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The Role of Global Oil Prices in US Monetary Policy Spillovers to Small Open Economies: Evidence From MINT Countries

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We explore the importance of global oil prices in the spillovers of US monetary policy to four small open economies (SOEs): Mexico, Indonesia, Nigeria, and Turkey (MINT). Our findings indicate that oil prices amplify the spillover effects on MINT's real GDP. The negative impact is more pronounced when oil prices fall. This suggests that oil prices are a crucial determinant of US monetary policy spillovers.

I. Introduction

In this paper, we investigated the effect of global oil prices on the intricate link between US monetary policy spillovers and real economic growth in four small open economies (SOEs), *viz.* Mexico, Indonesia, Nigeria, and Turkey (MINT). While it is widely acknowledged that monetary policy has always had spillover effects and the effects intensified following the 2008 global financial crisis (GFC) and the great recession of 2010 (Aizenman et al., 2020; Danladi, 2022; Prasad & Khamis, 2011; Tillmann et al., 2019; Tumala et al., 2021), the role of global oil prices in shaping this relationship has been overlooked.

A number of reasons motivate this current study. First, oil serves as a crucial input in the production process and a major driver of inflationary pressures, particularly evident in recent years (Choi et al., 2018; Conflitti & Luciani, 2019). The dramatic surge in inflation rates across the globe, reaching 8.6% in the US in May 2022, with energy prices playing a pivotal role (Baba & Lee, 2022), underscores the importance of this study. Even though Kilian & Lewis (2011) found no compelling evidence that the FED responded "mechanically" to oil price shocks, the normative question of whether such responses are warranted will always be of interest, especially amid heightened volatility in global oil prices.

Second, the optimal monetary policy literature that attempts to answer the normative question of how monetary authorities should respond to oil price shocks often focuses on conventional interest rate policy rules and closed economies (Bodenstein et al., 2012), leaving gaps in understanding the implications for SOEs like the MINT countries, despite their rising level of integration into the global economy. Third, the optimistic projections and forecast of annual GDP growth exceeding 5% up to 2020 for the MINT countries by Ernst & Young and Goldman Sachs in 2012 and the recessionary experience of these countries thereafter underscore the importance of investigation into the factors shaping the economic trajectories of these economies.

Therefore, this study seeks to provide insight into the role of oil prices in the relationship between US monetary policy and MINT's real GDP. This study finds significant spillover effects of US monetary policy on the real GDP of MINT countries. The effect is consistently negative when the interaction between oil prices and US monetary policy spillover is considered. Furthermore, the analysis uncovers the amplification of the spillover effect during the period of falling oil prices.

The rest of the study is organized as follows: In Section II, we present the methodology and data used. In Section 3, we present the results. In Section IV, we present additional analysis. Section V concludes the paper.

II. Methodology and Data

A. The ARDL Model

Following the lead of Adedeji et al. (2019), we start with a baseline equation built on the assumption of the asymmetric response of real GDP to monetary policy shocks of the US and global prices of crude oil, which is specified as follows:

$$\begin{aligned}\ln RGDP_t = \beta_0 + \beta_1 \ln RGDP_{,t-1} + \beta_2 USSR_{t-1} \\ +\beta_3 \ln \text{ oilP } P_{t-1} + \sum_{j=1}^{N1} \lambda_j \Delta \ln RGDP_{t-j} \\ + \sum_{j=0}^{N2} \gamma_j \Delta USSR_{t-j} + \sum_{j=0}^{N3} \delta_j \Delta \ln \text{oilP}_{\text{t-j}} + \varepsilon_t\end{aligned} \tag{1}$$

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From the above equation, $\ln RGP_t$ denotes the logarithm of real gross domestic product for each country over the time period *t*; $USSR_t$ denotes the shock to US shadow rate over period t; $\ln oilP_t$ denotes the logarithm of oil prices benchmark at period *t*. Equation (1) represents a statistical model that includes the number of periods (t). Adding an error correction term, Equation (1) can be specified as follows:

$$\begin{aligned}\Delta \ln RGDP_t = \phi v_{t-1} + \sum_{j=1}^{N1} \lambda_j \Delta \ln RGDP_{t-j} \\ + \sum_{j=0}^{N2} \gamma_j \Delta USSR_{t-j} \\ + \sum_{j=0}^{N3} \delta_j \Delta \ln oilP_{t-j} + \varepsilon_t\end{aligned} \tag{2}$$

where ϕ represents the speed of adjustment for each country which is also equal to $v_{t-1} = \ln RGDP_{t-1} - \theta_0 - \theta_1 USSR_{t-1} - \theta_2 \ln oilP_{t-1}$ is the linear error correction term for each country. The parameters θ_0, θ_1, and θ_2 are computed as $-\frac{\beta_0}{\beta_1}$, $-\frac{\beta_2}{\beta_1}$, and $\frac{\beta_3}{\beta_1}$ respectively.

To achieve the set objective, we further allow the spillover of US monetary policy to depend on real oil prices. Besides Adedeji et al. (2019) and Di Giovanni & Shambaugh's (2008) studies, which consider how different exchange rate regimes affect the spillovers of United States' monetary policy that is comparable to our article in the literature. As far as we are aware, this study is the first to look at the effect oil prices on spillovers of monetary policy from the US to MINT countries. Thus, the extended versions of Equation (2), which includes the interaction of real GDP – US monetary policy spillover nexus with oil prices is expressed below as Equation (3):

$$\begin{aligned}\Delta \ln RGDP_t = \phi v_{t-1} + \sum_{j=1}^{N1} \lambda_j \Delta \ln RGDP_{t-j} \\ + \sum_{j=0}^{N2} \gamma_j \Delta USSR_{t-j} \\ + \sum_{j=0}^{N3} \omega_j \left(USSR_{t-j} \mathrm{X} \ln oilP_{t-j}\right) \\ + \sum_{j=0}^{N3} \delta_j \Delta \ln oilP_{t-j} + \varepsilon_t\end{aligned} \tag{3}$$

From Equation (1) through to Equation (3), there are no decompositions of both the US shadow rate and oil prices changes into negative and positive; hence, the assumption of symmetric impact of variables on real GDP under this scenario. The asymmetric version of Equation (2) is expressed below:

$$\begin{aligned}\Delta \ln RGDP_t = \phi v_{t-1} + \sum_{j=1}^{N1} \lambda_j \Delta \ln RGDP_{t-j} \\ + \sum_{j=0}^{N2} \gamma_j^+ \Delta USSR_{t-j}^+ + \gamma_j^- \Delta USSR_{t-j}^- \\ + \sum_{j=0}^{N3} \delta_j^+ \Delta \ln oilP_{t-j}^+ + \delta_j^- \Delta \ln oilP_{t-j}^- + \varepsilon_t\end{aligned} \tag{4}$$

Given Equation (4), we further estimate a nonlinear version of Equation (3) as Equation (5), where the US monetary policy spillover is further conditioned on the positive and negative oil prices. This enables us to understand the conditional effect of monetary policy spillovers from the US on MINT countries' real GDP when oil prices are rising or falling. This is specified as:

$$\begin{aligned}\Delta \ln RGDP_t \\ = \phi v_{t-1} + \sum_{j=1}^{N1} \lambda_j \Delta \ln RGDP_{t-j} \\ + \sum_{j=0}^{N2} \gamma_j \left(\Delta USSR_{t-j} \mathrm{X} \Delta \ln oilP_{t-j}^+\right) \\ \times \sum_{j=0}^{N3} \delta_j \left(\Delta USSR_{t-j} \mathrm{X} \Delta \ln ARoilP_{t-j}^-\right) + \varepsilon_t\end{aligned} \tag{5}$$

Here $\ln oilP_t^+$ and $\ln oilP_t^-$ denotes partial sum decomposition of positive and negative changes in prices of crude oil, respectively.

B. Data and Preliminaries

The variables used in this study include the logarithm of real GDP, real oil prices, and the US shadow rate. The data from 2000 – 2022 were obtained from FRED database at https://fred.stlouisfed.org/ and the Central Bank of Nigeria. The descriptive statistics in Table 1 show that, while the mean value of real GDP for the MINT countries range between -0.0191 to 1.1921, Nigeria has the least and most volatile growth. The mean of the US shadow rate is -0.024, the maximum is 0.890, and the minimum is -1.670. All the variables are negatively skewed, as Nigeria's real GDP has the highest Kurtosis. The data are further subjected to three different types of unit root tests, which show that the variables are of mixed order of integration. That is, while some are I(1), most of the variables are I(0). Thus, the underlying framework for estimation in this paper is valid for our analysis. In essence, the results further reaffirm the appropriateness of our ARDL model.

III. Results

The results of the linear and nonlinear ARDL models reported as Table 2 are presented and discussed in this section. The linear estimates reveal that the directional impact of these spillovers is positive across both short- and long-run estimates. Conversely, while oil prices exhibit a positive and significant influence in other MINT countries, the effect is negative but statistically insignificant in Nigeria. When interacted with oil prices, the influence of US monetary policy spillover turned negative over the short and long run. While this finding is consistent with Adedeji et al. (2019), the effect is observed to diminish over time.

The Nonlinear Autoregressive Distributed Lag (NARDL) outcomes show that, while both positive and negative perturbations in US monetary policy spillovers yield adverse repercussions on the real *GDP* of Mexico and Indonesia, the effects are positive in Nigeria and Turkey. These suggest high level of the MINT countries' integration with the global economy, and particularly with the United States. The effect of the spillovers may be due to currency depreciation experienced in Mexico and Indonesia in the recent past, increased borrowing costs, and reduction in both consumer and business spending as documented. The posi-

Table 1. Preliminary test results

Variables Statistics	*MRGDP*	*IRGDP*	*NRGDP*	*TRGDP*	*USMPR*	*OILP*
Average	0.5161	1.1921	-0.0191	1.1049	-0.0456	4.064421
Highest	14.3119	3.2202	10.4691	15.1963	0.890285	4.77498
Lowest	-21.1095	-7.1433	-46.6733	-11.3318	-1.67024	2.971521
Std. Dev.	2.7476	1.0833	14.1256	2.7979	0.443271	0.457343
Skewness	-3.5279	-5.0237	-10.2179	-0.0418	-0.93333	-0.40483
Kurtosis	43.0523	40.1296	106.6821	12.0235	5.331456	2.377925
Unit Root Test						
ADF-Test	-12.458***a	-9.741***a	-10.979***a	-10.779***a	-10.060***a	-8.132***b
PP-Test	-13.062***a	-9.741***a	-10.996***a	-10.780***a	-10.059***a	-7.822***b
ADF with Break	14.394***a (2020Q2)	10.152***a (2019Q4)	14.816***a (2021Q4)	12.619***a (2020Q2)	-10.718***a (2011Q3)	-10.251***b (2008Q4)

Note: RGDP, USMPR, and OILP represent real GDP for MINT countries, US monetary policy rate, and oil prices respectively. While a and b represents significance at levels and first difference, ***, **, and * denotes 1%, 5%, and 10% level of significance, values in the () represent the break dates

tive effect observed in Nigeria and Turkey can be attributed to increased capital inflows and improved investor sentiment emanating from US monetary policy stance, which can boost both investment and domestic demand.

Conversely, with the exception of Nigeria where rising oil prices exert negative effect on real *GDP*, the effect of both positive and negative oil prices are consistently positive in Mexico, Indonesia, and Turkey. The effect of negative (falling) oil prices appears to be higher in magnitude especially in the short run. The contrasting result of Nigeria relative to other MINT countries can be attributed to heavy dependency on oil exports, which can harm other sectors of the economy, such as agriculture and manufacturing, leading to high import dependency. The result can also be an indication that windfall gains from oil are not effectively invested. The positive effects of oil price changes in Mexico, Indonesia, and Turkey may indicate their ability to adapt and capitalize on global economic trends, contributing to more stable and sustained economic performance compared to Nigeria's oil-dependent economy.

Upon conditioning the spillovers from US monetary policy on the trajectories of rising and falling oil prices, a consistent negative and statistically significant impact of falling global oil prices on the real *GDP* of Mexico and Indonesia emerges over both short and long horizons. The effect of rising oil prices, on the other hand, is positive in Mexico and Indonesia but statistically insignificant in Indonesia. Opposite results is documented for Nigeria and Turkey. While the interaction with positive oil prices produced a negative effect, the interaction with negative oil prices produced positive effects. The results are significant for Nigeria but insignificant for Turkey. These results further highlight the complexity of the relationship between oil prices, US monetary policy spillovers, and real *GDP*.

IV. Additional Analysis

The estimates of the linear and nonlinear models reported as Table 3 are robust to alternative global oil prices (Brent instead of West Texas Intermediate). With a few exceptions, the results are largely the same compared to the baseline. For example, the sign of US monetary policy and oil prices are consistent for all the MINT countries. We further observed that the sign of spillovers also becomes negative when affected by real oil prices.

V. Conclusion

This paper investigates the spillover effect of monetary policy from the US on the MINT countries' real *GDP*, with an emphasis on the role of global oil prices. This is motivated by inflationary pressures, especially in advanced economies, driven by rising global oil prices. We employ both linear and non-linear ARDL models to quantify the effect of monetary policy spillovers from the US on the real *GDP* of MINT countries and how rising and declining oil prices affect this relationship. We found that monetary policy spillovers from the US exerted heterogeneous effects on the real *GDP* of MINT countries. However, when conditioned by oil prices, spillover was beggar-thy-neighbor, and this is consistent through the linear and non-linear models. We also unraveled that negative oil prices exerted a bigger effect as the non-linear model has a better fit.

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Table 2. Linear and nonlinear ARDL results

Variables	Mexico	Indonesia	Nigeria	Turkey
Long-Run Results				
USMPR	3.1039**	3.2229***	12.3468	3.8301**
lnoilP	0.1029**	0.3031***	-0.0822	0.2625***
*USMPR*lnoilp*	-0.7031**	-0.7371***	-3.7835	-0.9451**
Short-Run Results				
RGDP(-1)	-1.2879**	-1.0813***	-1.0937***	-1.1138**
USMPR	3.9976**	3.4848***	13.5047	4.2659**
lnoilP(-1)	0.1326**	0.3277***		0.2923***
lnoilP	5.6323**	2.2496***	-0.0899	7.7768***
ΔlnoilP(-1)	3.8452***			
*USMPR*lnoilp*	-0.9055**	-0.7969***	-3.7835	-1.0526**
EC	-1.2879***	-1.0813***	-1.0999***	-1.1112***
Nonlinear Model				
Long run				
USMPR-Positive	-1.0606***	-0.0046	4.6015**	0.0189
USMPR-Negative	-1.0953***	-0.0713	4.0395*	0.0783
lnoilP-Positive	0.1012	1.3996***	-1.8688	1.1601**
lnoilP-Negative	0.4316	1.3411***	3.7054	0.4323
*USMPR*lnoilp-Positive*	0.2982***	0.0164	-2.1520***	-0.1735
*USMPR*lnoilp-Negative*	-0.4273***	-0.1158**	2.4394***	0,0904
Short run				
ΔUSMPR-Positive	-1.3546***	-0.0036	5.5239**	0.0222
ΔUSMP-Negative	-1.3989***	-0.0666	4.8492*	0.0919
ΔlnoilP-Positive	0.1293	0.5686	-2.2434	1.3621**
ΔlnoilP-Negative	10.0352***	1.1887***	4.4481	11.7033***
*USMPR*lnoilp^{+} Positive*	0.3712***	0.0131	-2.5811***	-0.2022
*USMPR*lnoilp^{-} Negative*	-0.5458***	-0.1081**	2.9284***	0.1061
ECM	-1.2444***	-0.09588**	-0.0182***	-0.1003**

Note: RGDP, USMPR, and lnoilP represent real GDP for MINT countries, US monetary policy rate, and log of oil prices respectively. ***, **, and * denotes 1%, 5%, and 10% level of significance.

Table 3. Additional analysis results using Brent

Variables	Mexico	Indonesia	Nigeria	Turkey
Long-Run Results				
USMPR	2.0009	2.4009***	10.2368	2.9813*
lnoilP	0.1052**	0.2959***	-0.0929	0.2609***
*USMPR*lnoilp*	-0.3663	-0.5342***	-2.9239	-0.7167*
Short-Run Results				
RGDP(-1)	-1.4752***	-1.0748***	-1.0919***	-1.1239***
USMPR	2.5715	2.5807***	11.1779	3.3510*
lnoilP(-1)	0.1552**	0.3181***		0.2933***
lnoilP	4.4155**	2.0980***	-0.1014	6.7442***
*USMPR*lnoilp*	-0.5403	-0.5741***	-3.1928	-0.8055*
EC	-1.2879***	-1.0748***	-1.0999***	-1.1112***
Nonlinear Model				
Long run				
USMPR-Positive	-1.2308***	-0.7909***	5.3595**	0.0078
USMPR-Negative	-1.256***	-0.0027	5.1451**	0.0890
lnoilP-Positive	0.1288	0.6934**	0.2573	1.1177**
lnoilP-Negative	0.4204	0.9427***	2.6623	0.2038
*USMPR*lnoilp-Positive*	0.2982***	0.2529***	-2.1434***	-0.1209
*USMPR*lnoilp-Negative*	-0.4987***	-0.1921**	2.6833***	0,0429
Short run				
ΔUSMPR-Positive	-1.5785***	-0.7669***	6.3310**	0.0091
ΔUSMP-Negative	-1.6109***	-0.4827**	6.0778**	0.1041
ΔlnOilP-Positive	0.1652	0.6723*	0.3039	1.3073**
ΔlnOilP-Negative	8.9522***	4.7135***	3.3812	10.2570***
*USMPR*lnOilp-Positive*	0.4249***	0.2452***	-2.5141***	-0.1404
*USMPR*lnOilp-Negative*	-0.6397***	-0.1717***	3.1698***	0.0502
ECM	-1.2452***	-0.09588**	-0.0182***	-0.1003**

Note: RGDP, USMPR, and lnoilP represent real GDP for MINT countries, US monetary policy rate, and log of oil prices respectively. ***, **, and * denotes 1%, 5%, and 10% level of significance.

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