Oil Price Shocks and Yield Curve Dynamics in Emerging Markets

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Abstract

In a local projections framework, we study the impact of oil price shocks, based on a refined approach to disentangle oil price movements, on the dynamics of the entire yield curve in nineteen emerging economies with different positions on the oil market. Responses of the term structure factors to oil market shocks are shown to differ conditional on not only the underlying sources that drive oil price, but also based on the oil-dependence of these economies. In particular, we find that oil price risk shocks put upward pressure on the level, slope, and curvature of interest rates across the board. Supply-driven shocks in oil markets cause a rise in the level of interest rates in oil-importing economies more significantly, yet the downward impact on yield curve slope is more pronounced in oil-exporting countries. Demand-driven shocks have a significant and persistent upward impact on level factors in oil-importing countries. Furthermore, the effect of precautionary demand shocks on the curvature factor is more pronounced in oil-importing countries vis-à-vis oil-exporters. Significance, direction, and duration of our results may guide monetary policymakers in emerging countries as well as international investors in portfolio and hedging decisions.

JEL classification: E43; E44; G12; G15; Q43

Keywords: Emerging markets; Local projections; Oil price; Supply and demand shocks; Yield curve factors

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1. Introduction

There exists a large international literature on the impact of oil price movements on equity markets (see, for example, Degiannakis et al., (2018), and Smyth and Narayan (2018) for detailed reviews in this regard). Given that the size of the global bond market is estimated to be over 100 trillion US dollars, relative to the size of the worldwide equity market standing at around 65 trillion US dollars (Securities Industry and Financial Markets Association (SIFMA)), a growing number of recent studies have started highlighting the role of oil price in driving the bond markets of developed and emerging economies (see, for example, Kang et al., (2014), Bouri et al., (2017, 2018, 2019a, 2019b), Lee et al., (2017), Shahzad et al., (2017), Gormus et al., (2018), Bouri (2019), Demirer et al., (2019), Balcilar et al., (2020), Coronado et al., (2020), Nazlioglu et al., (2020), Filis et al., (forthcoming)). This is not surprising simply because of the importance of the bond market in comparison to the stock market, but also since the bond market is often viewed as a safe-haven (Kopyl and Lee, 2016; Habib and Stracca, 2017; Hager, 2017), and the entire yield curve as a predictor of economic activity and inflation (Gogas et al., 2015a, 2105b; Plakandaras et al., 2017a, 2017b, 2019; Hillebrand et al., 2018). Naturally, the impact of oil shocks on the bond market movement (of various maturities) is an important question from the perspectives of both investors and policymakers alike.

While the abovementioned studies provide an understanding of the relationship between the bond and oil markets, this existing line of research primarily concentrates on long-term (10-year) government bond yields and sovereign credit default swaps (CDS), and oil price or returns. We aim to add to this literature by examining the effects of oil price shocks on the entire term structure of interest rates for nineteen emerging countries. In this regard, given the suggestion of Kilian (2009) that "Not all oil price shocks are alike", we first disentangle the oil price movement due to demand and supply shocks. Then we relate the supply and demand oil shocks with the term structure of interest rates, by using the well-established framework of Nelson and Siegel (1987) from the finance literature which summarises the entire term structure into three latent yield factors of level, slope, and curvature, which in turn are considered to be the only relevant factors that characterise the yield curve (Litterman and Scheinkman, 1991). The factor model of the term structure in combination with the decomposition of oil price shocks, into different causes, enable us to characterise the responses of the yield curve to various shocks and to calculate the entire yield curve movement in the wake of these shocks. Besides, we also check if the dynamics between oil shocks and the yield curve is contingent upon whether the country can be considered as an exporter or importer in the oil market. Note that, theoretically, high oil prices increase inflation expectations and hence, increases nominal bond yields, which in turn moves bond prices or returns in the opposite direction, with this channel being important especially for oil importers on one hand. On the other hand for oil exporters, higher oil prices generate increased domestic income and can result in higher demand for investment in the financial asset market (including bonds), and hence produce higher asset prices or returns. To the best of our knowledge, this is the first paper to link oil price shocks to the term structure of interest rates of emerging markets.

Our paper is closely related to the work of Ioannidis and Ka (2019), given that these authors studied the impact of oil price shocks on the dynamics of the entire yield curve in four countries (US, Canada, Norway, and South Korea). The authors showed that responses of the term structure factors to oil market shocks are contingent on the underlying sources that drive oil price shocks and the country's dependence on oil. In particular, oil market-specific demand shocks result in increases in the level factor in oil-importing countries, but have no such effect in oil-exporting countries. At the same time, oil supply disruptions have short-lived negative responses to the slope factors in the US and Canada, associated with loosening monetary policy, whilst demand side shocks tend to lead to increases in the slope of all countries. In sum, oil supply and demand shocks are shown to jointly account for a considerable amount of the observed variation in the term structure of interest rates. Unlike this paper, our focus on the emerging bond market is motivated by the fact that, in the wake of the global financial and European sovereign debt crises, bonds of emerging markets have caught the attention of global investors aiming to diversify their portfolios with the relatively higher yields on average derived from these bonds in comparison to their developed market counterparts, resulting in the massive size (21.9 trillion US dollars) of the debt markets of emerging economies (International Monetary Fund, 2018).

In addition, and more importantly, unlike the work of Ioannidis and Ka (2019), who relies on the decomposition of the oil shocks as suggested by Kilian (2009), we use the more refined recent approach of Clements et al., (2019). Although the decomposition method of Kilian (2009) has been popularly used in the literature relating oil shocks to asset markets, it tends to give too much weight to oil-specific demand shocks relative to supply shocks. In this regard, Ready (2018) overcame the limitation by employing a decomposition that only defines oil demand and risk shocks, with supply shocks representing elements that are unclassified by the decomposition. But, Clements et al., (2019), improved the work of Ready (2018) by providing an explicit role to precautionary demand shocks using an independent measure constructed from oil futures data, and hence, reducing the role of the supply shocks obtained as the final residual in the recursive identification scheme of Ready (2018). Note that, Clements et al., (2019) provided a clearer delineation between shocks to equity market discount rates and aggregate demand, which we modify to be appropriate in explaining the bond market. Also, while Ioannidis and Ka (2019) incorporated the term structure factors and variables driving supply and demand in global crude oil markets into a structural vector autoregressive (SVAR) model, we rely on the Local Projection (LP) method of Jorda (2005), which has been shown to have many advantages over the standard VAR methods. In particular, the LP approach not allows estimating responses on a variable-by-variable basis, thus overcoming the degrees of freedom problem associated with standard VARs, but it also reduces the dependence of the impulse response functions on the specification of the data generation process, i.e., the results are independent of the identification of the structural shocks.

The remainder of the paper is organized as follows: Section 2 discusses the data used, while Section 3 and 4 respectively devoted to outlining the various methodologies employed and presenting the empirical results, with Section 5 concluding the paper.

2. Data

We collect monthly zero coupon yields of maturities 3, 6, 12, 24, 36, 48, 60, 72, 84, 96, 108 and 120 months to estimate the yield curve factors for each market in our panel of emerging countries. The zero coupon bond yields are retrieved from Bloomberg terminal. We have a panel data-set of 19 emerging countries and the sample covers the period of January 2004 to January 2020. However, the panel is not balanced because data availability varies by country. The list of countries, data availability periods and summary statistics for the zero-coupon bonds are reported in Table 1.

– Insert Table 1 about here. –

We follow Ready (2018) and its extension by Clements et al. (2019) for decomposition of oil price shocks. As per their use, monthly returns on the Word Integrated Oil and Gas Producers Index is obtained from Datastream to be used as one of the main identifying variables. Similarly, the closest expiry NYMEX

West Texas Intermediate (WTI) crude oil futures contract at month-end is used, and is obtained from the Energy Information Administration (EIA). As a proxy for changes in the discount rates, the previous studies use VIX. However, we opt to use Bank of America Merrill Lynch Option Volatility Estimate Index (MOVE) available from Bloomberg as the more appropriate alternative for the bond market. In order to estimate the n-month convenience yield, the 3-month expiry contact is obtained from EIA and, 3-month LIBOR rate is downloaded from the FRED database of the Federal Reserve Bank of St. Louis.

3. Methodologies

3.1. Extraction of the yield curve factors

The conventional Nelson and Siegel (1987) model for zero-coupon yield curve has the following functional form:

$$y_t(\tau) = \beta_1 + \beta_2 \left(\frac{1 - e^{-\lambda\tau}}{\lambda\tau} \right) + \beta_3 \left(\frac{1 - e^{-\lambda\tau}}{\lambda\tau} - e^{-\lambda\tau} \right), \qquad t = 1, \ldots, T \text{ and } \tau = 1, \ldots, N \tag{1}$$

where $y_t(\tau)$ represents the continuously-compounded zero-coupon nominal yield at time t of a bond with maturity τ, and β_1, β_2, and β_3 are yield curve factors with loadings of 1, $\left(\frac{1-e^{-\lambda\tau}}{\lambda\tau}\right)$, and $\left(\frac{1-e^{-\lambda\tau}}{\lambda\tau} - e^{-\lambda\tau}\right)$ respectively. The factor loading for β_1 is a constant equal to 1 indicating that the loading is the same for all maturities. Hence, an increase in this factor results in a change in the level of the yield curve. It is therefore interpreted as a long-term factor. The factor loading for β_2 starts at its maximum of 1 at $\tau = 0$ and decays monotonically to 0, so it is viewed as a short-term factor. Finally, the factor loading for β_3 begins at 0 at short maturities, increases until maturity reaches intermediate maturity and then decays back to zero as the maturity increases. As a result, β_3 has the largest impact on medium-term yields, so it is interpreted as a medium-term factor. Put differently, these time-varying factors represent the level (L_t), slope (S_t), and curvature (C_t) of the a yield curve.

The yield curve factors are estimated using non-linear least squares where the objective function is to minimize the squared difference between duration-inverse weighted actual and fitted prices. However, utilizing the non-linear least-squares optimization may result in non-smooth parameter estimates particularly for slope and curvature parameters. Hence, we estimate yield curve parameters with Ordinary Least Squares (OLS) via fixing λ to lower the variance of these parameters as suggested by Diebold and Li (2006). We carry out a grid analysis to determine the optimal parameter λ for each country in our sample that gives us the smallest root mean squared error (RMSE).

3.2. Identifying oil shocks with structural VAR methodology

Ready (2018) introduces a new approach in which oil price shocks can be categorized as supply or demand-driven using the information in asset prices. The three variables necessary to decompose the oil price movements into supply and demand shocks are an index of oil-producing firms, a measure of oil price changes, and a proxy for changes in expected returns. As in Ready (2018), monthly returns on the Word Integrated Oil and Gas Producers Index are used as the proxy for oil production R_t^{Prod}. For changes in oil price, the 1-month returns Δp_t on the closest expiry NYMEX WTI crude oil futures contract at month-end is used. Finally, Ready (2018) uses innovations to the VIX index as a proxy for changes in the discount rate since the variance risk premium captured in VIX is both closely linked to stock return and is useful for prediction of stock return indicating that the VIX may be a reasonable proxy for risk adjustment (Bollerslev et al. (2009)).

Although the VIX is desirable to use as a proxy for discount factor shocks in the equity market, we propose a new modified identification scheme which replaces the innovations of VIX with the innovations of Bank of America–Merrill Lynch Option Volatility Estimate Index (MOVE). As by construction, the MOVE index reflects the future volatility in U.S. Treasury yields implied by current prices of options on government bonds of various maturities. Hence, it provides a signal for changes in risk in the fixed income markets.

Defining $X_t = \begin{bmatrix} \Delta p_t & R_t^{\text{Prod}} & \xi_{\text{MOVE},t} \end{bmatrix}'$ a structural VAR model is used to identify the supply shocks s_t, demand shocks d_t, and risk shocks r_t which is defined as:

$$X_t = C + \sum_{i=1}^{P} \Phi_i X_{t-i} + AZ_t \tag{2}$$

$$Z_t \equiv \begin{bmatrix} s_t \\ d_t \\ r_t \end{bmatrix}, \qquad A \equiv \begin{bmatrix} 1 & 1 & 1 \\ 0 & a_{22} & a_{23} \\ 0 & 0 & a_{33} \end{bmatrix} \tag{3}$$

where the matrix A relates the identified shocks into the observable variables with the following equation:

$$X_t = AZ_t \tag{4}$$

The lag length P=1 is selected by the BIC. To impose orthogonality, a_{22}, a_{23}, a_{33} and σ_s, σ_d, σ_r is subjected to the following condition:

$$Var(Z_t) = A^{-1}\Sigma_X \left(A^{-1}\right)^T = \begin{bmatrix} \sigma_s^2 & 0 & 0 \\ 0 & \sigma_d^2 & 0 \\ 0 & 0 & \sigma_r^2 \end{bmatrix} \quad (5)$$

where Σ_X is the covariance matrix of the observable X_t, and σ_s, σ_d, σ_r are the volatilities of the identified shocks. Furthermore, the shocks are normalised to add up to the total change in oil prices. This identification scheme explicitly defines the demand shock, while the supply shock is considered to be the final residual component of the model.

Clements et al., (2019) offers a key refinement to Ready (2018) by incorporating precautionary demand shocks as the fourth shock factor in addition to aforementioned three of risk, demand and supply. Thus, the interpretation of the final residual as a supply shock is refined by also taking into account the possibility of precautionary demand shocks contributing to these residuals. In order to identify precautionary demand shocks, an estimate of the convenience yield is obtained by imposing a no-arbitrage condition on the log of the n-month futures price $f_t^{(n)}$ as proposed by Alquist et al., (2014). Specifically, we employ the following equation:

$$f_t^{(n)} = y_t + ni_t^{(n)} - n\delta_t^{(n)} \quad (6)$$

where y_t is the log spot price, $i_t^{(n)}$ is the nominal interest rate that investors can borrow at between time periods t and $t+n$, and $\delta_t^{(n)}$ is the n-month raw convenience yield. The 3-month expiry contract and 3-month LIBOR rate are used to obtain an estimate for $\delta_t^{(n)}$[1]. Hence, the precautionary demand shocks are then defined as the projection of the supply shocks onto the space of innovations to convenience yield that is orthogonal to the risk and demand shocks.[2]

3.3. Estimating impulse response functions using local projections

We now turn to estimate the impacts of the identified oil shocks on yield curve factors. The Local Projection (LP) method of Jorda (2005) is employed in our analysis since it has many advantages over the

[1] The projection of $\delta_t^{(n)}$ onto Working's T-index is used as the ultimate proxy for convenience yield as suggested by Alquist and Kilian (2010). The Working's T-index is computed using the data on open interest in oil futures, made publicly available by CFTC through weekly Commitment of Traders Reports, following the methodology of Buyuksahin and Robe (2014).

[2] See Alquist et al., (2014) and Clements et al., (2019) for detailed explanations.

standard VAR methods. A big advantage of LPs is that they allow estimating responses on a variable-by-variable basis, thus overcoming the degrees of freedom problem associated with standard VARs. The second advantage of LPs is that they reduce the dependence of the impulse response functions on the specification of the data generation process (Jorda, 2005).

Our baseline panel specification is:

$$y_{i,t+h} = \alpha_h + \sum_{k=0}^{m} \beta_{k,h} \text{oilshocks}_{t-k}^{j} + u_i + e_{i,t+h} \tag{7}$$

where $y_{i,t}$ is alternatively, level, slope, and curvature; j= supply shocks, demand shocks and risk shocks; $i = 1, 2, \ldots, N$ is the subscript for the country to which the effects of oil shocks are investigated over its sovereign yield curve factors; $t = 1, 2, \ldots, T$ is the time subscript; $k = 0, \ldots, m$, are the lags of oil shocks; u_i represents country fixed effects; $e_{i,t}$ is an error term and finally h is the horizon of the local projections[3]. The coefficient $\beta_{k,h}$ corresponds to the response of y at time $t + h$ to the shock variable (shock) at time t. Hence, the impulse responses are the sequence of all estimated $\beta_{k,h}$.

4. Empirical results

4.1. Estimated latent term structure factors

In this section, we present the estimation results of the yield curve latent factors for the panel of countries in our sample based on the Nelson and Siegel (1987) model. Table 2 reports the estimated factors and the optimal value of λ for each country. Since the parameter λ controls both the exponential decay rate and the maturity at which the loading on the curvature factor attains its maximum, the small values of λ result in slower decay and yields better fit of the curve at longer maturities, while the large values of λ are indicative that the curvature factor reaches its maximum value at the short maturities. Furthermore, the higher positive values of the curvature factor generates more pronounced hump.

In Table 2, the average value of the slope factors is negative for all countries, and is indicative that on average yields increase along maturities. Hence, many studies in the literature state that slope parameter is highly correlated with real activity and has a predictive content for economic growth (Stock and Watson, 2003; Ang et al., 2006; Diebold et al., 2006; Argyropoulos and Tzavalis, 2016; Cepni et al., 2019). On the

[3]The two lags is selected by BIC. We exclude the contemporaneous lag of the shock variable when calculating the impulse responses.

other hand, the average value of our estimates of the level factor has a high variation ranging between 3.06 to 12.34. Given the fact that level factor represents long-term rates, a natural consequence is that the higher value of the level factor should be associated with high volatility of the inflation rates in emerging markets economies.

– Insert Table 2 about here. –

4.2. Oil shocks decompositions

In this section, we report the decomposition of the oil shocks based on the baseline and modified specifications. While baseline utilizes the identification framework of Ready (2018), the modified one is based on the same identification scheme of Clements et al. (2019), which uses the convenience yield to separate precautionary demand shocks from supply shocks. We also substitute VIX with MOVE to more reliably identify risk shocks in fixed income markets.

Table 3 presents the variance decomposition of oil price changes for the two identification schemes. It is clear that supply shocks keep their dominance power for explaining the variation in oil prices under both identification schemes. In particular, the baseline scheme identifies that roughly 78.8% of the variance in oil prices is attributed to the supply shocks and 16.6% to the demand shocks, with the shocks to VIX accounting only for 4.7% of the total variation in oil price. This result is qualitatively compatible with the findings of Ready (2018), but due to the variability of the data and sample period used, the precise proportions are slightly different.

On the other hand, the modified scheme leads to a different decomposition in the oil prices, with the impact of supply and risk shocks becoming less important relative to the baseline identification scheme, which now account for 76% and 1% of the total variation. Interestingly, the demand shocks become much more relevant under the modified scheme indicating that using the VIX conflates information relating to other shocks in times of higher volatility as suggested by Clements et al., (2019). Hence, using the MOVE to identify the risk shocks may eliminate this misclassification and leads to a relatively more important role for aggregate demand shocks compared to the baseline scheme. Furthermore, the previously measured supply shocks also includes the precautionary demand capturing the uncertainty about future supply, although the role of precautionary demand is limited and it only accounts for 3% of the variation when it is included in the identification scheme.

– Insert Table 3 about here. –

4.3. Local projections - impulse responses

Figure 1 presents the impulse response functions (IRFs) that are based on our modified decomposition scheme as described above. The solid line show impulse response functions to the oil price shocks and shaded gray areas correspond to the 68% confidence interval. The first column of the Figure 1 shows that a risk shock is associated with an immediate increase in the level, slope and curvature factors. The impact of the shock is persistent and lasts more than a year, except for the slope factor where the impact turns to be negative nearly after four months.

The effect of unanticipated demand shocks on estimated yield curve factors is shown in the second column of Figure 1. Unanticipated demand shocks have an immediate and persistent positive effect on the level factor, which is also statistically significant. Aggregate demand shocks are associated with output growth, and oil price increases, all of which contribute to higher inflation expectations. As a consequence, the level factor rises following the aggregate demand shock. A more surprising finding is that unanticipated demand shocks initially have a negative effect on the slope factor contrary to conventional monetary policy reaction based on the Taylor-rule (Taylor, 1993). As suggested by Ioannidis and Ka (2018), the demand shocks lead to flattening of the yield curve since investors conclude that the response of the short rate was not adequate to control future expected inflation. This leads to a strong monetary tightening in the coming months to support price stability which results in a positive impact on slope factor. Furthermore, a shock to demand leads to a statistically significant increase in the curvature of the yield curve implying that investors demand higher long term rates to keep the future value of their investments.

– Insert Figure 1 about here. –

The third column of Figure 1 shows the impulse response of yield curve factors to oil supply shocks. A supply shock results in a statistically significant increase in the level factor but the response dies out after nearly nine months. The positive response of the level factor may be related to elevated oil prices due to supply disruptions which are interpreted as a signal of surge in inflation expectations. The slope factor decreases following the supply shocks, which is consistent with the monetary policy reaction that central banks decrease interest rates in order to offset possible negative effects of oil supply disruption on economic activity. A supply shock is also associated with a decrease in the curvature factor, implying that oil supply shocks influence the medium-term bond yields.

The responses of yield curve factors to the precautionary demand shocks are plotted in the last column of Figure 1. These shocks can be described as speculative demand shocks due to shifts in the uncertainty about expected future shortfalls of oil supply relative to oil demand. A precautionary demand shock has an upward and persistent effect on the level factor. This finding validates the result of Anzuini et al., (2015), who show that the inflation rate has been rising substantially and stays above the benchmark for a long time after a higher oil price shock induced by precautionary demand. However, following a precautionary demand shock, the slope factor initially declines significantly. The reason may be that elevated uncertainty leads to delay in consumers' and firms' investment decisions until the future price situation becomes clearer (Bernanke, 1983). Finally, the precautionary demand shocks for oil leads to increased uncertainty in financial markets by depressing the stock market returns. This results in a positive effect on the curvature factor since investors demand a higher risk premium for the medium-term.

Overall, our results show that the distinct oil price shocks may have very different effects on the latent factors characterising the yield curve. Hence, it is important to understand the underlying reasons for yield curve movements which may be driven by different types of shocks before formulating policy responses.

4.4. Do countries respond differently to oil price shocks? oil exporting countries versus oil importing countries

We differentiate oil-exporting countries from oil-importing countries, and analyze the effects of oil price shocks on yield curve factors separately, since the impact of oil price shocks on the yield curve of oil-exporting countries can be different from those of oil-importing countries. Our selection criteria based on the country's net trade position in crude oil market (export minus import) is sourced from the International Energy Agency (IEA)[4]. Hence, our final dataset includes six oil-exporting countries (Brazil, Colombia, Malaysia, Mexico, Russia and United Arab Emirates) and thirteen oil-importing countries (Chile, China, Czech Rep., Hungary, India, Indonesia, Peru, Philippines, Poland, South Africa, South Korea, Thailand, Turkey).

Before undertaking the dynamic interaction between yield curve factors and different oil shocks, an initial empirical investigation is performed by using a panel fixed estimation technique.[5] Table 4 presents

[4] https://www.iea.org/.

[5] In particular, we estimate the following model: $YC_{it} = \beta_0 + \beta_1 riskshock_{it} + \beta_2 demandshock_{it} + \beta_3 supplyshock_{it} + \beta_4 precautionaryshock_{it} + u_i + e_{it}$ where $YC_{i,t}$ is alternatively, level, slope, and curvature factors, u_i represents country fixed effects and $e_{i,t}$ is an error term.

the regression results for both oil-exporting and oil-importing countries. In this setting, a positive risk shock coincides with a statistically significant increase in level factor in both categories, but the coefficient is higher for oil-importing countries, indicating that these countries suffer more from risk shocks because of the higher oil dependency. This situation is also validated under the curvature factor which shows that any risk shock is associated with significant positive impact on the curvature factor. Furthermore, when demand shocks to oil prices are considered, the negative relationship with the slope factor is found to be much stronger in case of oil-importing countries. In contrast to oil-exporting countries, the precautionary demand shocks play a significant role in explaining movements of the slope factor in oil-exporting countries. It also appears that the relatively higher portions of level and curvature factors are explained by the oil shocks as the corresponding R^2 values are higher in both categories.

– Insert Table 4 about here. –

Figures 2-3 present the impulse responses for oil importing and oil exporting countries, respectively. An inspection of Figures 2-3 leads to a number of clear-cut conclusions. Firstly, although the effect of supply shocks on level factor is stronger and persistent in oil-importing countries, these effects are negligible in oil-exporting countries. This result support the findings of Baumeister et al., (2010), who show that countries with greater reliance on oil are affected more by oil supply shocks as a consequence of rising oil prices, which will then translate into higher inflation rates, while inflationary pressures remain negligible in net-energy exporting countries. However, a supply-driven oil price shock results in a oil supply destruction and has an adverse impact on economic activity which may eventually pave the way to downward pressure on the slope factor in both oil-importing and oil-exporting countries, but the effect is more pronounced in the latter case.

– Insert Figure 2 about here. –

– Insert Figure 3 about here. –

Secondly, Figure 2 shows that the response of the level factor to aggregate demand shocks is significant and persistent in oil-importing countries. This implies that an increase in oil prices driven by demand shocks will give rise to funding risk challenges and tightening in financial conditions, since oil-importing countries generally have current account deficits. On the other hand, the magnitude of the demand shocks on the level factor is negligible in oil-exporting countries.

Thirdly, the effect of precautionary demand shocks on the curvature factor is more pronounced in oil-importing countries than those of oil-exporting countries. Since precautionary demand in general arises from the uncertainty about shortfalls of expected supply relative to expected demand and leads to rise in oil price, higher risk premium will be demanded by global investors for the medium-term nominal treasury bonds due to the oil price pass-through into inflation in oil-importing countries.

Overall, our results show that persistence and direction of response of yield curve factors to oil market shocks depend on whether the country is classified as a net-importer or a net-exporter in the world oil market. Hence, our findings may present diversification benefits for global investors and help them to develop trading and hedging strategies in fixed income securities market by analyzing the distinct effects of oil shocks in both oil-importing and oil-exporting countries.

5. Conclusion

In this paper, we study the impact of the oil price shocks, disentangled based on a refined approach, on the term structure of interest rates across nineteen emerging countries, using local projection methods, which has multiple advantages over structural VAR models. Our results indicate that the yield curve factors of level, slope, and curvature react differently to oil market shocks contingent upon the underlying sources that drive the oil price, as well as conditional on the oil-dependence of these countries as a net exporter or net-importer. In particular, we find that supply shocks put upward pressure on the level and downward pressure on the slope of interest rates, but more significantly and persistently so in oil-importing countries than oil-exporting ones. Likewise, demand shocks draw a strong positive response from the level of interest rates in oil-importing countries. Precautionary demand shocks have a significant upward impact on the level and downward impact on the slope across the board, yet its impact on curvature is more pronounced in oil-importing countries. We conjecture that various components of oil price movements yield differing signals of inflation and economic activity expectations in countries with different exposures to oil markets.

The findings suggest that oil price movements indeed contain valuable predictive information for the evolution of future interest rates, which can help policymakers to fine-tune their monetary policy models. Furthermore, investors can improve asset allocation strategies by exploiting the role of oil shocks in their interest-rate prediction models. But both the policy authorities and agents operating in the financial markets would need to conduct proper identification of the structural shocks that drive the oil market. Finally, academicians may utilize our findings to explain deviations from models of random walk, by embedding oil shocks in their pricing models.

As part of future research, it would be interesting to extend our analysis to the out-of-sample prediction of the bond market based on the information-content of oil price movements.

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Table 1: Summary statistics for zero coupon yields across maturities

Country	Period		3M	6M	1Y	2Y	3Y	4Y	5Y	6Y	7Y	8Y	9Y	10Y
Brazil	2007M03-2020M01	Mean	10.07	10.18	10.35	10.91	11.30	11.55	11.71	11.81	11.88	11.92	11.96	11.99
		Std Dev.	2.74	2.76	2.75	2.62	2.52	2.42	2.39	2.34	2.31	2.27	2.24	2.22
Chile	2005M09-2020M01	Mean	4.35	4.31	4.28	4.54	4.76	4.94	5.05	5.16	5.26	5.35	5.39	5.41
		Std Dev.	2.25	1.90	1.59	1.40	1.28	1.20	1.16	1.13	1.11	1.10	1.07	1.05
China	2004M01-2020M01	Mean	2.43	2.49	2.61	2.81	3.02	3.20	3.33	3.43	3.53	3.60	3.67	3.73
		Std Dev.	0.78	0.78	0.73	0.68	0.63	0.60	0.59	0.57	0.57	0.56	0.57	0.59
Colombia	2005M04-2020M01	Mean	5.50	5.61	5.86	6.37	6.83	7.18	7.49	7.70	7.91	8.03	8.10	8.15
		Std Dev.	1.84	1.86	1.90	1.89	1.87	1.89	1.91	1.88	1.87	1.82	1.76	1.71
Czech Rep.	2004M01-2020M01	Mean	1.31	1.38	1.36	1.61	1.84	2.03	2.20	2.37	2.54	2.71	2.83	2.93
		Std Dev.	1.25	1.31	1.32	1.39	1.44	1.48	1.50	1.51	1.52	1.54	1.56	1.56
Hungary	2004M01-2020M01	Mean	4.84	4.87	4.94	5.13	5.32	5.46	5.58	5.69	5.79	5.87	5.90	5.93
		Std Dev.	3.70	3.67	3.62	3.47	3.27	3.04	2.84	2.66	2.51	2.39	2.27	2.18
India	2004M01-2020M01	Mean	6.76	6.90	6.97	7.14	7.31	7.47	7.58	7.66	7.74	7.80	7.83	7.80
		Std Dev.	1.46	1.44	1.31	1.10	0.99	0.94	0.93	0.89	0.86	0.85	0.85	0.86
Indonesia	2004M01-2020M01	Mean	7.24	7.29	7.47	7.98	8.29	8.54	8.72	8.95	9.10	9.20	9.28	9.32
		Std Dev.	2.31	2.29	2.28	2.35	2.37	2.43	2.52	2.48	2.49	2.50	2.54	2.60
Malaysia	2004M01-2020M01	Mean	2.90	2.95	3.04	3.24	3.42	3.60	3.73	3.84	3.95	4.05	4.14	4.22
		Std Dev.	0.49	0.47	0.44	0.33	0.28	0.28	0.31	0.32	0.35	0.39	0.42	0.44
Mexico	2004M01-2020M01	Mean	5.97	6.03	6.09	6.30	6.56	6.78	6.95	7.12	7.30	7.43	7.53	7.62
		Std Dev.	1.93	1.91	1.85	1.70	1.57	1.48	1.39	1.39	1.40	1.38	1.35	1.35
Peru	2006M05-2020M01	Mean	3.85	3.83	3.95	4.21	4.53	4.82	5.11	5.37	5.61	5.82	6.00	6.15
		Std Dev.	1.24	1.29	1.30	1.28	1.23	1.20	1.14	1.08	1.03	0.99	0.98	0.97
Philippines	2004M01-2020M01	Mean	5.21	5.43	5.68	6.13	6.35	6.57	6.82	6.75	6.72	6.71	6.72	6.78
		Std Dev.	3.09	3.15	3.19	3.22	3.24	3.23	3.39	3.12	3.09	2.91	2.86	2.89
Poland	2004M01-2020M01	Mean	3.35	3.42	3.57	3.79	3.96	4.13	4.27	4.37	4.46	4.54	4.62	4.67
		Std Dev.	1.69	1.74	1.78	1.76	1.72	1.68	1.62	1.56	1.51	1.48	1.45	1.42
Russia	2007M01-2020M01	Mean	6.91	7.10	7.35	7.74	8.01	8.10	8.22	8.42	8.65	8.38	8.57	8.53
		Std Dev.	2.27	2.30	2.06	2.05	2.09	2.06	1.98	2.24	2.70	1.89	2.25	2.07
S. Africa	2004M01-2020M01	Mean	7.11	7.20	7.25	7.50	7.73	7.92	8.06	8.22	8.37	8.54	8.64	8.74
		Std Dev.	1.34	1.37	1.31	1.22	1.11	0.95	0.85	0.79	0.74	0.76	0.75	0.75
S. Korea	2004M01-2020M01	Mean	2.89	2.92	3.02	3.19	3.27	3.40	3.49	3.58	3.65	3.70	3.74	3.77
		Std Dev.	1.21	1.23	1.24	1.28	1.29	1.31	1.33	1.34	1.35	1.35	1.36	1.36
Thailand	2004M01-2020M01	Mean	2.30	2.36	2.46	2.64	2.85	3.05	3.22	3.37	3.51	3.61	3.72	3.83
		Std Dev.	1.05	1.07	1.07	1.08	1.07	1.04	1.05	1.05	1.07	1.07	1.09	1.11
Turkey	2005M04-2020M01	Mean	12.00	12.36	12.64	12.82	12.80	12.61	12.39	12.34	12.30	12.35	12.35	12.33
		Std Dev.	4.59	4.68	4.79	4.71	4.53	4.28	4.04	3.96	3.90	3.87	3.82	3.79
United Arab E.	2006M06-2020M01	Mean	2.19	2.22	2.28	2.38	2.63	2.89	3.14	3.39	3.61	3.80	3.98	4.14
		Std Dev.	1.41	1.31	1.24	1.23	1.17	1.10	1.04	0.98	0.92	0.88	0.85	0.83

Note: The table reports the average and standard deviation values of the yield with selective maturities.

Table 2: Summary statistics for the estimated yield curve latent factors

Country	Curvature	Slope	Level	λ
Brazil	-0.82	-2.36	11.72	0.012
Chile	-1.72	-1.54	5.74	0.014
China	-1.74	-1.52	3.96	0.010
Colombia	-2.35	-3.43	8.65	0.014
Czech Rep.	-3.15	-1.93	3.39	0.012
Hungary	-1.09	-1.64	6.25	0.018
India	0.35	-1.40	7.89	0.031
Indonesia	-0.60	-2.87	9.66	0.022
Malaysia	-1.96	-1.53	4.46	0.011
Mexico	-2.19	-2.44	8.21	0.019
Peru	-4.43	-2.80	6.75	0.012
Philippines	0.94	-1.88	6.68	0.014
Poland	-0.66	-1.87	5.09	0.022
Russia	0.69	-1.92	8.44	0.020
S. Africa	-2.01	-2.22	9.10	0.018
S. Korea	-0.87	-1.16	3.98	0.015
Thailand	-2.53	-1.75	4.14	0.011
Turkey	2.83	-0.37	11.27	0.009
United Arab E.	-4.73	-1.93	4.51	0.010

Note: The table reports the average values of the yield curve factors and the optimal value of λ.

Table 3: Oil shock variance decomposition

Shock	Baseline		Modified	
	Stdev.	% of Var.	Stdev.	% of Var.
Risk	0.058	4.65	0.026	0.95
Demand	0.109	16.59	0.120	20.33
Supply	0.237	78.77	0.232	76.00
Precautionary			0.044	2.71

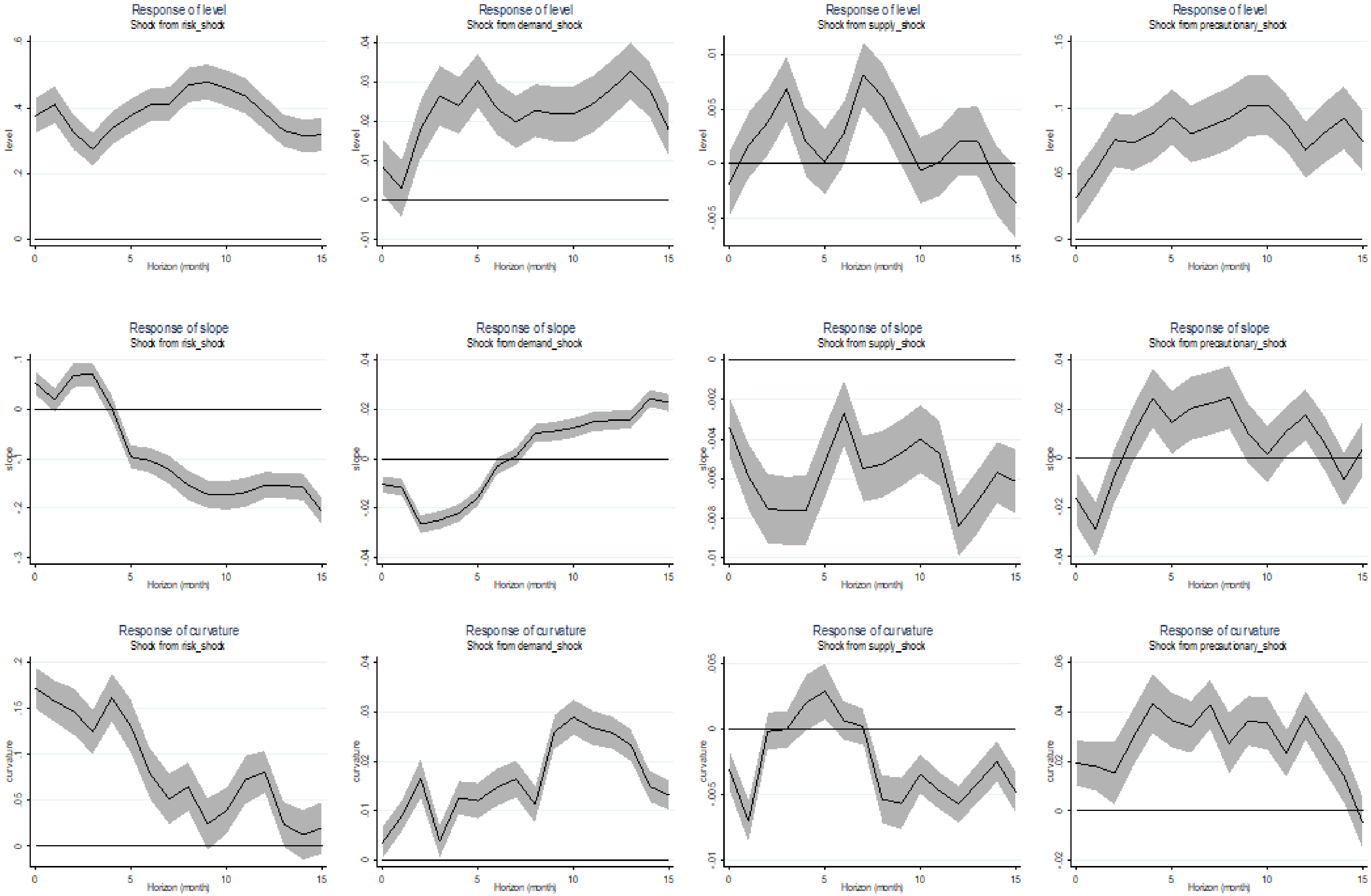
Note: The table reports the annualised standard deviations for each oil shocks identified based on baseline and modified scheme together with the percentage of variance explained by each orthogonal oil shock.

Table 4: Yield curve factor and identified oil shocks: panel fixed effects estimation results

	Oil-exporting countries			Oil-importing countries		
	Dependent variable			Dependent variable		
Shock	Level	Slope	Curvature	Level	Slope	Curvature
Risk	0.287**	-0.025	0.112	0.351***	0.095	0.169***
	(0.082)	(0.067)	(0.062)	(0.089)	(0.091)	(0.058)
Demand	0.007	-0.012	-0.005	0.015	-0.013	0.003
	(0.006)	(0.009)	(0.004)	(0.009)	(0.008)	(0.007)
Supply	-0.004	-0.004	0.001	0.002	-0.008**	-0.001
	(0.005)	(0.004)	(0.001)	(0.002)	(0.003)	(0.003)
Precautionary	-0.051	-0.008	0.032	0.024	-0.03*	-0.005
	(0.026)	(0.044)	(0.020)	(0.026)	(0.016)	(0.09)
Constant	0.074***	-0.02***	-0.001***	0.063***	-0.014***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R^2	0.28	0.14	0.50	0.27	0.06	0.51
Observations	1040	1040	1040	2446	2446	2446

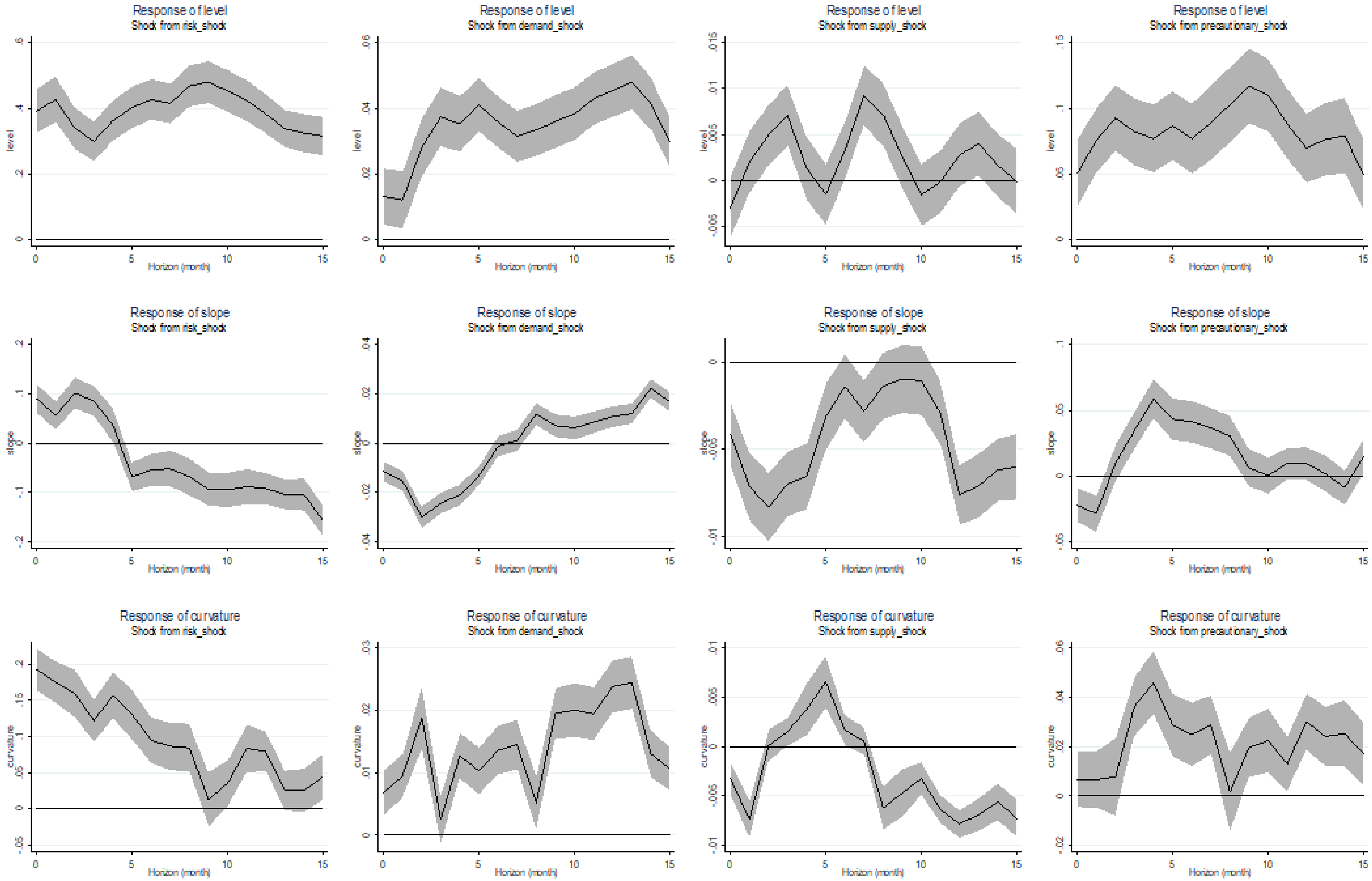
Note: The table presents the panel regression of yield curve factors on identified oil shocks across both oil-exporting and oil-importing countries. The country-based cluster-robust standard errors are given in parenthesis. ***, **, and * denote 1%, 5%, and 10% significance level, respectively.

Figure 1: Responses of the yield curve factors to oil markets shocks



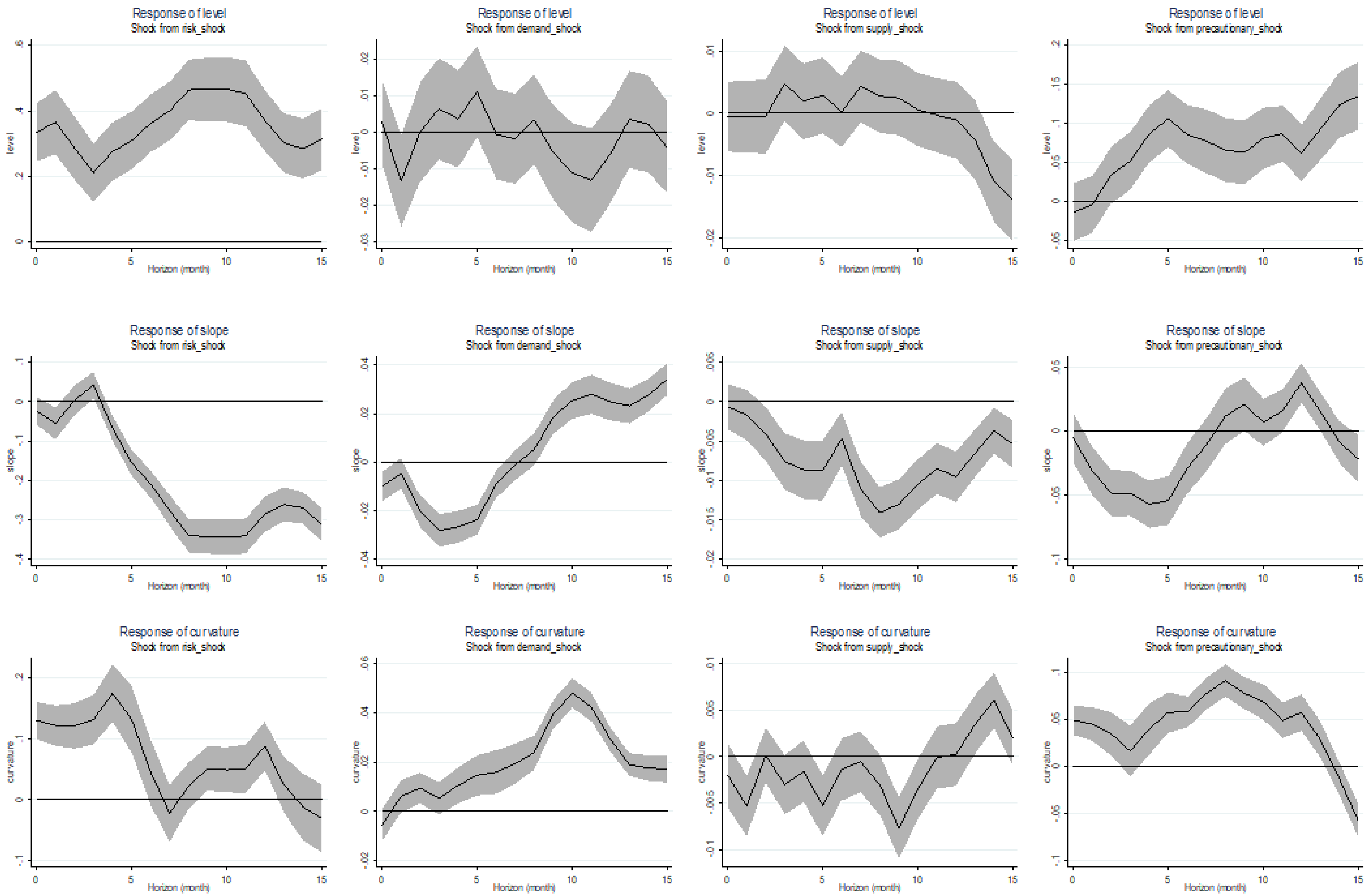
Notes: Solid line are responses to one-standard deviation shocks in market shocks based on local projections. Shaded gray areas correspond to the 68% confidence intervals. The heteroscedasticity and autocorrelation robust standard errors of Newey and West (1987) are used.

Figure 2: Responses of the yield curve factors to oil markets shocks - oil importing countries



Notes: See notes to Figure 1.

Figure 3: Responses of the yield curve factors to oil markets shocks - oil exporting countries



Notes: See notes to Figure 1.