**Oil price shocks and cost of capital: Does market liquidity play a role?**

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**Abstract**

This paper provides novel perspective to the oil-stock market nexus by examining the role of stock market liquidity in the propagation of oil price shocks to the cost of capital (CoC) estimates from a set of 34 global economies. Utilizing implied cost of capital estimates that are extracted from a dividend discount model and disaggregated oil price shock series including oil supply, consumption demand, inventory demand and economic activity shocks, we show that oil price shocks have quite heterogeneous effects on equity financing costs across the world economies, depending on the nature of the shock and the time horizon. Our findings show that oil supply shocks have a consistent positive effect on CoC, particularly for emerging economies and net oil importers, suggesting that supply driven oil price uncertainty significantly raises firm level financing costs regardless of the level of market liquidity. Interestingly however, market liquidity takes on a significant role when interacted with oil consumption demand shocks, suggesting that the effect of oil demand shocks on firms' financing costs is transmitted via the liquidity channel. Considering that liquidity dry-ups can severely impact firm financing costs, our findings provide important insights to policy makers as demand driven oil market shocks present a double challenge via its effects on market liquidity dynamics, which in turn, can enhance the negative impact of these shocks on firm financing costs and corporate investment activity. Overall, the findings highlight the role of market liquidity in the propagation of oil price shocks to firm financing costs with significant implications for corporate managers and policy makers.

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## 1. Introduction

The effect of oil prices on macroeconomic fundamentals and financial market dynamics has been studied extensively in the literature. The large majority of these works, however, have examined the oil-stock market nexus from an aggregate perspective by focusing on aggregate stock and sector indexes (or aggregate macroeconomic indicators) rather than firm-level dynamics. Equally interesting, however, is the role of oil price uncertainty on corporate financial management and how this interaction plays out in terms of risk-taking and investment behavior by firms. In recent studies focusing on oil price uncertainty on corporate investments, Maghyereh and Abdoh (2020) show that oil market uncertainty has a negative and asymmetric effect on corporate investment in energy related firms such that downside oil price volatility plays a dominant role on investment behavior than upside. Building on this evidence, Ilyas et al. (2021) show that oil market uncertainty interacts with economic policy uncertainty as a determinant of corporate investment behavior, particularly in oil producing economies. More recently, using the implied cost of capital as a proxy to measure risk preferences at the firm level, Yin and Lu (2022) show that oil uncertainty increases risk-taking among Chinese firms through the channel of risk compensation or real options related to firms' growth opportunities.

This paper contributes to this emerging literature from a novel perspective by examining: (i) the effect of disentangled oil price shocks on the implied cost of capital estimates from a set of 34 global economies, and (ii) the role of stock market liquidity in the propagation of oil price shocks to equity financing costs. Although the literature explores the determinants of cost of capital from various aspects including agency costs (Chen et al., 2011), regulatory environment (Hail and Leuz, 2006), market listing structure (Hail and Leuz, 2009) and disclosure incentives (Francis et al., 2005), to the best of our knowledge, the role of oil price shocks in equity financing costs and how they interact with stock market liquidity has not yet been explored in the context of cost of capital. Clearly, this is an issue of high importance both from a corporate decision making and policy perspective as cost of capital is a primary determinant of investment and risk-taking behavior at the firm-level, with significant implications for firm valuation (Lang et al., 2012), dividend and equity issuance policies (Banerjee et al., 2007; Hanselaar et al., 2019) as well as capital structure decisions (Lipson and Mortal, 2009).

From an economic perspective, one can argue that oil price shocks could affect financing costs, implied by the cost of capital estimates, from multiple channels. The first is the risk-taking channel in which rising oil market uncertainty contributes to a risk premium embedded in required investment returns as oil price shocks capture signals regarding future economic conditions. Financing costs can also be affected by the inflationary pressures associated with oil price hikes as inflationary pressures contribute to higher discount rates and weaker global demand (e.g. Hamilton, 2014; Baumeister and Kilian, 2016). Furthermore, considering the limited but growing evidence that oil price risk exposure captures a risk premium in the cross-section of stock market returns (e.g. Demirer et al., 2015; Chen and Demirer, 2022), oil price uncertainty could serve as a systematic risk factor which contributes to financing costs in the form of an equity risk premium, in line with the recent evidence in Ouyang et al. (2022).

A second channel in which oil price shocks could affect cost of capital is the market liquidity channel as oil market driven shocks can trigger investors' reaction that is manifested through trading activity, thus establishing a link between market liquidity patterns and capital financing costs. While the role of liquidity as a determinant of capital costs has been well established in the literature (e.g. Amihud and Mendelson, 2000; 2008; 2015; Saad and Samet, 2017), a separate strand of the literature links oil prices to stock market liquidity without making a link to cost of capital. For example, examining 130 energy firms in the U.S. during the period 2006–2011, Sklavos et al. (2013) find that rising oil prices lower the cost of trading and reduce market depth by lowering the price spread set by market makers. Supporting this evidence, Lambertides et al. (2017) link oil demand and supply shocks to stock market liquidity such that oil related news increase trading activity in the stock market, resulting in higher liquidity. Similarly, in an application to the Chinese stock market, Zheng and Su (2017) show that stock market liquidity increases in response to positive oil price shocks, driven by oil-specific demand factors, while shocks associated with oil supply and aggregate demand side shocks are found to be negatively linked to stock market liquidity. Accordingly, although two separate stands of the literature establish a link between stock market liquidity and oil prices as well as a link between stock market liquidity and cost of capital, to the best of our knowledge, the effect of oil price shocks on capital financing costs has not yet been examined and certainly not in the presence of stock market liquidity effects. Clearly, a better understanding of the role played by market liquidity in the propagation of oil price shocks to equity financing costs faced by corporations is an issue of great concern as illiquidity affects corporate investment and production, thus inducing firms to adopt less capital-intensive operations (Amihud and Levi, 2022), hurting the efficiency and productivity of the overall economy. Accordingly, our study contributes to the evidence on the effect of oil price shocks on corporate investment behavior from a novel perspective.

Our empirical analysis is motivated by the argument in Kilian and Park (2009) that failing to consider the source of oil price shocks in stock market analysis will yield biased results towards insignificance. Accordingly, we utilize disaggregated oil price series as per Baumeister and Hamilton (2019) and present a comparative analysis of structural oil shock effects on firm financing costs with respect to oil supply (production), economic activity (aggregate demand), oil inventory (speculative demand) and oil-market-specific (consumption demand) shocks. Given that our sample covers a large number of global economies, this approach is motivated by the evidence in Demirer et al. (2020) that supply and demand related oil shocks have quite heterogeneous effects on global stock and bond markets and the recent evidence in Ouyang et al. (2022) that oil specific demand and supply shocks exert asymmetric effects on systemic risk depending on market conditions. Furthermore, considering that a novelty of our analysis is to examine the role of liquidity in the propagation of oil price shocks, utilizing disaggregated oil shock series in our analysis builds on the evidence of heterogeneous effects of oil demand and supply shocks on stock market liquidity patterns (e.g. Lambertides et al., 2017; Zheng and

Su, 2017), implying that a similar pattern could hold when it comes to how oil shocks interact with market liquidity as a driver of equity financing costs.

Our analysis yields several interesting patterns regarding the effect of disaggregated oil price shocks on capital financing costs in advanced and emerging economies as well as the role played by market liquidity in the propagation of these shocks. We show that oil price shocks have quite heterogeneous effects on equity financing costs across the world economies and that these effects can take on opposite signs depending on the nature of the shock and the time horizon. While oil supply shocks lead to a rise in equity financing costs, particularly in the short run up to several months, positive oil consumption demand shocks lead to an initial drop in cost of capital, particularly for emerging economies and net oil importers, although the effect turns the other way around in the intermediate term for oil importers, leading to higher financing costs. The results also indicate clear distinctions on how disentangled oil market shocks affect capital financing costs based on market liquidity. The role of market liquidity is found to be particularly important when it comes to the propagation of oil consumption demand shocks, meaning that oil demand shocks are propagated to firm financing costs primarily via its effects on trading behavior among market participants. Considering the established evidence in the literature that liquidity dry-ups can severely impact firm financing costs, our findings provide important insights to policy makers as demand driven oil market shocks present a double challenge via its effects on market liquidity dynamics, which in turn, can enhance the negative impact of these shocks on firm financing costs and corporate investment decisions.

The remainder of this paper is organized as follows. Section 2 briefly reviews the vast literature on the nexus between oil price shocks and financial markets with a special focus on stock market liquidity and capital financing costs. Section 3 describes the data and empirical methodology, Section 4 presents the empirical findings and Section 5 concludes the paper.

## 2. Literature Review

Motivated by the pioneering studies by Kilian (2009) and Kilian and Park (2009) that advocate accounting for the nature of oil price shocks in stock market analyses, a rapidly growing literature has emerged over the last decade, examining the effect of disaggregated oil price shocks on financial markets. In their popularly cited study, Kilian and Park (2009) show that the stock return-oil price nexus is primarily determined by the nature of the oil price shock and that demand shocks are far more relevant than supply side shocks in explaining stock market dynamics in the U.S. This evidence is further explored in a large number of subsequent works applied to the stock markets of oil-exporting and oil-importing countries (e.g., Apergis and Miller, 2009; Filis et al., 2011; Basher et al., 2012; Wang et al., 2013; Güntner, 2014; Kang et al., 2015; Basher et al., 2018; Demirer et al., 2020). Some of these works have also documented asymmetries in the effect of oil price shocks such that positive oil price shocks due to unexpected global real economic activity increase stock returns, while positive oil price shocks due to unexpected oil-market specific demand factors decrease stock returns (e.g. Filis et al., 2011; Basher et al., 2012).

Separately, there is also a well-established literature that provides ample evidence on the role of liquidity as a systematic driver of stock market returns (e.g., Amihud, 2002; Pastor & Stambaugh, 2003; Bekaert et al., 2007; Butt et al., 2022) and capital financing costs (e.g. Amihud and Mendelson, 2000; 2008; 2015; Saad and Samet, 2017). In a relatively smaller strand of this literature, however, several studies have established a direct link between oil prices and stock market liquidity without making a link to cost of capital. For example, Balke et al. (2002) show that higher oil price volatility raises the perceived risks associated with less creditworthy firms, reducing the demand for illiquid instruments and raising financing costs for such firms. Similarly, Sklavos et al. (2013) link oil price changes to trading activity by market participants, arguing that rising oil prices result in a reduction in market liquidity in energy stocks as market makers adapt their spreads according to market trends. Focusing on the Chinese stock market, Zheng and Su (2017) show that stock market liquidity increases in response to positive oil price shocks, but only if those shocks are driven by demand side factors. This finding is further supported by Lambertides et al. (2017) who show that oil demand shocks can explain a significant percentage of variation in daily order flow imbalances, while oil supply shocks have a relatively less significant effect on liquidity. None of these studies, however, have examined the effect of oil price shocks on equity financing costs and whether or not stock market liquidity plays an intermediary role in the propagation of oil price shocks to cost of capital faced by corporations. This is clearly an important concern as liquidity patterns in the stock market reflect new information that can be conveyed by oil price shocks, which in turn, creates a channel in which oil price shocks are transmitted to the real economy through higher financing costs faced by corporations, resulting in lower investment in capital assets, R&D and inventory.

## 3. Data and Methodology

### *3.1. Data*

The empirical analysis utilizes monthly implied cost of equity capital and market liquidity data for 34 countries in addition to the oil price shock series that capture oil supply, economic activity, oil-specific consumption demand and oil inventory demand shocks. Table 1 provides the list of countries in the sample along with the sample periods for each country with a common ending date for all series in June 2021. The estimation procedure for the implied cost of capital (ICC) series builds primarily on Claus and Thomas (2001) and Gebhardt et al. (2001), which aims at extracting an implied discount rate within a dividend discount model.[1] In this framework, the market value of a firm *i* can be formulated as:

$$MV_{i,0} = \sum_{j=1}^{n} \frac{D_{i,0}}{(1+k_i)^j} + \frac{D_{i,n+1}}{(k_{i-}g_i)^j(1+k_i)^2} \quad (1)$$

where $k_i$ is the implied cost of capital of a firm i, $MV_{i,0}$ is the current market value of firm i, $D_{j,0}$ the j-year ahead dividend forecast and $g_i$ the long-run growth rate. The current market value of the firm

[1] Pastor et al. (2008) argue that the implied cost of capital is a good proxy for a stock's conditional expected return as it does not rely on noisy realized returns or specific asset pricing models.

($MV_{i,0}$) is the product of the number of shares outstanding and the share price. The per-share dividend forecasts ($D_{i,j}$) for the first two years are taken from the mean estimates of all analysts providing dividend estimates for a particular firm. The dividend forecast for a firm is then determined by multiplying the per-share forecast by the number of shares outstanding. In our application, dividend forecasts for the first two years (n=1, 2) are used to derive the dividend in year n=3 jointly from the earnings forecast and the long-run growth rate. Assuming that payout ratios and growth rates from year n+1 on must be consistent, i.e., dividends must grow in line with the long-run book value, we obtain

$$\frac{E_{i,n+1} - D_{i,n+1}}{BV_{i,n}} = g_i \tag{2}$$

which yields the dividend estimate for n=3 calculated as $D_{i,3} = E_{i,3} - g_i BV_{i,2}$. The long-run growth rate ($g_i$) in Equation (2) is specified as $g_i = \max(r_f - 2\%, 0)$ , where $r_f$ is the 10-year Government bond yield of the respective country. This formulation follows the argument that government bond yields should be equal to the long-run nominal growth rate of the economy and therefore, in the spirit of Claus and Thomas (2001), the 2% deduction is applied to the government bond yield to account for the fact that part of this growth is likely to come from new firms so that existing firms should grow at a rate somewhat lower than the growth rate of the economy. In our application, we utilize cost of capital estimates at the country-level obtained by aggregating firm-level market cap, dividends and earnings within Equation (1).[2]

As the main focus of our analysis is to examine the role of market liquidity in the propagation of oil price shocks to the cost of capital, we utilize the popularly employed Amihud (2002) liquidity measure which serves as a measure of the price impact of illiquidity. Amihud (2002) illiquidity measure is defined as the daily ratio of the absolute stock return over the local currency volume of the stock, thus capturing the low frequency price response associated with one unit of trading volume. Belkhir et al. (2020) note that this measure of illiquidity is especially suitable for international data that often suffer

[2] See Berg et al. (2017) for further details on the estimation methodology. The cost of capital data is publicly available at https://www.fa.mgt.tum.de/fm/research/data/.

from data limitations (Karolyi et al., 2012), while Hasbrouck (2009) argues that the Amihud (2002) measure captures high-frequency price impact better than any other liquidity proxies. In our application, we follow Karolyi et al. (2009) who formulate the liquidity of stock i on day d as:

$$liq_{i.d} = -\log(1 + \frac{|R_{i,d}|}{P_{i,d}VO_{i,d}}) \quad (3)$$

where $liq_{i.d}$ is the Amihud liquidity proxy, $R_{i,d}$ is the return in local currency, $P_{i,d}$ is the price in local currency, and $VO_{i,d}$ is the trading volume of stock i on day d. To obtain an aggregate measure of market liquidity for each country, we collect daily total market index price and volume data from Datastream to compute daily measure of liquidity and construct monthly time-series as the average daily liquidity value in a given month for each country.

Finally, the procedure to compute structural oil price shock series follows Baumeister and Hamilton (2018). The authors utilize the quantity of global crude oil produced, the real price of oil, real economic activity and crude oil inventories to describe the global oil market and capture oil market shocks from various dimensions. In their formulation, the production of world crude oil is used as a proxy for oil supply. The real price of oil is calculated by deflating the nominal spot prices of West Texas Intermediate crude oil using the US consumer price index. The industrial production index, which includes the Organization for Economic Cooperation and Development (OECD) countries, is used as a proxy for real economic activity and an estimate of crude oil inventories (i.e. the quantity of oil that is produced but not consumed) is calculated by multiplying US crude oil stocks by the ratio of the petroleum inventory of the OECD to that of the US. Utilizing these variables within a structural Bayesian vector autoregression (SBVAR) model, Baumeister and Hamilton (2018) derive oil market shock series disaggregated into four components that capture oil supply (OSS), economic activity (EAS), oil consumption demand (OCDS), and oil inventory demand (OIDS) shocks.[3]

[3] Data available at Christiane Baumeister's research page: https://sites.google.com/site/cjsbaumeister/research

*3.2. Methodology*

*3.2.1. Response of cost of capital to structural oil shocks*

To examine the effect of disaggregated oil price shocks on implied cost of capital, we utilize the linear projections (LP) method proposed by Jordà (2005) as our benchmark model. The benchmark model is first used to examine the response of implied cost of capital to structural oil market shocks irrespective of the state of stock market liquidity. In the next step, we extend our analysis to compare the effects of oil shocks on implied cost of capital during high and low liquidity regimes. To that end, we follow Auerbach and Gorodnichenko (2016) who extend the linear model to a non-linear (LP) framework using a dummy variable approach to capture regime-switching between various market states (in our case stock market liquidity states).

The linear projections impulse response functions (LPIRFs) in their linear form can be obtained by estimating the following set of OLS regressions for each forecast horizon:

$$Y_{t+h} = \alpha^h + \beta_1^h y_{t-1} + \cdots + \beta_1^h y_{t-p} + u_{t+1}^h, h = 0,1,2,..H-1 \quad (4)$$

where $\alpha^h$ is a vector of constants, $\beta_1^h$ are parameter matrices for lag p and forecast horizon h and the vector $u_{t+1}^h$ are autocorrelated and/or characterized by heteroscedastic disturbances.[4] The collection of all regressions of Equation (4) are called LPs and the slope matrix $\beta_1^h$ is interpreted as the response of $Y_{t+h}$ to a reduced form shock in t (Kilian and Kim, 2011). Structural impulse responses are then estimated by:

$$\widehat{IR}(t,h,d_i) = \beta_1^h d_i, \quad (5)$$

where $d_i = \beta_0^{-1}$ . The shock matrix $d_i$ must be identified from a linear VAR. Given the serial correlation of $u_{t+1}^h$, Jordà (2005) proposes to estimate robust standard errors using the Newey and West (1987) approach. The LP method that computes impulse responses do not require specification and

[4] We select number of lags using Akaike information criterion (AIC) and the maximum length of forecast horizons is set to 24, which corresponds to a 24-month forecast horizon.

estimation of the underlying multivariate dynamic system itself. The central idea consists of estimating local projections at each period of interest rather than extrapolating into increasingly distant horizons from a given model, as it is done with a VAR.

The framework in Equations (4) and (5) can be extended to accommodate a non-linear form. In our case, we follow Auerbach and Gorodnichenko (2016) and compute the state probabilities using the following logistic function:

$$F(z) = \frac{e^{(-\gamma Z_t)}}{(1 + e^{(-\gamma Z_t)})}, \tag{6a}$$

$$var(z_t) = 1, E(z_t) - 0, \tag{6b}$$

where $z_t$ is standardized such that γ (> 0) is scale-invariant. In our context, $F(z)$ corresponds to changes in liquidity at time t so that an increase in $z_t$ would lead to a decrease in $F(z_t)$. $F(z_t)$ values close to zero thus indicate periods of high liquidity. The observations for the two regimes are the product of the transition function and the endogenous variables:

$$\text{Regime 1 } (R_1) : y_{t-1} * (1 - F(z_{t-1})), \; l = 1, \ldots, p,$$
$$\text{Regime 2 } (R_2) : y_{t-1} * (F(z_{t-1})), \; l = 1, \ldots, p, \tag{7}$$

Finally, structural nonlinear impulse responses are estimated using the following:

$$\widehat{IR}^{R1}(t, h, d_i) = \hat{\beta}^h_{1,R1} d_i, \quad h = 0, \ldots, H\text{-}1 \tag{8}$$
$$\widehat{IR}^{R2}(t, h, d_i) = \hat{\beta}^h_{1,R2} d_i, \; h = 0, \ldots, H\text{-}1$$

where $\hat{\beta}^0_{1,R1}$ = I and $\hat{\beta}^0_{1,R2}$= I. The coefficient matrices $\hat{\beta}^h_{1,R1}$and $\hat{\beta}^h_{1,R2}$ are obtained from the following LPs:

$$y_{t+h} = \alpha^h + B^h_{1,R1}(y_{t-1} * \left(1 - F(z_{t-1})\right) + \ldots + B^h_{p,R1}(y_{t-p} * \left(1 - F(z_{t-1})\right) + B^h_{1,R2}(y_{t-1} * \left(1 - F(z_{t-1})\right) + \ldots + B^h_{p,R2}(y_{t-p} * \left(1 - F(z_{t-1})\right) + u^h_{t+h'} \tag{9}$$

with h = 0, . . . , H − 1.

*3.2.2. Cross-sectional regressions*

In the second part of our analysis, we utilize cross-sectional regressions to examine the impact of oil price shocks on cost of capital within country groups. Similar to the approach followed in the impulse response analysis described in the previous section, we first examine the impact of oil shocks on implied cost of capital without accounting for market liquidity by estimating:

$$ICC_{i,t} = \alpha_0 + \alpha_1 OSS_{t-1} + \alpha_2 EAS_{t-1} + \alpha_3 OCDS_{t-1} + \alpha_4 OIDS_{t-1} + \varepsilon_{i,t} \tag{10}$$

$$ICC_{i,t} = \alpha_0 + \alpha_1 ICC_{i,t-1} + \alpha_2 OSS_{t-1} + \alpha_3 EAS_{t-1} + \alpha_4 OCDS_{t-1} + \alpha_5 OIDS_{t-1} + \varepsilon_{i,t} \tag{11}$$

where $ICC_{i,t}$ is the implied cost of capital for country *i* in month *t* and OSS, EAS, OCDS, OIDS refer to oil supply, economic activity, oil consumption demand and oil inventory demand shocks, respectively. Next, we augment our benchmark model by interacting oil shocks with liquidity to examine whether stock market liquidity plays a significant role in the propagation of oil shocks to cost of capital. Specifically, we estimate the following models and test the significance of the interaction term for each oil shock and liquidity:

$$\begin{aligned} ICC_{i,t} = \alpha_0 &+ \alpha_1 OSS_{t-1} + \alpha_2 (OSS * liquidity)_{i,t-1} + \alpha_3 EAS_{t-1} \\ &+ \alpha_4 (EAS * liquidity)_{i,t-1} + \alpha_5 OCDS_{t-1} + \alpha_6 (OCDS * liquidity)_{i,t-1} \\ &+ \alpha_7 OIDS_{t-1} + \alpha_8 (OIDS * liquidity)_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{12}$$

$$\begin{aligned} ICC_{i,t} = \alpha_0 &+ \alpha_1 ICC_{i,t-1} + \alpha_2 (ICC * liquidity)_{i,t-1} + \alpha_3 OSS_{t-1} \\ &+ \alpha_4 (OSS * liquidity)_{i,t-1} + \alpha_5 EAS_{t-1} \\ &+ \alpha_6 (EAS * liquidity)_{i,t-1} + \alpha_7 OCDS_{t-1} + \alpha_8 (OCDS * liquidity)_{i,t-1} \\ &+ \alpha_9 OIDS_{t-1} + \alpha_{10} (OIDS * liquidity)_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{13}$$

where $liquidity_{i,t}$ is the Karolyi et al. (2009) liquidity measure for country *i* in month *t* as described in Equation (3). Note that as per the construction of the liquidity measure, higher values for $liquidity$ indicate greater market liquidity.

## 4. Empirical results

### *4.1. Responses to structural oil price shocks*

Preliminary descriptive checks presented in Table 1 show that Russia and Turkey top the list in terms of implied cost of capital values estimated at 14.69 and 13.97 percent, respectively. Equity financing costs can be as high as 24.6 and 20.1 percent for these two developing economies, suggesting that firms generally face higher financing costs for their investment projects. At the same time, developed economies including Japan and Switzerland enjoy the most favorable equity financing costs estimated at 6.68 and 7.11 percent, respectively. In order to explore whether or not the higher implied costs of capital observed for most emerging economies in Table 1 have any link to stock market liquidity, we present in Table 2 the univariate analysis for the ICC estimates during periods of high and low market liquidity. For this purpose, capturing market liquidity by the Karolyi et al. (2009) measure presented in Equation 3, we categorize a month $t$ in high (low) market liquidity state if the market liquidity value for the month is greater (lower) than the median value over the trailing 12-month period. Consistent with the literature that shows that improved liquidity can contribute to lower capital costs (e.g. Bekaert et al., 2007; Saad and Samet, 2017; Amihud and Mendelson, 2000; 2008; 2015; Amihud and Levi, 2022), we observe in Table 2 that periods during which stock markets enjoy higher liquidity are generally associated with lower cost of capital values. This is further supported statistically by the highly significant t-statistics, reported in the last two columns in the table, for the difference in cost of capital for low minus high liquidity states. Overall, our preliminary checks support the evidence in the literature and show that advanced economies generally enjoy lower cost of capital, while greater stock market liquidity is associated with lower capital financing costs.

Having confirmed the established evidence in the literature regarding the link between stock market liquidity and cost of capital, we next examine the effect of disentangled oil price shocks on the ICC estimates, for each country individually and across various country groups. Table A1 in the Appendix presents the list of the country groups considered in our analysis, primarily based on the MSCI stock market classification. Specifically, we examine developed, emerging, net oil importer/exporter, G7 and BRICS in order to provide comparative analysis of the oil shock effects based on economic characteristics. Figure 1 shows the impulse responses to a one unit increase in disaggregated oil shocks of cost of capital up to 24-months into the future. The shaded areas represent the 95% confidence intervals and are calculated based on panel corrected standard errors. We observe that oil supply shocks lead to a rise in equity financing costs, particularly in the short run up to several months, while the effect of the shocks on financing costs adjusts back over the next twelve months as firms adapt to the shock. Oil supply shocks are particularly significant, both in magnitude and statistical significance, for oil exporters and BRICS economies, while the impact on developed economies is relatively smaller, although still statistically significant. Further examining, the country specific results reported in Figure A1 in the Appendix, we see that the positive effect of oil supply shocks on equity financing costs in the short run is particularly strong for commodity exporters like Australia, Brazil and Canada, while all economies in general enjoy lower financing costs due to positive oil supply shocks in the long run, particularly India, China and Japan. Clearly, positive oil supply shocks help firms lower their financing costs after several months of adjustment to the new normal.

While economic activity shocks have largely insignificant effects in the short run, with the exception of BRICS economies who are favorably affected in terms financing costs, we observe that all country groups end up facing higher cost of capital in the long run as rising economic activity puts pressure on inflationary expectations and interest rates, thereby driving financing costs faced by firms. In contrast, positive oil consumption demand shocks lead to an initial drop in financing costs, particularly for emerging economies and net oil importers although the effect turns the other way around in the intermediate term for oil importers, leading to higher financing costs. The intermediate positive effect of oil demand shocks in the intermediate term, particularly for oil importers, supports the argument in Killian (2009) that oil-specific demand shocks generally indicate uncertainty over future oil supply. This argument is further supported in Figure A1 by the strong long-run positive effect of oil-specific demand shocks on cost of capital, particularly for China and Japan where the impact of financing costs can as high as 4% and 2% percent, respectively. Finally, we observe in Figure 1 generally insignificant effects on cost of capital due to oil inventory demand shocks across all country groups. Overall, the finding show that oil supply and demand shocks have quite heterogeneous effects on equity financing costs across the world economies and that these effects can take on opposite signs depending on the nature of the shock and the time horizon. However, whether or not stock market liquidity plays any role in the propagation of these shocks to cost of capital is yet to be explored next.

### *4.2. The role of market liquidity*

In Figure 2, we present the impulse responses of cost of capital to a one unit increase in disaggregated oil shocks during the high and low market liquidity regimes. We observe quite distinct patterns in the responses across the two regimes, suggesting that stock market liquidity indeed plays a significant role in the effect of these shocks on financing costs. The distinction between high and low liquidity regimes is particularly evident for developed countries, net oil importers and G7 nations for which positive oil supply shocks lower cost of capital during the high liquidity regimes whereas the opposite effect happens when the stock market suffers from illiquidity, which in turn, raises financing costs in response to oil supply shocks. This finding suggests that market illiquidity indeed hurts the real economy by enhancing the magnitude and duration of oil supply shocks on capital financing costs in those economies, while improved liquidity serves as a cushion against oil supply shocks.

In contrast, market liquidity does not make a significant difference when it comes to the effect of economic activity shocks of financing costs. We do not observe a significant difference in the response of ICC values to economic demand shocks due to market liquidity with positive economic activity shocks generally yielding insignificant effects during both regimes. Interestingly, the only exception to this is net oil exporters for which positive economic activity shocks lower cost of capital in those countries during the liquid market state whereas the opposite effect is found during the illiquid state indicated by a positive response of ICC to these shocks. Clearly, market liquidity takes on a significant role for net exporting nations when it comes to how capital financing costs respond to economic activity shocks, which is an important consideration from a policy making perspective.

In the case of oil consumption demand shocks, however, the distinction between high and low liquidity regimes is found to be even stronger. While the initial effect of positive oil demand shocks on financing costs is negative during both regimes, we observe that the effect turns positive in the long run during the liquid regime. This asymmetric pattern is particularly evident for Canada, Mexico, Norway and the U.S. in Figure A1, with a significant rise in capital financing costs for firms in these countries in the long run up to 1 year in response to a positive oil consumption demand shock. This finding is indeed consistent with the evidence by Filis et al. (2011) and Basher et al. (2012) that positive oil price shocks due to unexpected oil-market specific demand factors decrease stock returns and our findings suggest that the negative effect on stock returns could be driven by the rise in firm financing costs in the long-term as a response to consumption demand driven oil price shocks.

Finally, we observe oil inventory demand shocks result in generally insignificant effects on cost of capital regardless of the liquidity regime, in line with the evidence from the linear model in Figure 1. Several distinct patterns are observed, however, at the individual country level. The most striking example is Mexico where we observe higher (lower) capital financing costs in the intermediate and long term during the low (high) liquidity regimes in response to oil inventory demand shocks. Clearly, market illiquidity strengthens the negative effect of these shocks on firm financing costs in this economy. Similarly, while positive oil inventory demand shocks raise capital financing costs in the short and intermediate terms during the liquid regime in Australia, Norway, U.K. and the U.S., we observe that the effect of the shock is largely insignificant during the illiquid regime. Overall, the results from the non-linear VAR specification indicate clear distinctions on how disentangled oil market shocks affect equity financing costs during the high and low liquidity market states, suggesting that market liquidity plays a critical role in the propagation of these shocks to firm financing costs.

These findings support the general notion that firm trading environment plays a critical role in equity financing and, in turn, the value of the firm (Lang et al., 2011) as well as capital structure decisions (Lipson and Mortal, 2009). The results also support the evidence in Balke et al. (2002) and Zheng and Su (2017) that establish a link between market liquidity and oil prices. Our evidence, thus, adds a novel perspective to these discussions in that we show that the interaction between oil market shocks and cost of capital depends not only on the nature of the oil price shock, but also the state of the market in terms of liquidity. Clearly, these findings have significant implications for not only policy makers as financing costs are a major determinant of investment in capital assets and R&D in the economy, but also for corporate decision makers when it comes to valuing investment projects that are highly sensitive to cost of capital estimates.

*4.3. Oil price shocks and cost of capital: Cross-sectional analysis*

In the final part of our analysis, we conduct cross-sectional regressions, as described in Equations 10-13, in order to quantify the impact of oil price shocks on cost of capital within country groups. Table 3 presents the estimates for Equation 10 (Model 1) and Equation 11 (Model 2 ), estimated cross-sectionally across various country groups. In Model 2, we include the lagged ICC term in the equation in order to ensure the robustness of our findings regarding the marginal effect of each type of oil shock on cost of capital. The results from the cross-sectional tests point to a robust positive effect of oil supply shocks on equity financing costs across all country groups. The positive effect of oil supply shocks is particularly strong in magnitude and statistical significance for emerging countries as well as BRICS nations. While the marginal effect of a one-unit oil supply shock is found to be as high as 14.9% (Model 1) for emerging economies overall, the effect rises to 24.4% for BRICS economies. The marginal effect of oil supply shocks on developed nations, however, is relatively smaller (although still statistically significant) at 12.3%. These findings, therefore, clearly show that oil price shocks that are driven by supply side factors indeed raise firm financing costs, albeit more severely in emerging economies.

These results support the evidence by Ready (2018) that oil supply shocks are generally negatively correlated with stock market returns and suggest that the effect of oil supply shocks on stock market returns could be driven by the effects on capital financing costs that drive equity valuations, particularly in the long run. Interestingly, however, we do not observe any consistent patterns in terms of the effect of economic activity or demand related oil price shocks on cost of capital, with the exception of oil consumption demand shocks in emerging economies for which a positive effect is found (0.011). In any case, the results in Table 3 highlight the role oil supply shocks as a robust driver of implied cost of capital faced by firms globally, while the effect of the other type of oil price shocks could be manifested via the market liquidity channel.

Extending our analysis to the role of market liquidity in our cross-sectional tests, the findings for Equations 12 and 13 reported in Table 4 show that the effect of oil supply shocks on cost of capital generally manifests itself irrespective of market liquidity, implied by the insignificant coefficients for the interaction term, $(OSS * liquidity)$, while positive and highly significant coefficient estimates are observed for $OSS$ in both model specifications. Once again, the effect of oil supply shocks is greater in size for emerging economies compared to their developed counterparts, suggesting that oil supply shocks have a relatively greater negative effect on firms in emerging economies by leading to a greater rise in financing costs for capital projects.

In contrast, we find that the interaction term for oil consumption demand shocks, $(OCDS * liquidity)$, is highly significant and positive for both the developed and emerging economies. While oil consumption demand shocks are generally insignificant in our cross-sectional tests, we find that these shocks take on a significant role when interacted with market liquidity. The interaction effect is particularly significant for emerging economies with estimated coefficient values of 0.004. The significant interaction between liquidity and oil demand shocks is indeed in line with the evidence in

Lambertides et al. (2017) that associates positive oil-demand shocks with market illiquidity and in Zheng and Su (2017) that oil-specific demand side factors are more important as a driver of stock market liquidity patterns compared to the other type of oil price shocks. Considering that oil specific demand shocks raise uncertainty regarding future oil supply conditions (Kilian, 2009), it can be argued that these shocks contribute to order flow imbalances across traded stocks as investors face greater uncertainty regarding the future state of the energy market. Nevertheless, considering oil price volatility can affect liquidity dynamics in the stock market (e.g. Balke et al., 2002), our findings suggest that the effect of an oil demand shock on capital financing costs could be further enhanced through its effect on liquidity. Therefore, our findings show that market liquidity can indeed contribute to the propagation of oil demand shocks on firm financing costs, which is an important concern for the growth and innovation in the economy. Overall, our findings show that market liquidity plays a critical role in the effect of oil market shocks on cost of capital values, while the effect depends largely the nature of the oil shock and how it interacts with trading behavior among market participants.

## 5. Conclusion

The oil-stock market nexus is a topic of high interest for investors, policy makers and academics given its implications on asset allocation, risk management, asset pricing as well as macroeconomic forecasting and planning. Recent studies show that oil market uncertainty serves as a determinant of corporate investment behavior through the channel of risk compensation or real options related to firms' growth opportunities. Following this argument, if oil market uncertainty contributes to a risk premium required by firms in corporate investment decisions via a risk compensation channel, then one can argue that this effect should manifest itself on equity financing costs faced by corporations when it comes to funding investment projects. We approach this nexus from a novel perspective by: (i) providing a comparative analysis of the effect of disaggregated oil price shocks on equity financing costs from a large set of developed and emerging countries; and (ii) exploring the role of market liquidity in the propagation of oil price shocks to corporate financing costs. Clearly, the interaction between market liquidity and oil price shocks as a driver of equity financial costs is an issue of great concern as illiquidity affects corporate investment and production, thus inducing firms to adopt less capital-intensive operations, in turn, hurting the efficiency and productivity of the overall economy.

Utilizing implied cost of capital estimates for 34 global economies, extracted from a dividend discount model, and disaggregated oil price shock series including oil supply, consumption demand, inventory demand and economic activity shocks, we find that oil price shocks have quite heterogeneous effects on capital financing costs across the world economies and that these effects can take on opposite signs depending on the nature of the shock and the time horizon. While oil supply shocks lead to a rise in capital financing costs, particularly in the short run up to several months, positive oil consumption demand shocks lead to an initial drop in financing costs, particularly for emerging economies and net oil importers although the effect turns the other way around in the intermediate term for oil importers, leading to higher financing costs. Interestingly, the results from the non-linear VAR specification indicate clear distinctions on how disentangled oil market shocks affect capital financing costs during the high and low liquidity market states. We find that market illiquidity hurts the real economy by enhancing the magnitude and duration of oil supply shocks on capital financing costs, while improved liquidity serves as a cushion against oil supply shocks.

Interestingly, the role of market liquidity is found to be particularly important when it comes to the propagation of oil consumption demand shocks. While oil consumption demand shocks are found to be generally insignificant in our cross-sectional tests, we find that these shocks take on a significant role when interacted with market liquidity, suggesting that oil demand shocks are propagated to firms' financing costs primarily via its effects on trading behavior among market participants. Considering the established evidence in the literature that liquidity dry-ups can severely impact firm financing costs, our findings provide important insights to policy makers as demand driven oil market shocks present a double challenge via its effects on market liquidity dynamics, which in turn, can enhance the negative impact of these shocks on firms' financing costs and corporate investment decisions. Therefore, it is imperative for market regulators to monitor market liquidity proxies, particularly in response to demand driven oil market shocks, in order to mitigate the possible negative effects of these shocks on capital investments and R&D activity in the economy. For future work, it would be interesting to extend our analysis to a firm- or industry-level context and explore whether certain firm or industry characteristics play a role in how disentangled oil price shocks impact financing costs conditional on liquidity conditions.

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**Table 1.** Summary statistics.

| | N | Mean | S.D | Min | Max | Sample period |
|---|---|---|---|---|---|---|
| **Panel A: Implied Cost of Capital (ICC)** | | | | | | |
| Australia | 282 | 8.564 | 1.362 | 5.179 | 12.443 | 1-Jan-98 |
| Austria | 261 | 9.382 | 1.456 | 7.054 | 16.176 | 1-Oct-99 |
| Belgium | 256 | 8.671 | 1.686 | 5.558 | 13.913 | 1-Mar-00 |
| Brazil | 137 | 12.350 | 1.516 | 8.435 | 15.314 | 1-Jan-10 |
| Canada | 221 | 8.280 | 0.998 | 6.717 | 12.571 | 1-Feb-03 |
| China | 179 | 8.962 | 1.741 | 5.666 | 13.044 | 1-Aug-06 |
| Denmark | 276 | 7.408 | 1.469 | 4.106 | 11.408 | 1-Jul-98 |
| Finland | 270 | 7.842 | 1.285 | 5.389 | 11.959 | 1-Jan-99 |
| France | 540 | 8.057 | 1.412 | 5.420 | 11.864 | 1-Jan-99 |
| Germany | 268 | 8.346 | 1.204 | 6.290 | 12.388 | 1-Mar-99 |
| Greece | 246 | 10.600 | 2.330 | 7.065 | 18.920 | 1-Jan-01 |
| Hong Kong | 268 | 8.440 | 0.769 | 6.623 | 11.772 | 1-Mar-99 |
| India | 265 | 11.029 | 1.607 | 7.690 | 16.050 | 1-Jun-99 |
| Indonesia | 218 | 12.144 | 2.649 | 8.452 | 20.103 | 1-May-03 |
| Italy | 264 | 8.755 | 1.592 | 6.491 | 14.049 | 1-Jul-99 |
| Japan | 257 | 6.678 | 1.332 | 2.851 | 9.938 | 1-Feb-00 |
| Korea | 248 | 10.906 | 1.770 | 6.536 | 17.207 | 1-Nov-00 |
| Malaysia | 236 | 8.092 | 0.962 | 6.168 | 14.325 | 1-Nov-01 |
| Mexico | 148 | 9.161 | 1.015 | 6.840 | 11.292 | 1-Feb-09 |
| Netherlands | 266 | 8.350 | 1.724 | 4.664 | 13.286 | 1-May-99 |
| Norway | 277 | 9.174 | 1.549 | 5.929 | 17.626 | 1-Jun-98 |
| Poland | 217 | 9.087 | 1.151 | 7.234 | 13.674 | 1-Jun-03 |
| Portugal | 232 | 8.210 | 0.987 | 5.933 | 11.766 | 1-Mar-02 |
| Russia | 215 | 13.972 | 3.232 | 7.515 | 24.583 | 1-Aug-03 |
| Singapore | 266 | 7.797 | 0.776 | 6.258 | 11.360 | 1-May-99 |
| South Africa | 240 | 12.741 | 1.767 | 9.540 | 18.523 | 1-Jul-01 |
| Spain | 263 | 8.699 | 1.414 | 6.430 | 13.637 | 1-Aug-99 |
| Sweden | 276 | 7.676 | 1.211 | 4.999 | 11.831 | 1-Jul-98 |
| Switzerland | 282 | 7.117 | 1.081 | 4.820 | 10.451 | 1-Jan-98 |
| Taiwan | 218 | 7.843 | 0.801 | 6.161 | 10.667 | 1-May-03 |
| Thailand | 262 | 9.754 | 2.014 | 5.595 | 14.574 | 1-Sep-99 |
| Turkey | 136 | 14.685 | 2.345 | 11.036 | 20.138 | 1-Feb-10 |
| UK | 282 | 8.388 | 1.120 | 6.146 | 11.794 | 1-Jan-98 |
| US | 230 | 7.456 | 1.198 | 4.678 | 11.098 | 1-May-02 |
| **Panel B: Oil Shocks** | | | | | | |
| Supply (OSS) | 282 | -0.033 | 0.808 | -6.869 | 3.533 | |
| Economic Activity (EAS) | 282 | 0.130 | 4.152 | -21.847 | 9.053 | |
| Demand (OCDS) | 282 | -0.148 | 1.281 | -10.730 | 3.416 | |
| Inventory (OIDS) | 282 | -0.148 | 1.281 | -10.730 | 3.416 | |

**Note.** This table presents the descriptive statistics for the monthly implied cost of capital (ICC) and oil price series. The last column shows the start date for each country with a common ending date for all in June 2021. OSS: oil supply shock; EAS: economic activity shock; OCDS: oil-specific consumption demand shock; OIDS: oil inventory demand shock

**Table 2.** Univariate analysis of market liquidity and cost of capital.

| | Cost of Capital | | | |
|---|---|---|---|---|
| | Low liquidity | High liquidity | Difference | t-stat |
| Australia | 8.863 | 8.503 | 0.359 | 9.39 |
| Austria | 10.375 | 8.842 | 1.533 | 1.67 |
| Belgium | 9.904 | 8.179 | 1.726 | 8.33 |
| Brazil | 13.327 | 11.823 | 1.504 | 6.27 |
| Canada | 9.097 | 7.939 | 1.158 | 9.25 |
| China | 9.424 | 8.757 | 0.667 | 2.39 |
| Denmark | 8.785 | 7.139 | 1.646 | 7.54 |
| Finland | 8.165 | 7.699 | 0.465 | 2.78 |
| France | 8.79 | 7.653 | 1.137 | 9.7 |
| Germany | 8.424 | 7.876 | 0.548 | 2.63 |
| Greece | 11.57 | 9.109 | 2.461 | 9.44 |
| Hong Kong | 9.265 | 8.344 | 0.921 | 6.43 |
| India | 12.689 | 10.574 | 2.115 | 10.46 |
| Indonesia | 14.861 | 11.855 | 3.007 | 5.24 |
| Italy | 9.361 | 8.177 | 1.184 | 6.5 |
| Japan | 6.678 | 6.677 | 0.001 | 0 |
| Korea | 12.688 | 10.707 | 1.981 | 5.62 |
| Malaysia | 8.804 | 7.988 | 0.816 | 4.51 |
| Mexico | 9.444 | 9.053 | 0.391 | 2.12 |
| Netherlands | 8.952 | 7.428 | 1.524 | 7.8 |
| Norway | 10.246 | 8.927 | 1.319 | 5.86 |
| Poland | 10.388 | 8.917 | 1.471 | 6.57 |
| Portugal | 8.379 | 7.942 | 0.437 | 3.36 |
| Russia | 16.564 | 13.706 | 2.857 | 3.89 |
| Singapore | 8.343 | 7.688 | 0.655 | 5.38 |
| South Africa | 15.671 | 12.503 | 3.167 | 8.29 |
| Spain | 9.158 | 8.347 | 0.811 | 4.8 |
| Sweden | 8.512 | 7.44 | 1.072 | 6.55 |
| Switzerland | 7.594 | 6.904 | 0.69 | 5.17 |
| Taiwan | 8.291 | 7.603 | 0.688 | 6.62 |
| Thailand | 12.113 | 9.527 | 2.586 | 6.3 |
| Turkey | 14.39 | 14.727 | -0.337 | -0.55 |
| UK | 9.305 | 8.218 | 1.088 | 6.31 |
| US | 8.541 | 7.221 | 1.32 | 7.04 |

**Note.** This table presents the univariate analysis for cost of capital during periods of high and low market liquidity. Market liquidity is captured by the Karolyi et al. (2009) version of the Amihud (2002) proxy for liquidity. We categorize a month *t* in high (low) market liquidity state if the market liquidity value for the month is greater (lower) than the median value over the trailing 12-month period. The last two columns show the difference in cost of capital for low minus high liquidity states along with the corresponding t statistics.

**Table 3.** Cross-sectional regression results for country groups.

| | Developed Countries | | Emerging Countries | |
|---|---|---|---|---|
| | Model 1 | Model 2 | Model 1 | Model 2 |
| $\alpha$ | 8.183*** | 0.414*** | 10.723*** | 0.461*** |
| | (411.7) | (11.46) | (210.08) | (7.76) |
| $ICC_{i,t-1}$ | | 0.949*** | | 0.956*** |
| | | (218.25) | | (178.42) |
| $OSS_{i,t-1}$ | 0.123*** | 0.011* | 0.149*** | 0.039** |
| | (6.87) | (1.86) | (3.3) | (2.95) |
| $EAS_{i,t-1}$ | -0.079** | 0.005 | -0.092 | -0.022 |
| | (-3.19) | (0.66) | (-1.53) | (-1.28) |
| $OCDS_{i,t-1}$ | 0.006 | 0.003 | -0.002 | 0.011** |
| | (1.11) | (1.54) | (-0.17) | (2.68) |
| $OIDS_{i,t-1}$ | 0.062** | 0.006 | 0.063 | 0.008 |
| | (3.14) | (0.87) | (1.20) | (0.55) |
| R-Square | 0.0147 | 0.897 | 0.007 | 0.912 |
| | Oil Import Countries | | Oil Export Countries | |
| | Model 1 | Model 2 | Model 1 | Model 2 |
| $\alpha$ | 8.973*** | 0.268*** | 10.007*** | 0.426*** |
| | (151.47) | (4.8) | (127.21) | (4.98) |
| $ICC_{i,t-1}$ | | 0.97*** | | 0.956*** |
| | | (160.93) | | (116.11) |
| $OSS_{i,t-1}$ | 0.116** | 0.03** | 0.171** | 0.019 |
| | (2.19) | (2.43) | (2.48) | (0.94) |
| $EAS_{i,t-1}$ | -0.016 | 0.013 | -0.111 | -0.013 |
| | (-0.22) | (0.81) | (-1.19) | (-0.47) |
| $OCDS_{i,t-1}$ | 0.003 | 0.007* | -0.006 | 0.006 |
| | (0.19) | (1.87) | (-0.28) | (0.92) |
| $OIDS_{i,t-1}$ | 0.081 | 0.019 | 0.003 | 0.006 |
| | (1.38) | (1.42) | (0.04) | (0.25) |
| R-Square | 0.005 | 0.947 | 0.01 | 0.915 |
| | G7 Countries | | BRICS Countries | |
| | Model 1 | Model 2 | Model 1 | Model 2 |
| $\alpha$ | 8.033*** | 0.384*** | 11.886*** | 0.7*** |
| | (251.52) | (7.03) | (140.75) | (5.44) |
| $ICC_{i,t-1}$ | | 0.952*** | | 0.94*** |
| | | (142.15) | | (89.1) |
| $OSS_{i,t-1}$ | 0.106*** | 0.013 | 0.244** | 0.044* |
| | (3.69) | (1.5) | (3.27) | (1.73) |
| $EAS_{i,t-1}$ | -0.076* | 0.006 | -0.07 | -0.02 |
| | (-1.94) | (0.51) | (-0.71) | (-0.59) |
| $OCDS_{i,t-1}$ | 0.005 | 0.004 | 0.005 | 0.006 |
| | (0.54) | (1.37) | (0.24) | (0.82) |
| $OIDS_{i,t-1}$ | 0.037 | -0.003 | 0.061 | 0.017 |
| | (1.16) | (-0.29) | (0.7) | (0.59) |
| R-Square | 0.012 | 0.909 | 0.015 | 0.887 |

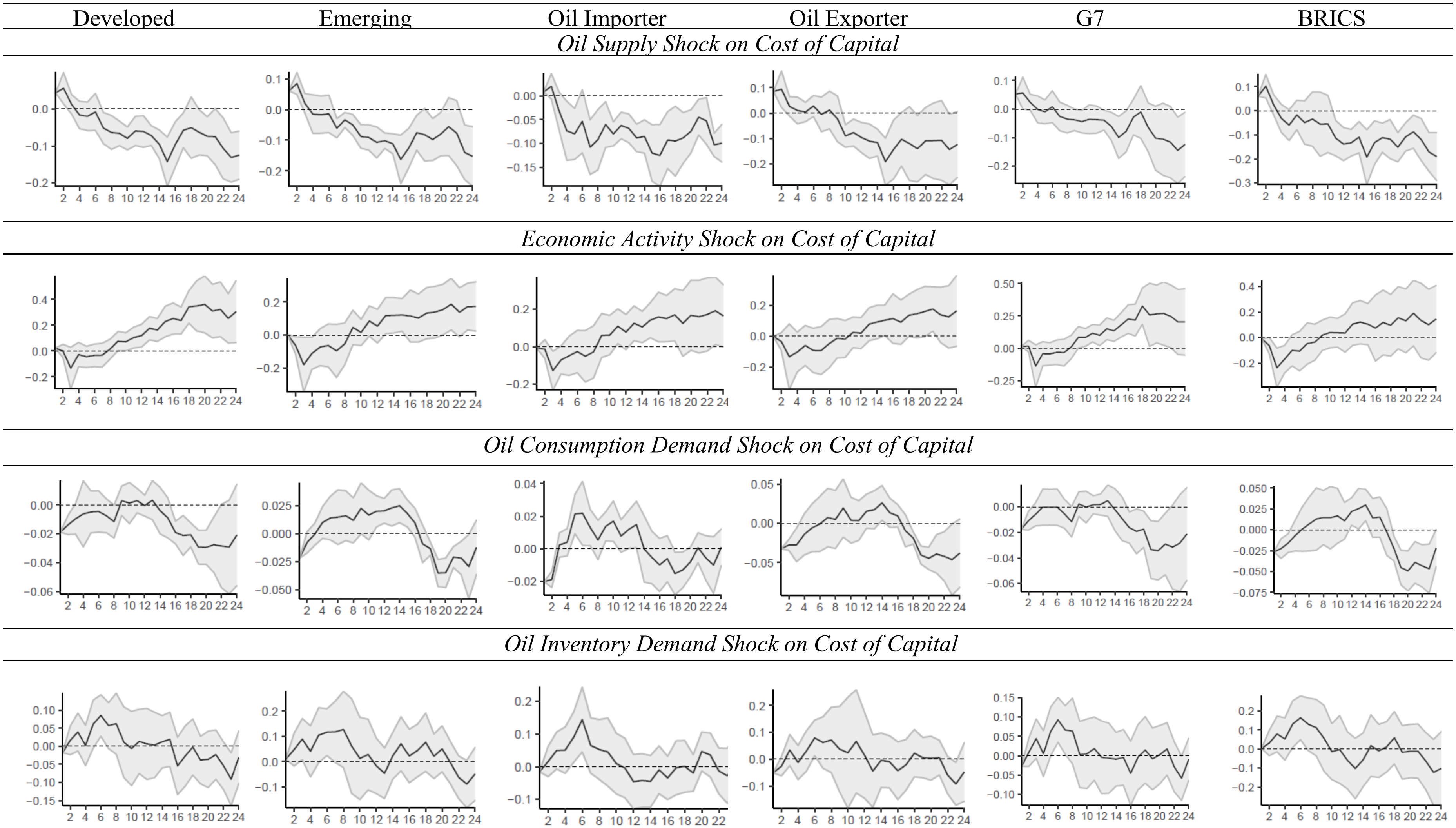
**Note.** This table presents the estimates for Equation 10 (Model 1) and Equation 11 (Model 2 ), estimated cross-sectionally across various country groups. ICC: implied cost of capital; OSS: oil supply shock; EAS: economic activity shock; OCDS: oil-specific consumption demand shock; OIDS: oil inventory demand shock

**Table 4.** The role of market liquidity: Cross-sectional regressions.

| | Developed | | Emerging | | G7 | |
|---|---|---|---|---|---|---|
| | Model 3 | Model 4 | Model 3 | Model 4 | Model 3 | Model 4 |
| $\alpha$ | 8.179*** | 0.393*** | 10.715*** | 0.44*** | 8.031*** | 0.363*** |
| | (411.04) | (10.81) | (209.76) | (7.55) | (250.86) | (6.65) |
| $(ICC * liquidity)_{i,t-1}$ | | 0.000** | | 0.001*** | | 0.00* |
| | | (2.6) | | (4.18) | | (1.88) |
| $ICC_{i,t-1}$ | | 0.952*** | | 0.959*** | | 0.955*** |
| | | (214.81) | | (181.39) | | (141.53) |
| $(OSS * liquidity)_{i,t-1}$ | -0.002 | -0.000 | -0.004 | 0.00 | -0.001 | -0.001 |
| | (-0.72) | (-0.2) | (-0.66) | (0.11) | (-0.47) | (-0.94) |
| $OSS_{i,t-1}$ | 0.115*** | 0.008 | 0.135** | 0.034** | 0.101*** | 0.009 |
| | (6.09) | (1.39) | (2.9) | (2.58) | (3.36) | (1.03) |
| $(EAS * liquidity)_{i,t-1}$ | 0.008** | 0.002 | 0.005 | 0.004 | 0.001 | 0 |
| | (2.16) | (1.39) | (0.53) | (1.54) | (0.26) | (0.28) |
| $EAS_{i,t-1}$ | -0.061** | 0.007 | -0.088 | -0.019 | -0.075* | 0.005 |
| | (-2.32) | (0.84) | (-1.41) | (-1.06) | (-1.8) | (0.4) |
| $(OCDS * liquidity)_{i,t-1}$ | 0.001** | 0.002*** | 0.004** | 0.004*** | 0.000 | 0.001*** |
| | (2.02) | (9.56) | (2.32) | (9.65) | (0.41) | (5.2) |
| $OCDS_{i,t-1}$ | 0.005 | 0.003* | -0.002 | 0.012** | 0.004 | 0.004 |
| | (0.86) | (1.79) | (-0.17) | (2.89) | (0.41) | (1.59) |
| $(OIDS * liquidity)_{i,t-1}$ | 0.008** | 0.000 | 0.006 | -0.001 | 0.006 | 0.00 |
| | (2.19) | (0.15) | (0.75) | (-0.29) | (1.2) | (0.09) |
| $OIDS_{i,t-1}$ | 0.056** | -0.002 | 0.05 | -0.004 | 0.036 | -0.008 |
| | (2.79) | (-0.35) | (0.96) | (-0.29) | (1.1) | (-0.83) |
| R-Square | 0.0171 | 0.899 | 0.0096 | 0.919 | 0.0128 | 0.9105 |
| | Oil Importer | | Oil Exporter | | BRICS | |
| | Model 3 | Model 4 | Model 3 | Model 4 | Model 3 | Model 4 |
| $\alpha$ | 8.97*** | 0.266*** | 9.99*** | 0.424*** | 11.893*** | 0.751*** |
| | (150.8) | (4.77) | (126.64) | (4.98) | (140.16) | (5.76) |
| $(ICC * liquidity)_{i,t-1}$ | | 0.001 | | 0.025** | | 0.02* |
| | | (0.22) | | (2.58) | | (1.65) |
| $ICC_{i,t-1}$ | | 0.97*** | | 0.96*** | | 0.939*** |
| | | (159.67) | | (116.27) | | (89.08) |
| $(OSS * liquidity)_{i,t-1}$ | 0.026 | 0.03 | -0.300 | 0.168** | -0.01 | 0.008 |
| | (0.14) | (0.73) | (-1.08) | (2) | (-0.04) | (0.09) |
| $OSS_{i,t-1}$ | 0.117** | 0.034** | 0.12 | 0.043* | 0.247** | 0.051* |
| | (2.05) | (2.56) | (1.48) | (1.78) | (2.97) | (1.81) |
| $(EAS * liquidity)_{i,t-1}$ | 0.16 | -0.117 | 0.888 | -0.052 | -0.51 | -0.142 |
| | (0.48) | (-1.48) | (1.58) | (-0.31) | (-1.12) | (-0.9) |
| $EAS_{i,t-1}$ | 0.002 | 0.002 | 0.005 | -0.021 | -0.131 | -0.037 |
| | (0.03) | (0.08) | (0.04) | (-0.59) | (-1.14) | (-0.95) |
| $(OCDS * liquidity)_{i,t-1}$ | 0.029 | 0.014 | 0.071 | 0.066*** | 0.093 | 0.039* |
| | (0.61) | (1.29) | (1.43) | (4.52) | (1.47) | (1.8) |
| $OCDS_{i,t-1}$ | 0.002 | 0.007** | -0.006 | 0.005 | 0.011 | 0.008 |
| | (0.13) | (1.97) | (-0.25) | (0.87) | (0.48) | (1.05) |
| $(OIDS * liquidity)_{i,t-1}$ | 0.107 | -0.056 | 0.151 | -0.107 | -0.357 | -0.094 |
| | (0.48) | (-1.1) | (0.63) | (-1.53) | (-1.2) | (-0.93) |
| $OIDS_{i,t-1}$ | 0.073 | 0.018 | -0.027 | -0.007 | 0.047 | 0.014 |
| | (1.23) | (1.32) | (-0.33) | (-0.31) | (0.53) | (0.46) |
| R-Square | 0.0171 | 0.9475 | 0.016 | 0.916 | 0.0201 | 0.888 |

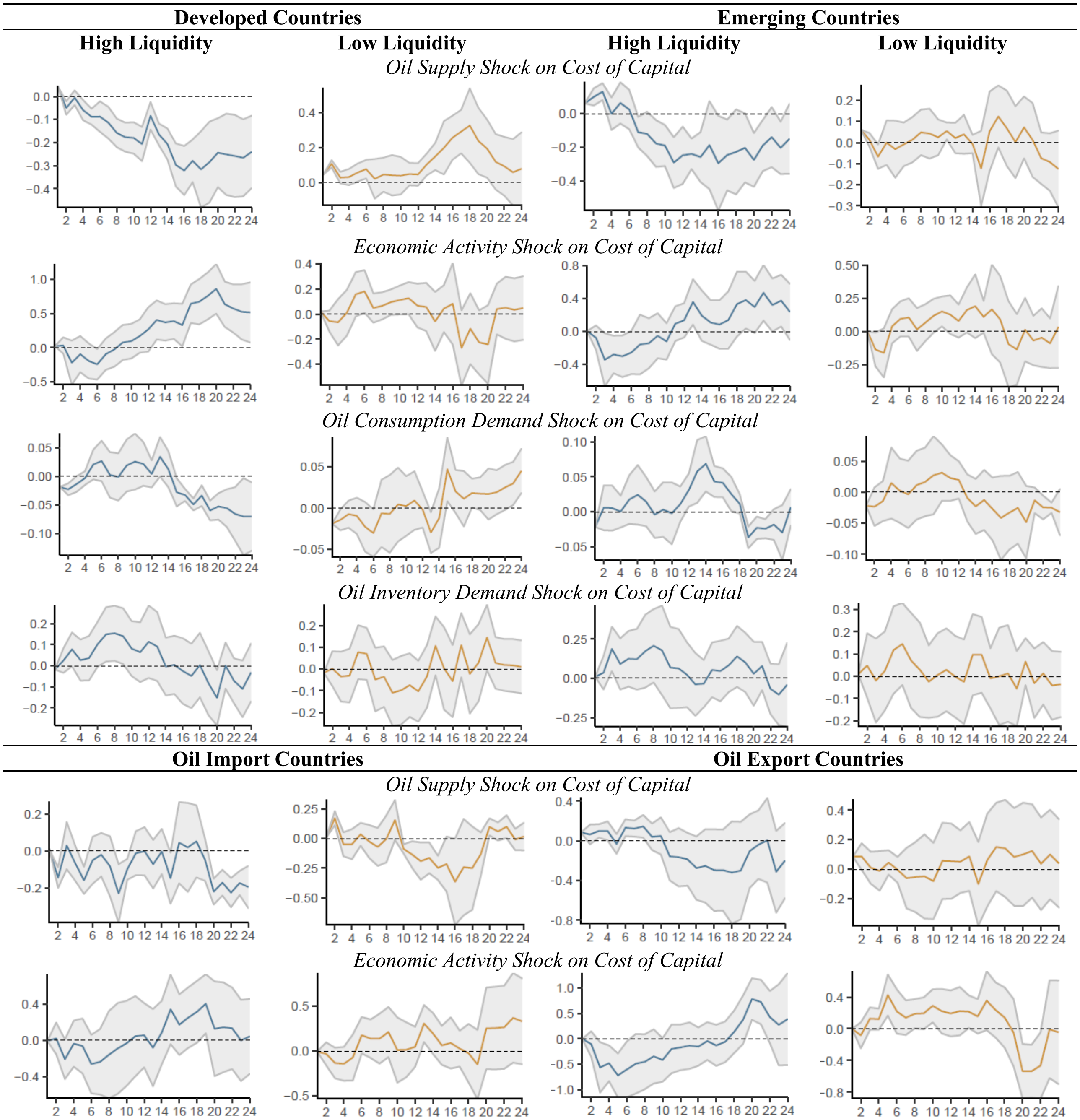
**Note.** This table presents the estimates for Equation 12 (Model 3) and Equation 13 (Model 4 ), estimated cross-sectionally across various country groups. ICC: implied cost of capital; OSS: oil supply shock; EAS: economic activity shock; OCDS: oil-specific consumption demand shock; OIDS: oil inventory demand shock

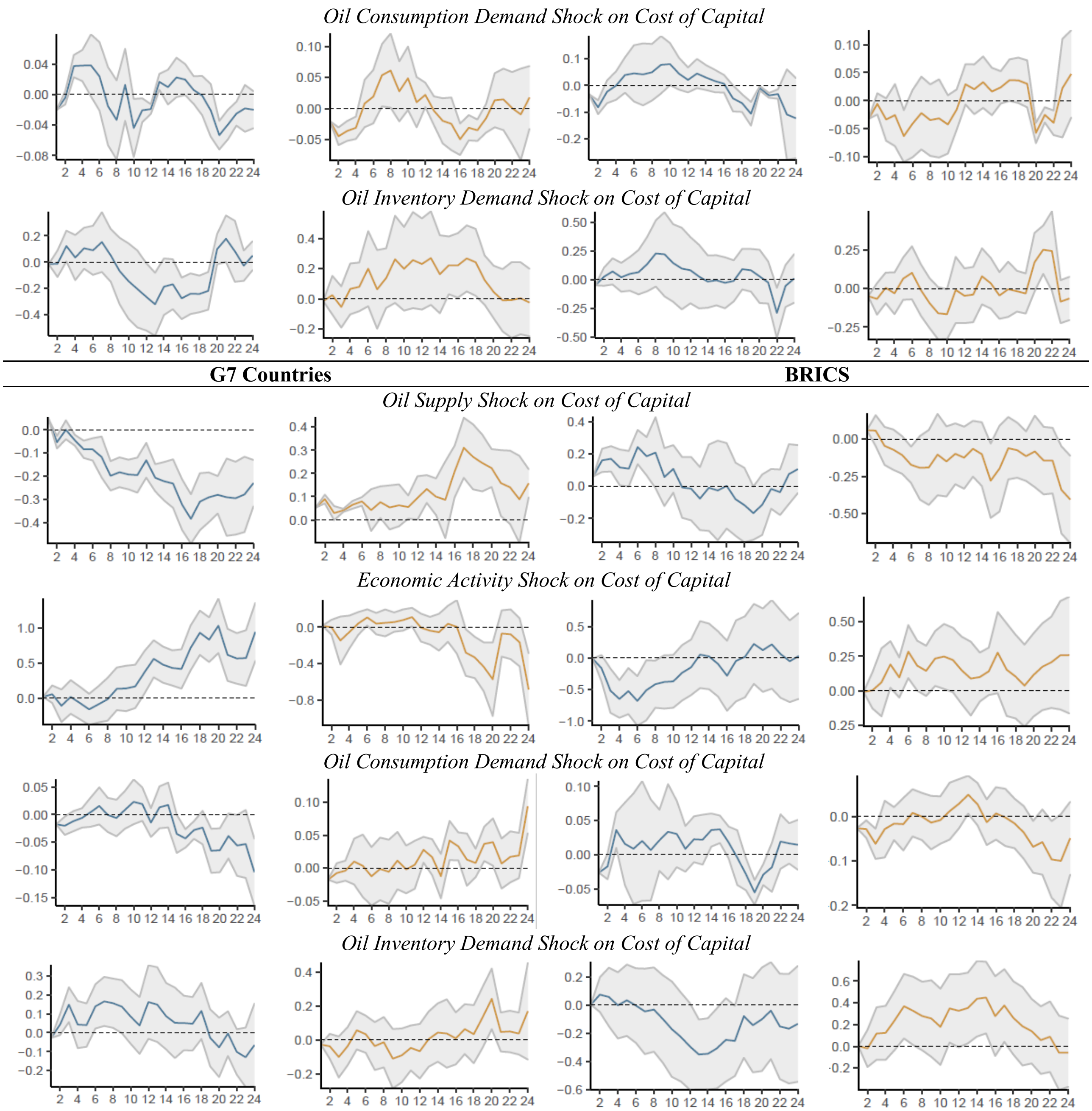
**Figure 1.** Responses to structural oil shocks (linear specification without regimes).




**Note:** The figures show impulse responses to a 1-unit increase in disaggregated oil shocks of cost of capital up to 24-months into the future. The shaded areas represent the 95% confidence intervals and are calculated based on panel corrected standard errors.

**Figure 2.** Responses to structural oil shocks during high and low liquidity regimes.






**Note:** The figures show impulse responses to a 1-unit increase in disaggregated oil shocks of cost of capital during high and low market liquidity regimes. The shaded areas represent the 95% confidence intervals and are calculated based on panel corrected standard errors.

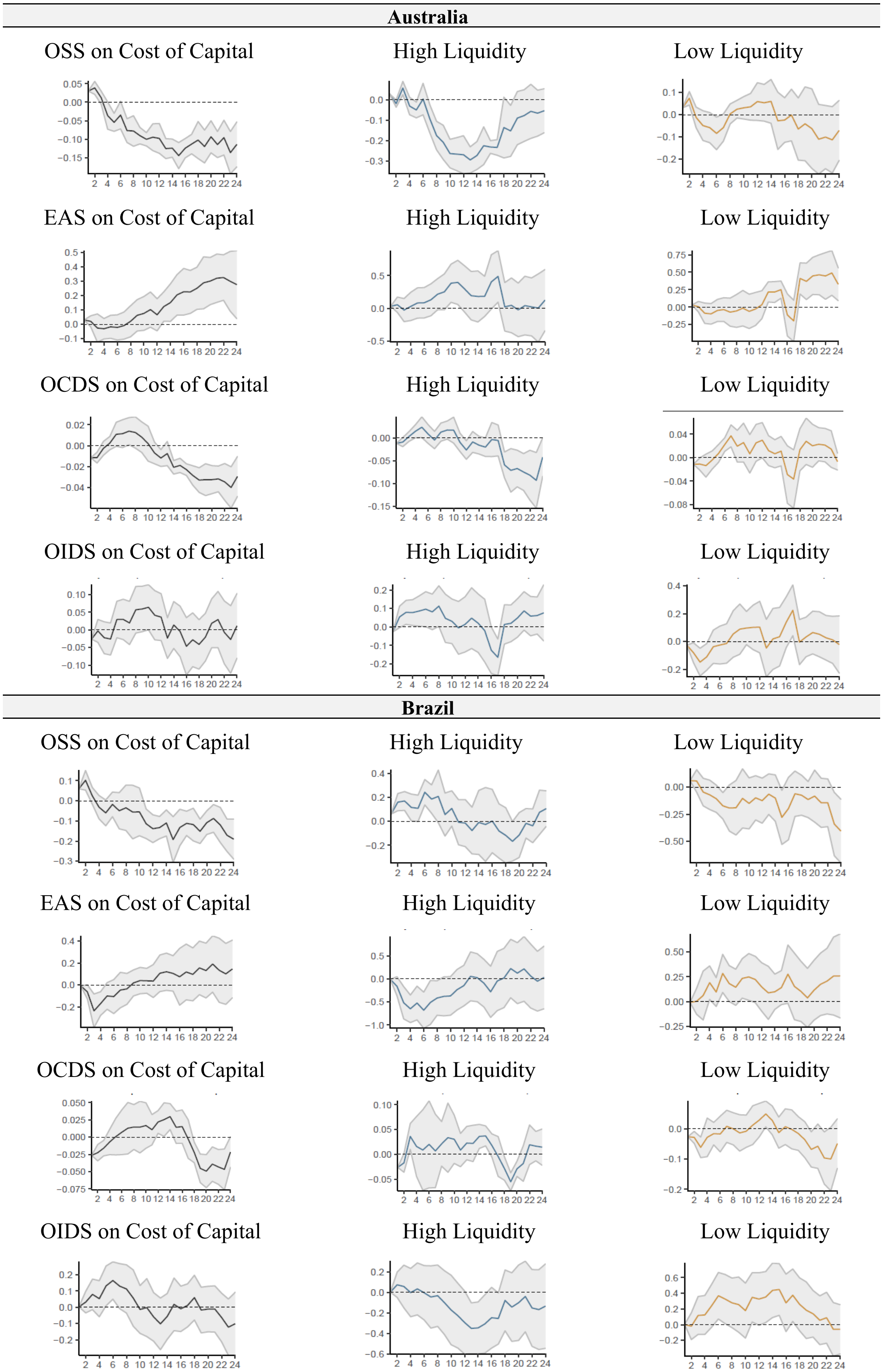
**Appendix.**

**Table A1.** Country groups used in cross-sectional analysis.

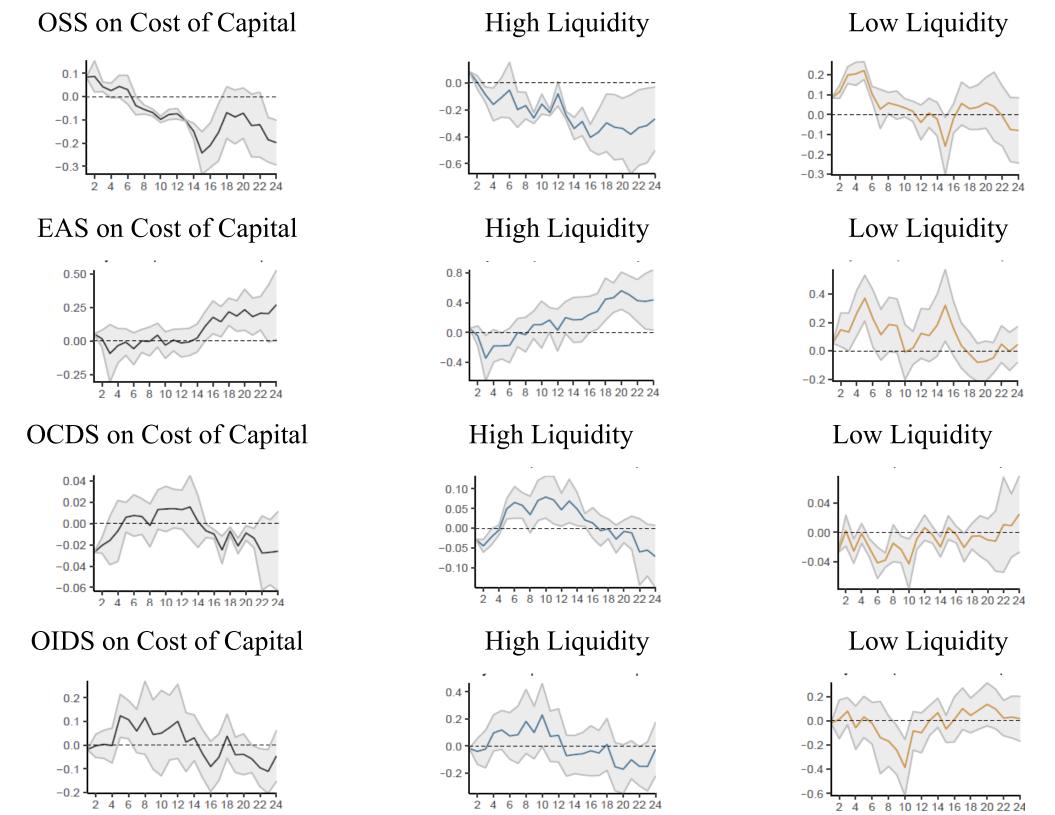
| | **Country Groups** | | | | | |
|---|---|---|---|---|---|---|
| | Emerging | Developed | Import | Export | BRICS | G7 |
| Australia | | x | x | | | |
| Austria | | x | | | | |
| Belgium | | x | | | | |
| Brazil | x | | | x | x | |
| Canada | | x | | x | | x |
| China | x | | x | | x | |
| Denmark | | x | | | | |
| Finland | | x | | | | |
| France | | x | | | | x |
| Germany | | x | | | | x |
| Greece | x | | | | | |
| Hong Kong | | x | | | | |
| India | x | | x | | x | |
| Indonesia | x | | | | | |
| Italy | | x | | | | x |
| Japan | | x | x | | | x |
| Korea | x | | x | | | |
| Malaysia | x | | | | | |
| Mexico | x | | | x | | |
| Netherlands | x | x | | | | |
| Norway | | x | | x | | |
| Poland | x | | | | | |
| Portugal | | x | | | | |
| Russia | x | | | x | x | |
| Singapore | | x | | | | |
| South Africa | x | | | | x | |
| Spain | | x | | | | |
| Sweden | | x | | | | |
| Switzerland | | x | | | | |
| Taiwan | x | | | | | |
| Thailand | x | | | | | |
| Turkey | x | | | | | |
| UK | | x | | x | | x |
| US | | x | x | | | x |

**Note:** The Country classifications are primarily based on the MSCI stock market classifications available at https://www.msci.com/our-solutions/indexes/market-classification.

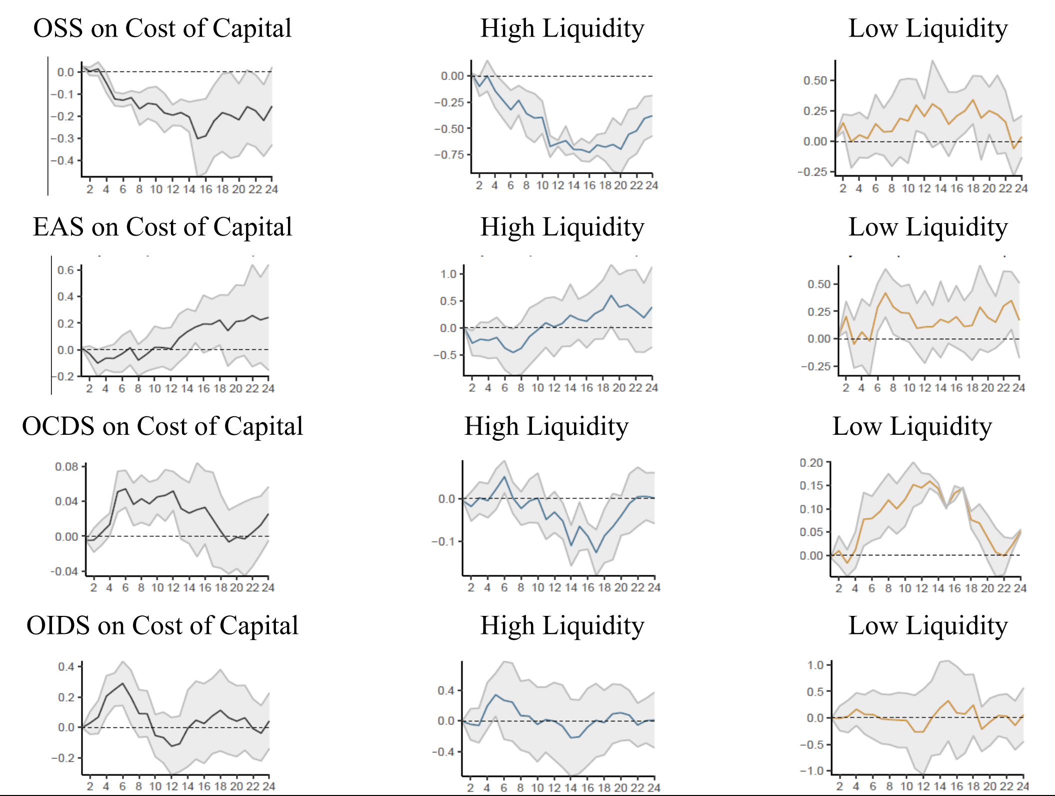
**Figure A1.** Responses to structural oil shocks (country specific results).

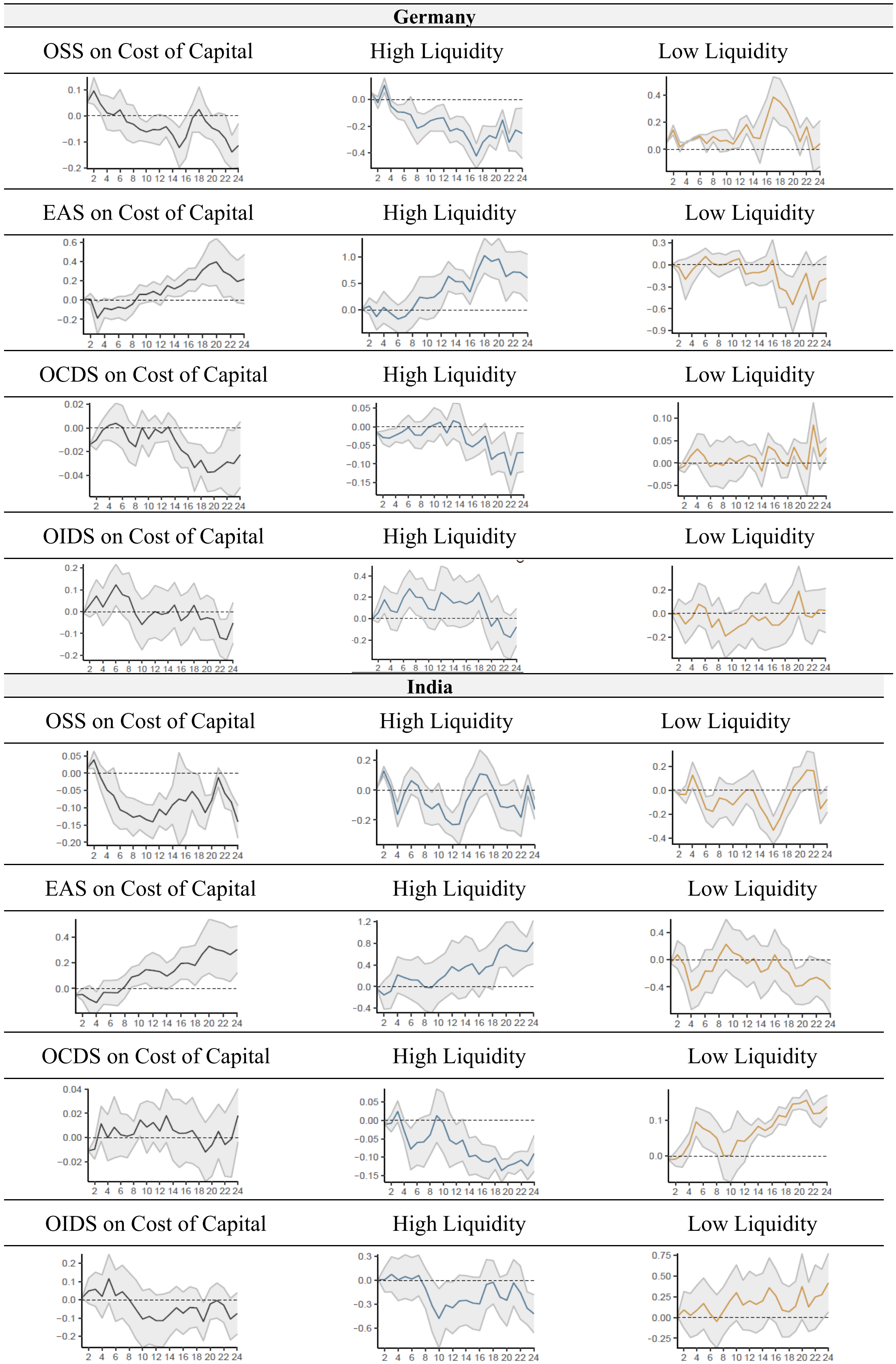


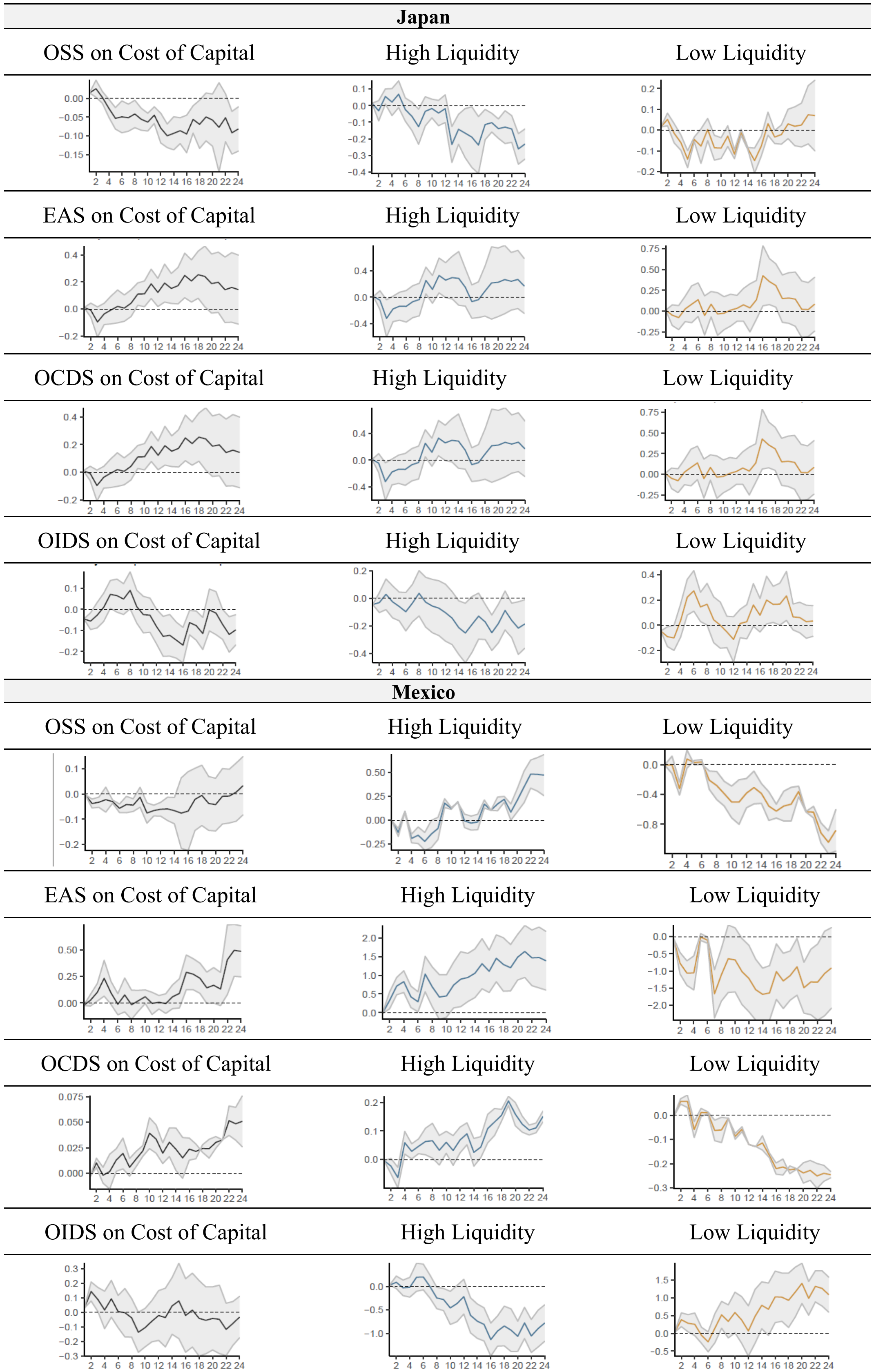
**Canada**

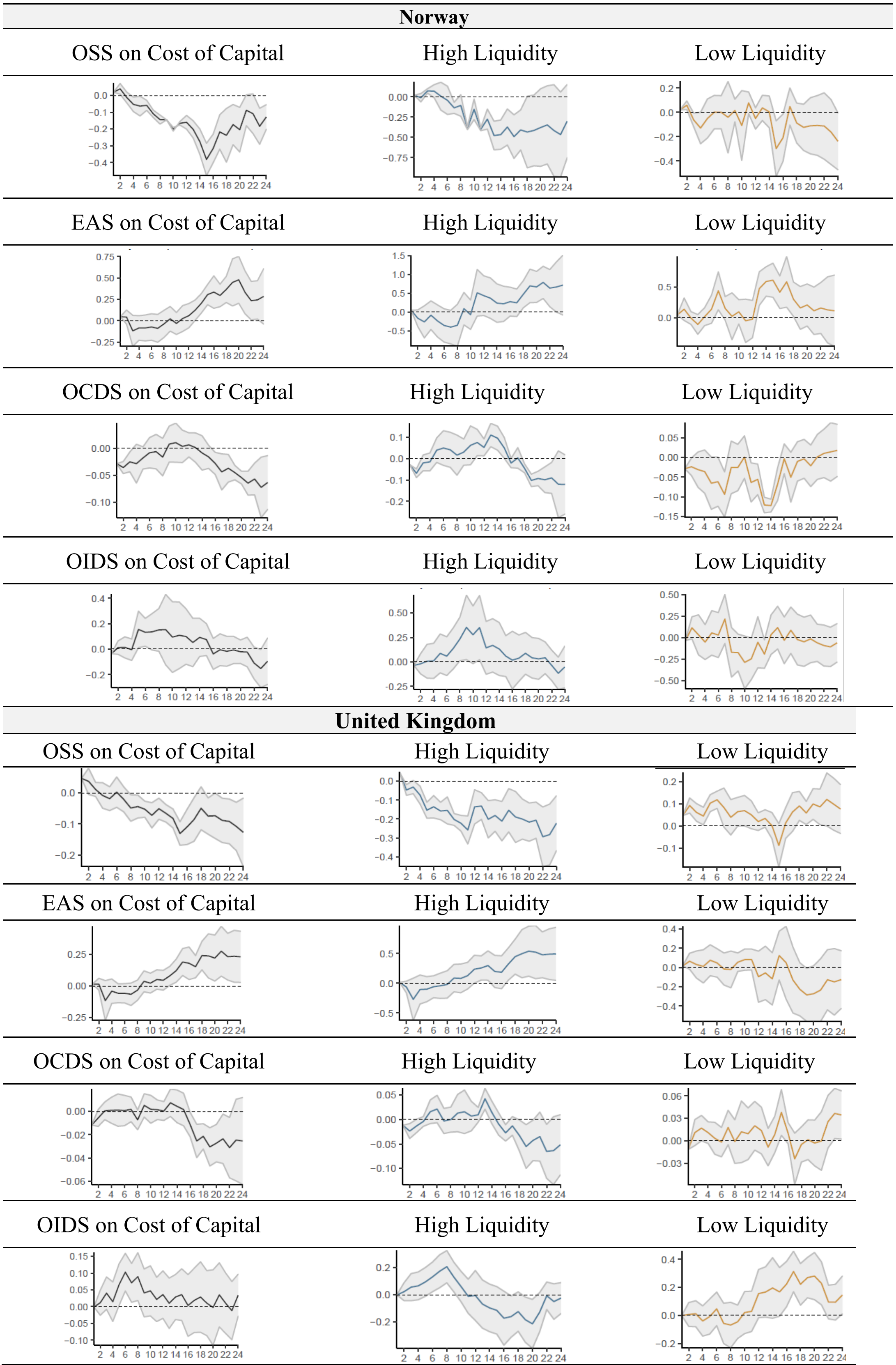


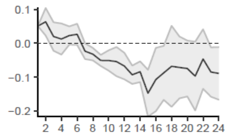
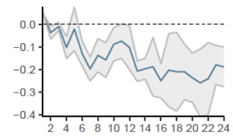
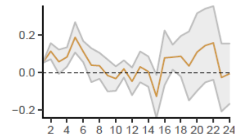
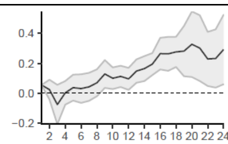
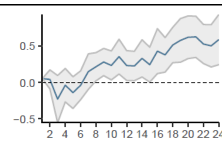
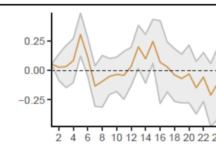
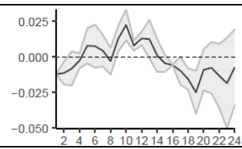
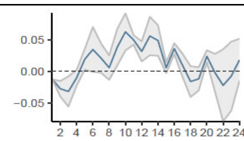
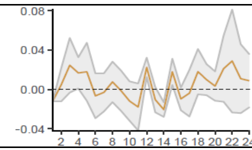
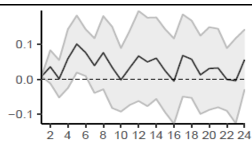
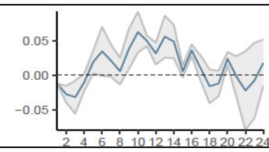
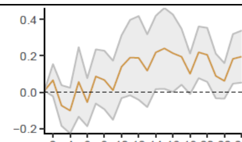

**China**




Germany
OSS on Cost of Capital
High Liquidity
Low Liquidity
EAS on Cost of Capital
High Liquidity
Low Liquidity
OCDS on Cost of Capital
High Liquidity
Low Liquidity
OIDS on Cost of Capital
High Liquidity
Low Liquidity
India
OSS on Cost of Capital
High Liquidity
Low Liquidity
EAS on Cost of Capital
High Liquidity
Low Liquidity
OCDS on Cost of Capital
High Liquidity
Low Liquidity
OIDS on Cost of Capital
High Liquidity
Low Liquidity


Japan
OSS on Cost of Capital
High Liquidity
Low Liquidity
EAS on Cost of Capital
High Liquidity
Low Liquidity
OCDS on Cost of Capital
High Liquidity
Low Liquidity
OIDS on Cost of Capital
High Liquidity
Low Liquidity
Mexico
OSS on Cost of Capital
High Liquidity
Low Liquidity
EAS on Cost of Capital
High Liquidity
Low Liquidity
OCDS on Cost of Capital
High Liquidity
Low Liquidity
OIDS on Cost of Capital
High Liquidity
Low Liquidity


Norway
OSS on Cost of Capital
High Liquidity
Low Liquidity
EAS on Cost of Capital
High Liquidity
Low Liquidity
OCDS on Cost of Capital
High Liquidity
Low Liquidity
OIDS on Cost of Capital
High Liquidity
Low Liquidity
United Kingdom
OSS on Cost of Capital
High Liquidity
Low Liquidity
EAS on Cost of Capital
High Liquidity
Low Liquidity
OCDS on Cost of Capital
High Liquidity
Low Liquidity
OIDS on Cost of Capital
High Liquidity
Low Liquidity

| **United States** | | |
| --- | --- | --- |
| OSS on Cost of Capital | High Liquidity | Low Liquidity |
|  |  |  |
| EAS on Cost of Capital | High Liquidity | Low Liquidity |
|  |  |  |
| OCDS on Cost of Capital | High Liquidity | Low Liquidity |
|  |  |  |
| OIDS on Cost of Capital | High Liquidity | Low Liquidity |
|  |  |  |

**Note.** The figures show impulse responses to a 1-unit increase in disaggregated oil shocks of cost of capital based on the linear specification and during high and low market liquidity regimes. The shaded areas represent the 95% confidence intervals and are calculated based on panel corrected standard errors. OSS: oil supply shock; EAS: economic activity shock; OCDS: oil-specific consumption demand shock; OIDS: oil inventory demand shock