil prices can affect the liquidity position of domestic banking sector in GCC countries and therefore can alter the impact of US monetary policy on the non-oil output of GCC economies. Current research differentiates itself as it considers the transmission of changes in the US monetary policy stance’ spillover effects on the monetary policy stance of dollar pegged economies of Middle Eastern region. As Mundell- Fleming trilemma suggests the interdependence of monetary policy of fixed exchange rate regimes with free capital mobility, our research tests this hypothesis using Bayesian Panel vector autoregression model.

Bayesian methods are commonly used as the statistical tools for the probability-based quantification of uncertainty in inferences. Especially, the Bayesian vector autoregression (BVAR) approach is advantageous because of its flexibility and objectivity. BVAR approach is useful in resolving the issue of over-parametrization of VAR and non-stationarity of the data, thereby helping to attain more accurate forecasts (Banbura et al., 2010). The problems of random walk and unit root can be treated by Litterman/Minnesota prior type (Litterman (1980,1986), Doan et al. (1984), Sims (1992), and Sims and Zha (1998). A BVAR mode allows flexibility to include many variables without imposing any restrictions while simultaneously taking care of spurious correlations which leads to better forecasting performance.

Since oil prices and monetary environment both are characterized with volatility and uncertainty, therefore this research employs a Bayesian panel VAR specification. We use the hierarchical prior of Gelman et al. (2007) that considers the common mean and covariance of VAR coefficients as random variables with some prior distribution. Over the years, empirical research diverts its focus to Bayesian panel vector autoregression methods, such as Ballabriga et al(1999) employ this approach to examine the transmission shocks in macroeconomics; Gerlach and Smets (1996) analysed the propagation effects of monetary policy in the European area. Whereas some researchers such as Hoffmaister and Roldos (1997) and Rebucci (1998) employed Bayesian panel approach to evaluate the average differential response of underdeveloped and developed countries to domestic and external shocks. Despite the rising interest in the panel BVAR, the literature is still limited. Canova & Ciccarelli (2003) specify a flexible panel Bayesian VAR model to identify the turning points. This model captures the time
variation in the parameters and interdependencies in the cross section with posterior distribution obtained through hierarchical and for Minnesota-type priors. Wieladek (2016) uses a varying coefficient Bayesian panel VAR specification to analyse the impact of commodity price shocks on a set of macroeconomic variables for selected OECD countries. Christou et al (2017) analyse the impact of economic policy uncertainty (EPU) on the returns of stock markets of a panel of six countries while using a Bayesian panel VAR model through the process of stochastic search specification selection (SSSS). Whereas Urbina & Rodriguez (2020) examine the impact of corruption on economic growth and human development while using the Bayesian panel vector autoregression specification with hierarchical prior proposed by Gelman et al. (2003).

**METHODOLOGY**

**Data Description**

To evaluate the causal impact of US monetary policy stance on the monetary policy of Middle Eastern economies, this research considers a four variables Bayesian panel vector autoregression model which constitutes: a measure of the stance of US monetary policy such as Federal Fund rate, domestic interest rate of each selected country of Middle East, domestic liquidity for each Middle Eastern country and global crude oil prices.

This research selects five regional countries that include; Saudi Arabia, United Arab Emirates, Qatar, Oman and Kuwait while considering the monthly data for the sample period 2009m10 until 2021m12. All variables are seasonally adjusted and data for each variable is extracted from the database of international financial statistics (IFS).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
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<tbody>
<tr>
<td>Federal Fund Rate</td>
<td>The federal funds rate is the main interest rate in the U.S. monetary system and its target rate is decided by the Federal Open Market Committee (FOMC). This rate is used for interbank lending and borrowing for short term transactions. Source: International Financial Statistics -2021</td>
</tr>
<tr>
<td>Domestic Interest Rate</td>
<td>3 months domestic bank rate for each country in the sample. Source: International Financial Statistics -2021</td>
</tr>
<tr>
<td>Domestic Liquidity</td>
<td>Domestic liquidity is measured by the broader monetary aggregate - M2 for each country in the sample. Source: International Financial Statistics -2021</td>
</tr>
<tr>
<td>Oil prices</td>
<td>Brent crude oil price (annual average). Source: International Energy Agency – 2021</td>
</tr>
</tbody>
</table>

Source: Prepared by the authors (2023).
Model Specification

To examine the international transmission of US monetary policy to the fixed exchange rate regimes of Middle East, current research specifies a Bayesian panel vector autoregression (PVAR) model. This approach considers both time variation and heterogeneity in the cross-sectional dimensions. A Bayesian PVAR specification draws the inferences while assuming all covariates as endogenous in the system. Given that our research constitutes a relatively small samples panel, we employ Bayesian PVAR to resolve over parameterization issue.

Generally, a panel VAR model entails $N$ “units” that may indicate countries, firms, industries or economic sectors. Each unit contains $n$ endogenous variables, $T$ periods with $p$ lags. This research employs a balanced panel which implies that number of samples panel, we employ Bayesian PVAR to resolve over parameterization issue.

Usually, we specify a panel VAR for unit $i$ (with $i = 1, 2, \ldots, N$) as follows:

$$ y_{i,t} = \sum_{j=1}^{N} \sum_{k=1}^{p} A_{ij,t}^k y_{j,t-k} + C_{i,t} x_t + \varepsilon_{i,t} = A_{i1,t}^1 y_{1,t-k} + \cdots + A_{i1,t}^p y_{1,t-p} + A_{i1,t}^2 y_{2,t-1} + A_{i2,t}^p y_{2,t-p} + \cdots + A_{in,t}^1 y_{N,t-1} + A_{in,t}^p y_{N,t-p} + \cdots + C_{i,t} x_t + \varepsilon_{i,t} \quad (i) $$

Where,

$y_{i,t}$ shows an $n \times 1$ vector of $n$ endogenous variables of unit $i$ at time $t$ and $y_{ij,t}$ is the $j^{th}$ endogenous variables of unit $i$ whereas $A_{ij,t}^k$ is a $n \times n$ matrix of coefficients that indicate the response of unit $i$ to the $k^{th}$ lag of unit $j$ at period $t$. while $x_t$ is the $m \times 1$ vector of exogenous variables and $C_{i,t}$ is the $n \times m$ matrix relating the endogenous variables to these exogenous variables. Finally, $\varepsilon_{i,t}$ is a $n \times 1$ vector of residuals for the variables of unit $i$ with the properties; $\varepsilon_{i,t} \sim N(0, \Sigma_{i,t})$ with period specific variance - covariance matrix, indicating a general form of heteroskedacity.

We estimate a total of $k = Nnp + m$ coefficients in the dynamic equation at period $t$ for each variable in unit $i$, which implies that we estimate $q = n(Nnp+m)$ coefficients for the whole unit. Stacking over the $N$ units, we can write Equation(i) as:

$$ y_t = \sum_{k=1}^{p} A_{k,t}^k y_{t-k} + C_{i,t} x_t + \varepsilon_{i,t} = A_{1,t}^1 y_{1,t-1} + \cdots + A_{p,t}^p y_{t-p} + C_{i,t} x_t + \varepsilon_{i,t} \quad (ii) $$

Equation (ii) represents the most general form of the panel VAR specification and contains $h = Nq = Nn(Nnp + m)$ coefficients to estimate while the vector of residuals $\varepsilon_t$ is characterised as: $\varepsilon_{i,t} \sim N(0, \Sigma_{i,t})$. However, this general type of representation is complex in nature to generate accurate estimates and consumes more degrees of freedom. Therefore, if the sample units are homogenous in their characteristics and expected to have symmetrical responses
to structural economic shocks, in that case we can relax some assumptions such as cross sub-sectional heterogeneity.

Under the Bayesian VAR specification, model parameters are considered as random variables with some probability distribution (Litterman, 1979 and Doan et al., 1984). This approach includes some prior information about the model parameters and update the probability distributions conditional on the observed data. Since our research aims to investigate the average response of Middle Eastern monetary policy to a shock in US monetary policy and our panel units are mainly homogenous in their characteristics, therefore we employ the Bayesian panel VAR pooled estimator, indicating homogenous coefficients across the selected countries. In this case we relax the properties of general form of panel VAR such as dynamic interdependencies ($A_{ik,t}^k \neq 0$ when $I \neq j$), static interdependencies ($\Sigma_{ij,t} \neq 0$ when $i \neq j$), cross sub-sectional heterogeneity ($A_{ik,t}^j \neq A_{jk,t}^i, C_{i,t} \neq C_{j,t}$ and $\Sigma_{ii,t} \neq \Sigma_{jj,t}$ when $i \neq j$) and dynamic heterogeneity ($A_{ij,t}^k \neq A_{ij,s}^k$ when $t \neq s$).

To estimate our Bayesian panel VAR, we employ the standard normal-Wishart prior with default hyperparameter values. The normal-Wishart prior is considered better than Minnesota (Litterman) prior as it is based on the assumption that our panel VAR estimates, and residual covariance matrix are unknown whereas later approach assumes that the residual covariance matrix is known.

RESULTS AND DISCUSSION

To conduct the empirical analysis, firstly we employ the Pesaran’s (2007) cross-sectionally augmented IPS (CIPS) panel unit root test to examine the unit root properties and the order of integration for the selected data series (Table 2). These test statistics include both a constant and trend. The estimates of CIPS stats indicate that some of the series are stationary at level but all the selected series are stationary at first difference (Table 2). However, under Bayesian framework non stationarity is not a concern as the properties of posterior distribution remain same for both stationary and non-stationary models.

<table>
<thead>
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<th></th>
<th></th>
<th>Level</th>
<th>1ST Difference</th>
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<tbody>
<tr>
<td>FFR</td>
<td>CIPS -stat</td>
<td>-0.38399</td>
<td>3.59402</td>
</tr>
<tr>
<td></td>
<td>p-value</td>
<td>0.0435</td>
<td>0.0321</td>
</tr>
<tr>
<td>DR</td>
<td>CIPS -stat</td>
<td>2.47935</td>
<td>-9.04130</td>
</tr>
<tr>
<td></td>
<td>p-value</td>
<td>0.9934</td>
<td>0.000</td>
</tr>
<tr>
<td>LIQ</td>
<td>CIPS -stat</td>
<td>-10.0345</td>
<td>-18.3298</td>
</tr>
<tr>
<td></td>
<td>p-value</td>
<td>0.000</td>
<td>0.000</td>
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</table>
Bayesian Panel Multivariate Impulse Response Analysis

This section presents the impulse response functions generated through the estimation of the time varying coefficient Bayesian Panel VAR model. It examines the presence of monetary policy trilemma for Middle Eastern countries and focuses on how changes in US monetary policy anchor – the federal fund rate affects the domestic interest rates in the Middle Eastern countries. To recover the structural shocks through Cholesky factorization, we placed the fast-moving variables last whereas slow moving variables are arranged first i.e. \( X_{it} = [FFR, OIL, LIQ, DR] \). Under this specification, domestic interest rate (DR) and banking sector’s liquidity (LIQ) are most endogenous variables in the system and any change in the US monetary policy (FFR) affects the Middle Eastern interest rates (DR) by a time lag.

Figure 1 presents the estimated impulse response functions for each variable. The first row shows the response of domestic interest rates (DR) to one standard deviation shock in the other variables that include federal fund rate (FFR), oil price (OIL) and domestic banking sector liquidity (LIQ). This research considers average response during the first three months as short run and average response for 12 months and 13-30 months as medium and long term respectively. Figure 1 shows that a one standard deviation shock in federal fund rate reduces the domestic interest rate by 0.6% in the first quarter and in the long run a similar shock in FFR induces a positive trend in the domestic interest rate, though it remains in negative range. This trend can be rationalised as higher US interest rate will make Middle Eastern exports more competitive and a consequent increase in liquidity reduces interest rate in the Middle Eastern region. However, this trend lasts only for short duration as oil being a supply side input in the US market, faces a lower US demand induced by lower economic activity caused by higher interest rate. This argument can further be supported by the evidence as changes in US interest rate (FFR) reduces the oil price for short duration (Figure 1). Similarly, one standard deviation shock in the global oil price reduces the Middle Eastern domestic interest rate due to large availability of liquidity in the region. Furthermore, a positive shock in liquidity reduces the domestic interest rate in the short run, however in the long run the average response of domestic interest rate to a liquidity shock becomes positive. However, a one standard deviation shock in FFR reduces the global oil price in the short run and it remain negative over the long term to the similar type of shock in FFR.

<table>
<thead>
<tr>
<th>OIL</th>
<th>CIPS -stat</th>
<th>-6.52277</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>p-value</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Source: Authors’ Estimation
Figure 1. Bayesian Panel Multivariate Impulse Response Functions

Note: Shaded area represents 95 percent credibility intervals for the normal-Wishart prior
Source: Prepared by the authors (2023).

The estimates of impulse response functions are further augmented by the analysis of historical decomposition in Figure 2 which reveal that around 20% variation in the domestic interest rate is caused by federal fund rate over the sample period (Figure 2). Whereas global oil prices capture around 35% of the total variation in domestic interest rate of Middle Eastern countries. In addition, oil prices constitute around 30% of the total variation in the federal fund rate which can be characterised as the supply side transmission mechanism of oil price fluctuations to US monetary policy. Figure 2 also reflects a smaller percentage contribution of Middle Eastern interest rate fluctuation to US monetary policy as US being the major trade partner of this region.
Robustness Checks

Moreover, to ensure the robustness of our results, we also applied some additional empirical techniques such as a homogenous panel VAR through the GMM estimator. Since our model contains only few variables, therefore GMM approach is capable to obtain robust results without any additional restrictions. Figure 3 presents the orthogonalized impulse response functions (IRFs) are based on Cholesky factorization and generated through the estimation of GMM based panel vector autoregression with 95% confidence intervals. The ordering for Cholesky decomposition follows the endogeneity criteria which implies that those variables which are ordered first affect the other variables with a time lag. In this this case $X_{it} = [OILPR, FFR, LIQ, DR]'$ and it indicates the domestic interest rate (DR) as the most endogenous in the system. The first row in the Figure 3 shows a shock in the specific variable, such as a shock in domestic interest rate has significant impact on oil price. Overall, these GMM based IRFs reveal the identical results to Bayesian panel VAR. It also shows a negative and statistically significant impact of a shock in Federal Fund rate on oil price, indicating that tight US monetary policy raises the cost of production and consequently demand for oil decreases. However, this relationship is positive and statistically significant for the oil exporting countries, as a tight domestic monetary policy leads to less oil production, leading a hike in oil production.
To augment our findings from impulse response function analysis, this research further employs the Granger causality tests to determine the causal relationships between the selected variables. In this context, first we use the homogenous GMM PVAR model to conduct Granger causality test introduced by Abrigo and Love (2016). Table 3 presents the estimates and this test is based on the null hypothesis that variable X (Row variable) does not Granger cause variable Y (Column variable). The estimates reveal that domestic interest rate does Granger -cause the liquidity in the domestic banking sector and oil price changes. In addition, Table 3 shows the that the US Federal Fund rate causes a change in the domestic interest rate in the Middle Eastern region. It also reveals a causal relationship from the US Federal Fund rate to Oil price. Furthermore, the test estimates reveal the causality from domestic banking sector liquidity to domestic interest rate. Finally, it presents the causality for oil price to domestic interest rate, US Federal Fund rate and domestic banking sector liquidity. In addition, we further confirm this causality through another Granger causality test introduced by Dumistrescu and Hurlin (2012) for heterogenous panels (Table 4). This test calculates individual Wald statistics for each cross-section unit and then averaged it for all cross-section units to test for Granger non-causality. This test is advantageous as it can handle small sample size in terms of time and cross section units. These test estimates confirm the same type of causal relationships as suggested by the Granger causality test based on the approach by Abrigo and Love (2016).
Shaheen, R., Almaktoom, A. T. (2023)

Testing Monetary Policy Trilemma for Middle Eastern Economies Under a Bayesian Panel VAR Specification

Table 3: Granger Causality Test Results - Abrigo and Love (2016) Approach

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>DR</th>
<th>FFR</th>
<th>LIQ</th>
<th>OILPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR</td>
<td>$\chi^2$</td>
<td>1.832</td>
<td>3.251</td>
<td>4.864</td>
<td>3.387</td>
<td></td>
</tr>
<tr>
<td>p value</td>
<td>0.025**</td>
<td>0.003***</td>
<td>0.042**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FFR</td>
<td>$\chi^2$</td>
<td>7.435</td>
<td>0.350</td>
<td>1.912</td>
<td>-3.392</td>
<td></td>
</tr>
<tr>
<td>p value</td>
<td>0.00</td>
<td>0.148</td>
<td>0.038</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIQ</td>
<td>$\chi^2$</td>
<td>7.435</td>
<td>0.350</td>
<td>1.912</td>
<td>-3.392</td>
<td></td>
</tr>
<tr>
<td>p value</td>
<td>0.00</td>
<td>0.148</td>
<td>0.038</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OILPR</td>
<td>$\chi^2$</td>
<td>0.324</td>
<td>-4.568**</td>
<td>0.856</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p value</td>
<td>0.345</td>
<td>0.0245</td>
<td>0.447</td>
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<td></td>
</tr>
</tbody>
</table>

Note: ***, **, * indicate statistical significance at the 1%, 5% and 10% level respectively
Source: Prepared by the authors (2023).

Table 4: Granger causality test results - Dumistrescu and Hurlin (2012) Approach

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>DR</th>
<th>FFR</th>
<th>LIQ</th>
<th>OILPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR</td>
<td>$\bar{Z}$</td>
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<td>-2.918</td>
<td>3.521</td>
<td>5.782</td>
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<tr>
<td>p value</td>
<td>0.052**</td>
<td>0.000***</td>
<td>0.000***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FFR</td>
<td>$\bar{Z}$</td>
<td>5.324***</td>
<td>0.456</td>
<td>0.642</td>
<td>-3.495</td>
<td></td>
</tr>
<tr>
<td>p value</td>
<td>0.00</td>
<td>0.215</td>
<td>0.051**</td>
<td></td>
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<tr>
<td>LIQ</td>
<td>$\bar{Z}$</td>
<td>0.321</td>
<td>-4.671</td>
<td>0.436</td>
<td>0.341</td>
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<tr>
<td>p value</td>
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<td>0.502</td>
<td>0.651</td>
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<tr>
<td>OILPR</td>
<td>$\bar{Z}$</td>
<td>0.321</td>
<td>-4.671</td>
<td>0.436</td>
<td>0.341</td>
<td></td>
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<tr>
<td>p value</td>
<td>0.431</td>
<td>0.0281**</td>
<td>0.000***</td>
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<td></td>
</tr>
</tbody>
</table>

Note: ***, **, * indicate statistical significance at the 1%, 5% and 10% level respectively
Source: Prepared by the authors (2023).

Overall, our results reveal that domestic interest rates in the Middle Eastern countries are influenced by the changes in the stance of monetary policy – the Federal Fund rate. This in turn indicates presence of Mundell- Fleming trilemma which implies that monetary policies in the US dollar based fixed exchange rate regimes are persuaded by the fluctuations in the US monetary policy. This research also finds the impact of the changes in the global oil prices on the US monetary policy stance, reflecting higher oil prices lead to lower economic activity and consequently US follows the expansionary monetary policy. Similarly, an increase in US interest rate leads to lower domestic demand for oil in US and this follows a drop in global oil prices. Moreover, our estimates reveal that an increase in the global oil prices enhance the domestic liquidity in Middle Eastern countries, and subsequently lead to lower domestic interest rates.

CONCLUSION

Since Middle Eastern economies are characterised as dollar pegged exchange rate economies and monetary policy in the region is influenced by the changes in US monetary policy stance. Therefore, this research aims to evaluate the existence of monetary policy trilemma in the region while selecting a panel of five Middle Eastern countries under a non –
linear specification of Bayesian panel vector autoregression. The sample of selected countries constitutes, Saudi Arabia, United Arab Emirates, Oman, Qatar, and Kuwait. This research considers a vector of four variables which includes, Domestic interest rate, a measure of domestic liquidity such as M2, oil prices and federal fund rate, covering the monthly data for the period 2009m10 until 2021m12. To examine the unit root properties and order of integration for the selected variables, this research employs the Pesaran’s (2007) cross-sectionally augmented IPS (CIPS) panel unit root test and estimates reveal that some of the variables are not stationary at level. However, under Bayesian framework, non-stationarity is not a concern due to specific characteristics of posterior distribution. The impulse response functions generated through the estimation of the time varying coefficient Bayesian Panel VAR model suggest that a one standard deviation shock in US federal fund rate increases the discount rate in the long run due to its impact on capital mobility and consequent appreciation of dollar. In addition, a positive shock in US federal fund rate reduces the global oil prices as contractionary monetary policy induces a reduction in the economic activity. Furthermore, a positive shock in oil price reduces the domestic interest rates in the Middle Eastern countries. These findings are also validated through alternative GMM specification. Henceforth, this research provides an evidence of relatively weaker form of monetary policy trilemma and suggests that regional central banks should account this phenomena while formulating monetary policy for their countries.

REFERENCES


World Bank, 2021, World Bank Database