Discussion Paper

The Macroeconomic Implications of Oil Price Uncertainty for Oil Exporting Economies

The Story of Saudi Arabia

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December 2025 | Doi: 10.30573/KS--2025-DP65



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Abstract

Oil price uncertainty – that is, greater unpredictability about future oil prices – is significant for oil exporters independently of whether today's price rises or falls. This paper investigates how oil price uncertainty affects Saudi Arabia's economy, using quarterly data from 2010 to 2024 and a Bayesian VAR model with stochastic volatility. Empirical results show that a surge in oil price uncertainty, such as the ones observed during the 2014 oil price crash and the COVID-19 pandemic, lowers aggregate real GDP, worsens the trade balance through falling oil exports, and raises domestic prices. Notably, oil GDP declines roughly twice as much as non-oil GDP and private consumption contracts significantly, and total investment rises, driven by public investment, while private investment is not significantly responsive. These patterns are robust to using external uncertainty proxies (option implied volatility and a news-based index) and to alternative specifications. This countercyclical public investment response suggests public capital spending is already deployed as a stabilizing buffer, diverging from global findings where uncertainty depresses investment. For policymakers, the key implication is that additional stabilization should target households via rules-based transfers, countercyclical credit guarantees, or insurance to offset precautionary cutbacks. Stabilization policies to improve the trade balance account through the short and the medium term are highly recommended. Policy focus should be on making fiscal buffers and macro frameworks robust enough to withstand uncertainty, using automatic, rules-based mechanisms to address household risk and volatility.

Keywords: Oil Price Uncertainty, Saudi Arabia Economy, Macroeconomic Stability, Oil Exporting Countries, Bayesian VAR Model, Fiscal Policy and Oil Revenues, Stochastic Volatility, Public Investment Response, Vision 2030 Saudi Arabia, Energy Market Volatility

Introduction

01

The macroeconomic performance of oil-exporting economies is tightly linked to developments in global oil markets. While a large body of literature studies the effects of *level* shocks to oil prices (e.g., Hamilton 2009; Kilian and Murphy 2014; Baumeister and Kilian 2016), far less is known about how *uncertainty* surrounding oil prices propagates through oil exporters' domestic economies. This question is of first-order importance for Saudi Arabia, where the state's intertemporal budget and investment agenda – which are central to Vision 2030 – are ultimately financed by hydrocarbon revenues (see Figure A7 in the Appendix).

The importance of oil price uncertainty for oil-exporting countries as a planning constraint is stressed not just by academic literature but is also a key element of discussion in policy literature (e.g., IMF 2024). When uncertainty about future oil prices rises, it can alter private and public decisions in distinct ways, with implications for output composition, inflation dynamics, and the design of stabilization policy under the fixed exchange rate.

This paper demonstrates that oil-price uncertainty transmits to the Saudi economy through real, external, and nominal channels. We bring new evidence based on a quarterly 2010-2024 dataset and an empirical framework that is standard in the macroeconometric literature yet tailored to the structure of an oil-exporting economy. Specifically, we estimate a Bayesian VAR with stochastic volatility that includes a measure of global oil-price uncertainty alongside Saudi macro-fiscal aggregates. The model allows us to identify an uncertainty shock[1] separately from movements in oil-price levels and from global activity, and to trace its dynamic effects on output components, prices, and the public sector.[2] Methodologically, our framework builds on the stochastic-volatility estimation of Kastner and Frühwirth-Schnatter (2014) and BVAR practice, and it aligns with the uncertainty literature's focus on second-moment shocks (see Bloom 2009).

Our contribution is threefold. First, we provide, to our knowledge, the first Saudi-specific analysis of identified oil-price uncertainty shock within a unified macro-fiscal empirical system. This fills a gap between work on global uncertainty and oil markets (e.g., Jo 2014; Abiad and Qureshi 2023) on the

one hand, and country-specific evidence for oil exporters on the other. Second, we disaggregate the transmission into oil versus non-oil GDP and into public versus private demand, which clarifies where the contractionary forces originate and how the fiscal channel operates – an angle largely missing in Saudi studies that focus on oil level shocks or non-macro outcomes (see Tausif, Haque, and Khan 2023). Next, we identify three distinct channels of transmission that are specific to KSA – namely, real, external, and nominal channels. The only previous work on Saudi-specific uncertainty is based on annual data and employs frequency-domain methods (see Tlili et al. 2024). Third, we document a novel fact about the investment margin: total investment does not contract after an oil-price uncertainty shock but rises instead, driven by government investment. This countercyclical public-investment response stands in contrast to the common finding in the broader uncertainty literature that investment typically falls,[3] and this matters for how policy should prioritize stabilization objectives. However, the stabilization of government investment might cause the crowding-out effect and partly dampen private investment.

We identify an oil-price uncertainty shock in a quarterly BVAR with stochastic volatility for Saudi Arabia, and we trace its impulse responses across GDP components and the public sector. This separates uncertainty from level movements in oil prices and delivers dynamic, component-level paths that a stabilization policy can target. Concretely, we (i) include the real oil-price level and a global activity proxy so uncertainty is identified conditional on contemporaneous price levels and global demand; (ii) treat oil-price uncertainty as its own VAR variable, identifying the uncertainty shock as the innovation orthogonal to oil-price-level innovations under a recursive scheme; (iii) estimate the system with stochastic volatility to allow time-varying shock variances; and (iv) check robustness by replacing our uncertainty series with external proxies (OVX and the news-based oil-price-uncertainty index, or OPU, index), ultimately finding similar qualitative results. For OPU, we rely on Abiad and Qureshi (2023), who construct a global, news-based index, and who show contractionary effects in BVARs for advanced economies. We argue that the quantitative differences originate from the fact that each proxy captures different elements of uncertainty.[4] Our results are consistent with structural oil-market models in which demand-side and precautionary forces interact with capacity constraints to shape export volumes and prices in the short run.

1.1 Results

An identified rise in oil price uncertainty is followed by a decline in aggregate real GDP and an increase in domestic prices. Disaggregated output responses show that oil GDP falls about twice as much as non-oil GDP on impact. Private consumption declines markedly, but public consumption remains steady. In contrast, total investment rises, driven by government investment; the response of private investment is not statistically significant and does not provide a correspondingly strong offset. The qualitative patterns are robust across specifications, including when we add global activity controls and when we replace our uncertainty measure with external proxies (e.g., option-implied oil volatility and news-based oil-uncertainty indices). These results imply that, in Saudi Arabia, the binding margin of adjustment to oil price uncertainty operates primarily through households and oil sector activity, and not through a pullback in public capital formation. Usually, the conventional policy focus is on insulating *public* investment from commodity-price cycles. Our evidence suggests that, in the face of oil price uncertainty spikes, Saudi public investment already behaves countercyclically while households retrench, external demand for oil drops, and terms of trade worsen. The policy margin with the highest payoff is therefore to smooth household consumption – for example, via rules-based transfers and credit or insurance mechanisms that automatically offset precautionary cutbacks.

Two mechanisms organize what follows the shock. On the external side, uncertainty behaves like a negative demand/precautionary shock to oil: export volumes and prices fall, hydrocarbon receipts contract, and the trade balance weakens. Because export prices drop while import prices are supported by pass-through and risk premia under easier global financial conditions, the terms of trade deteriorate, creating real-income loss that magnifies the retreat in private consumption, and which pulls non-oil GDP lower. On the nominal side, the SAR-US$ peg transmits U.S. easing: oil-uncertainty disinflates the U.S., the Federal Reserve cuts, Saudi rates follow, and easier local financial conditions interact with import-price volatility to raise CPI. This misalignment limits monetary autonomy and leaves fiscal and macroprudential policy to do most of the

stabilization. Nevertheless, even if public investment remains countercyclical, it cannot fully offset the combined hit from weaker export income and a terms-of-trade-driven squeeze on real household budgets.

More broadly, distinguishing uncertainty shocks from level shocks matters for calibrating fiscal buffers and risk-management tools, with the former depressing activity and raising prices even when public investment does not fall.

1.2 Policy Design Under the Riyal-Dollar Peg

With monetary policy imported via the peg, the main stabilization margins are fiscal and macro-prudential. Our results imply that the binding margin is in the household sector. We therefore emphasize tools that automatically offset precautionary retrenchment without derailing ongoing public investment:

- **Rules-based, temporary transfers** to low- and middle-income households that phase in when activity or labor-market indicators weaken and phase out as conditions normalize.
- **Countercyclical credit guarantees** and liquidity support for viable SMEs in order to mitigate precautionary credit tightening.
- **Public-investment continuity rules** (commitment ceilings, contingency buffers) to avoid stop-go cycles.
- **Volatility-aware fiscal buffers** keyed to uncertainty bands (not levels alone), so that risk spikes trigger pre-funded stabilizers.

Finally, while global shocks drive much of oil-price uncertainty, Saudi policy can *influence* volatility at the margin – through credible communication, buffer-building, and investment-execution continuity. Our empirical identification treats the within-quarter uncertainty innovation as exogenous to contemporaneous policy actions, and our policy discussion takes that agency explicitly into account.

The remainder of the paper provides the literature overview and the Saudi policy context. Sections 3 to 5 detail data and identification. Section 6 presents baseline results and robustness. Section 7 analyzes transmission via demand components and prices. Finally, Section 8 discusses policy implications for fiscal frameworks and social-risk smoothing.

Policy Context and Some Stylized Facts

02

Saudi policymakers and international institutions consistently underscore the importance of managing oil market stability to safeguard macroeconomic solidity and support the Kingdom's broader development objectives. The Saudi Ministry of Finance (MoF 2023) notes that the continued volatility in global oil markets calls for prudent fiscal policies to sustain medium-term development plans. By emphasizing fiscal prudence, the Ministry acknowledges the potential for abrupt revenue shortfalls to disrupt Vision 2030 projects, thereby recognizing oil price uncertainty as a core macroeconomic risk.

Echoing these domestic concerns, the International Monetary Fund (IMF 2019) emphasizes the heightened uncertainty in global oil markets as one of the key factors that may affect investor sentiment and complicate medium-term fiscal planning. The IMF recommends strengthening fiscal buffers and continuing structural reforms to mitigate the pro-cyclical effects of oil price shocks – a stance that is aligned with the government's own Fiscal Sustainability Program (FSP). These reports collectively demonstrate a convergence between Saudi authorities and the IMF on the necessity of policy measures to smooth macroeconomic fluctuations arising from oil price volatility.

Energy-transition policies create divergent – but plausible – oil-price paths, making uncertainty the salient, policy-relevant feature. Using structural scenario analysis in an identified oil-market VAR, Boer, Pescatori, and Stuermer (2023) show that if production declines are driven mainly by demand-side policies, real oil prices could fall to about US$25 by 2030, whereas supply-side policies could push prices to roughly US$130, while a 50/50 mix yields prices near US$85. Because the eventual policy mix is uncertain and may be uncoordinated across countries, future oil prices are inherently uncertain, and macro-fiscal frameworks should be designed for that uncertainty rather than any single price path. Our analysis takes this perspective and quantifies how oil-price uncertainty, irrespective of the ultimate price level, propagates through the Saudi economy.

The World Bank reports that dispersion among private forecasters – a proxy for economic uncertainty – had risen by about 13% in MENA since October 2023 (Gatti et al. 2024), and, by that metric, uncertainty in MENA was roughly twice the average across other emerging markets and developing economies. It has also been noted that OPEC+ had extended core production cuts through end-2025 (with additional voluntary cuts maintained through September 2024 and then phased out), reinforcing the oil-market channel through which uncertainty spilled into regional activity (Gatti et al. 2024).

Such prolonged uncertainty and oil-market management episodes risk complicating Saudi Arabia's diversification drive under Vision 2030 by increasing the cyclicality of fiscal balances and investment plans. Indeed, the IMF (2024) has emphasized the need to calibrate investment to mitigate pressures on fiscal and external accounts.

Collectively, these perspectives affirm that oil price uncertainty stands at the forefront of policy discourse, prompting both domestic and international stakeholders to advocate for strategies that stabilize revenues, bolster investor confidence, and maintain momentum toward the Kingdom's long-term economic goals.

Literature Review

03

Our study contributes to several strands of the literature on oil price uncertainty and its macroeconomic implications, with a particular focus on Saudi Arabia's Vision 2030 investment-driven transformation.

First, we extend the literature on the relationship between oil price uncertainty and investment. Bernanke (1983) suggests that an increase in uncertainty may reduce firm investment in the current period due to the "wait-and-see" effect. Bachmann and Bayer (2011, 2013) find that the "wait-and-see" effect delays investment when the oil price uncertainty shock hits entrepreneurs (other studies on "wait and see" include Gilchrist, Sim, and Zakrajšek (2014), Stokey (2016), Xiaowen, Dong, and Kasa (2020), among others).

Carroll and Kimball (2006) and Basu and Bundick (2017) argue that the rise in uncertainty gives rise to the precautionary saving motive of risk-averse households. Households react to the uncertainty in future income by reducing current consumption and tend to work more (increasing buffer stock) so that they can self-insure against uncertainty in the future. With the reinforcement of nominal rigidities and the "wait-and-see" effect, the decline in consumption may go together with a rise in unemployment and lower inflation (Leduc and Liu 2016).

Bernanke (1983) and Pindyck (1991) show that uncertainty discourages investment through the "wait-and-see" effect, as firms delay capital expenditures in response to unpredictable revenue streams. On the other hand, Bachmann and Bayer (2013) argue that the "wait-and-see" behavior induced by firm-level risk is too small to significantly impact average business cycle fluctuations, while suggesting that other mechanisms, such as financial frictions or nominal rigidities, might be more important in explaining the relationship between uncertainty and investment dynamics. Thiem (2017) employs a VAR GARCH-in-mean framework, and finds that oil price uncertainty has a highly significant negative effect on the U.S. business cycle, even after controlling for global supply and demand shocks. Our study builds on these findings by examining how oil price uncertainty disrupts investment momentum in Saudi Arabia.

Second, we contribute to the literature on fiscal policy responses to oil price uncertainty. Davis, Fedelino, and Ossowski (2003) emphasize that oil-exporting economies tend to adopt pro-cyclical fiscal policies, expanding expenditures during oil booms and cutting spending during downturns, which exacerbates macroeconomic volatility. Hamilton (2009) examines how oil price shocks contribute to economic downturns by reducing consumption spending and increasing macroeconomic volatility, underscoring the need for fiscal buffers, such as sovereign wealth funds (SWFs), to stabilize public finances in oil-dependent economies.

The permanent income hypothesis (PIH), which forms the basis of much of the IMF's guidance on SWF design (Barnett and Ossowski 2002; Leigh and Olters 2006; Van der Ploeg and Venables 2011; Venables 2010), suggests accumulating

oil revenues in an SWF that is large enough so that its returns can sustain public expenditures indefinitely. The bird-in-hand (BIH) hypothesis (Barnett and Ossowski 2002; Collier et al. 2010; Van der Ploeg and Venables 2011) aligns with PIH, but it adopts a more conservative approach by saving all revenues in an SWF and limiting spending to the fund's returns, recognizing windfalls only once secured.

Punzi (2019) employs a DSGE model for a small open economy, demonstrating that uncertainty in energy prices leads to macroeconomic volatility, which in turn may necessitate fiscal policy adjustments to stabilize the economy, raising the question of whether fiscal policy should cooperate with monetary policy to reduce macroeconomic volatility. Our study complements this research by evaluating the implications of uncertainty for fiscal policy.

Third, our research builds on studies analyzing the effects of oil price uncertainty on exchange rates and inflation. Cashin, Céspedes, and Sahay (2004) show that commodity price shocks significantly impact exchange rate dynamics in commodity-exporting countries, with evidence that real exchange rates adjust to changes in real commodity prices over time. Baumeister and Marcellino (2025) use Bayesian additive regression trees (BART) to forecast oil price tail risks and examine how oil price uncertainty and asymmetry influence monetary policy decisions. Punzi (2019) applies Panel VAR models on 10 Asian economies, finding that energy price volatility leads to short-term inflation spikes and real exchange rate depreciation, and notes that while energy price volatility initially boosts GDP, the effects reverse in the long run. Our study extends this literature by examining how oil price uncertainty affects Saudi Arabia's inflationary dynamics and the real exchange rate.

Finally, we contribute to the literature on economic diversification in resource-rich economies. Oil price uncertainty raises financing costs for private investment in non-oil industries, limiting structural transformation efforts (Medhioub and Makni 2020). Bergholt, Larsen, and Seneca (2019) use DSGE models to demonstrate that oil price shocks disrupt industrial expansion in resource-rich economies. Baumeister and Kilian (2016) analyze how oil price fluctuations shape macroeconomic conditions, highlighting the challenges that volatility poses for diversification. Punzi (2019) finds that energy price volatility leads households to reduce consumption due to precautionary savings, while firms initially increase investment before experiencing a long-run reversal. Building on these insights, our study examines how oil price uncertainty may impact the diversification initiatives.

By integrating these perspectives, our research provides a comprehensive framework for understanding the macroeconomic risks associated with oil price uncertainty, and it hints at some policy recommendations to enhance Saudi Arabia's economic resilience.

Data

04

We work with quarterly data for the Saudi economy. For the monthly data, such as oil price, we compute simple averages to convert them to a quarterly frequency. As global oil prices are denominated in U.S. dollars, we deflate them by the U.S. CPI to obtain the real oil price, which is our primary explanatory variable. All macroeconomic series are seasonally adjusted (see Table 1).

The data are drawn mainly from the Saudi Central Bank (SAMA) and the General Authority for Statistics (GASTAT). Moreover, we work with the real macroeconomic data that is provided by GASTAT. For the oil price, we use the Brent Crude Oil Price and obtain the real price using the U.S CPI. The list of variables is included below:

Table 1. List of variables.

Variables	Definition	Source (databases)
GDP_t	Real gross domestic product	GASTAT
$Oilgdp_t$	Oil activities	GASTAT
$NonOilgdp_t$	Non-oil activities	GASTAT
Gov_t	Real government activities	GASTAT
C_t	Real gross final consumption expenditure	GASTAT
I_t	Real gross fixed capital formation	GASTAT
PRI_I_t	Real private gross fixed capital formation	GASTAT
GOV_I_t	Real government gross fixed capital formation	GASTAT
TB_t	Trade balance	GASTAT
$Poil_t$	Brent crude oil price	FRED (POILBREUSDM)
$Oilprod_t$	World oil production	JODI-Oil World Database
$USCPI_t$	U.S. CPI	FRED (CPIAUCSL)
R_t	Interest rate repo rate (SAMA)	Repo Rate (SAMA)
Π_t	Inflation rate	World Bank Database
OPU_t	Oil price uncertainty (OPU)	Abiad and Qureshi (2023)
OVX_t	CBOE crude oil ETF volatility index	FRED (OVXCLS)
Vol_t	Real oil stochastic volatility	Author's calculation

Source: Authors.

Identification Strategy of Oil Uncertainty Shock

05

We estimate a stochastic volatility (SV) model in a Bayesian framework following Kastner and Frühwirth-Schnatter (2014) using the toolbox provided by Kastner (2016). We employ this model to estimate the stochastic volatility of the real crude oil price. In this section, we briefly outline the univariate stochastic volatility model and, for convenience, use the same notation as in Kastner (2016).

We define $y = (y_1, y_2, \ldots, y_n)'$ to be a vector of zero-mean returns. In the centered parameterization, the model is expressed as:

$$y_t | h_t \sim \mathcal{N}(0, \exp(h_t)),$$
$$h_t | h_{t-1}, \mu + \phi, \sigma_\eta \sim \mathcal{N}(\mu + \phi(h_{t-1} - \mu), \sigma_\eta^2),$$
$$h_0 | \mu, \phi, \sigma_\eta \sim \mathcal{N}(\mu, \sigma_\eta^2 / (1 - \phi^2)) \quad (1)$$

Here, $\mathcal{N}(\mu, \sigma_\eta^2)$ designates a normal distribution with mean μ and variance σ_η^2. The parameter vector $\theta = (\mu, \varphi, \sigma_\eta)^T$ collects the long-run log-variance level μ, its persistence φ, and the innovation volatility σ_η. The sequence $\mathbf{h} = (h_0, h_1, \ldots, h_n)$ is latent, and is usually interpreted as the time-varying log-variance (volatility) process. The starting value h_0 follows the stationary distribution of the associated AR(1) model. To finalize the specification, we assign priors to ϑ. Following Kim, Shepherd, and Chib (1998), we assume independence and write $p(\vartheta) = p(\mu)p(\varphi)p(\sigma_\eta)$.

For the level parameter $\mu \in \mathrm{R}$, we adopt the standard normal prior $\mu \sim \mathrm{N}(b_\mu, B_\mu)$. This prior is typically weak: daily-return applications often set $b_\mu = 0$ and $B_\mu \geq 100$, and empirical work shows that reasonable variations of these values rarely alter results.

The persistence coefficient $\varphi \in (-1,1)$ is given the transformed-beta prior $(\varphi + 1)/2 \sim \mathrm{B}(a_0, b_0)$, leading to:

$$p(\phi) = \frac{1}{2B(a_0, b_0)} \left(\frac{1+\phi}{2}\right)^{a_0 - 1} \left(\frac{1-\phi}{2}\right)^{b_0 - 1} \quad (2)$$

where a_0 and b_0 are positive hyperparameters, and where

$B(x, y) = \int_0^1 t^{x-1}(1-t)^{y-1}, dt$ is the beta function. The prior mean and variance are:

$$E(\phi) = \frac{2a_0}{a_0 + b_0} - 1 \quad (3)$$

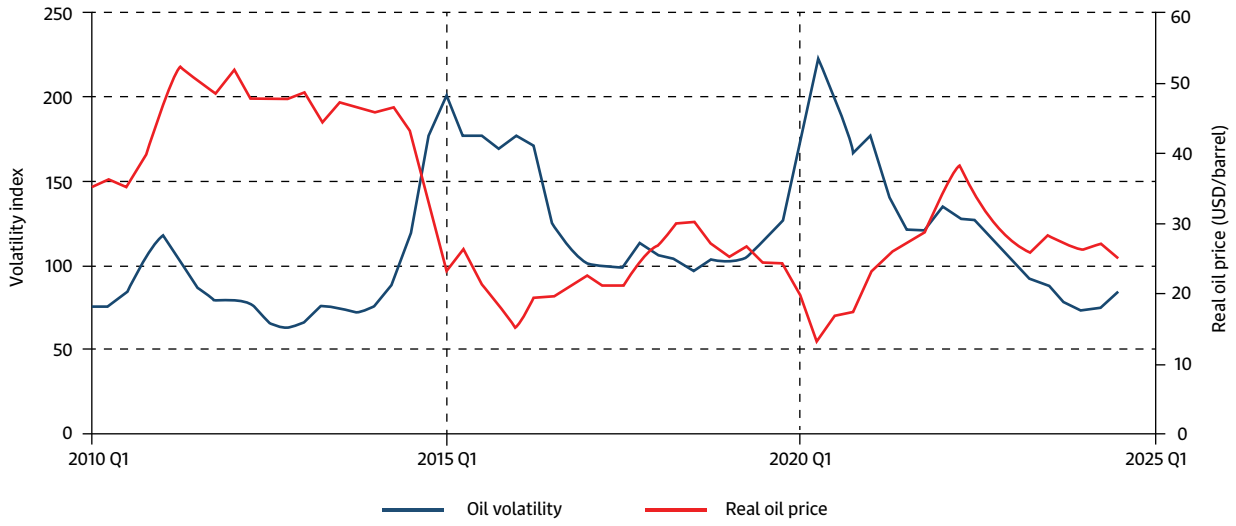
$$V(\phi) = \frac{4a_0 b_0}{(a_0 + b_0)^2 (a_0 + b_0 + 1)} \quad (4)$$

Hence, the prior mean depends solely on the ratio $a_0 : b_0$, and it is positive when $a_0 > b_0$, negative when $a_0 < b_0$, and zero when $a_0 = b_0$. Holding this ratio fixed, increasing a_0 and b_0 reduces the prior variance. The choice $a_0 = b_0 = 1$ yields the uniform prior on (−1,1).

For the volatility parameter $\sigma_\eta \in \mathrm{R}^+$, we specify $\sigma_\eta^2 \sim B_{\sigma\eta} \times \chi_1^2 = \mathcal{G}(1/2, 1/2B_{\sigma\eta})$. Following Frühwirth-Schnatter and Wagner (2010), this is equivalent to assuming $\pm\sqrt{\sigma_\eta^2} \sim \mathcal{N}(0, B_{\sigma\eta})$. Unlike the familiar inverse-gamma prior, this choice is non-conjugate under standard Gibbs sampling, but it does not rule out values of σ_η near zero. In practice, inference is insensitive to the exact size of $B_{\sigma\eta}$ provided it is not set too small.

To this end, we take the log return on the real oil price and run the SV model with a million draws and a 10% burn-in rate. In Figure 1, we plot our estimate of oil uncertainty against the real oil price from Q1 2010 to Q3 2024. The real oil price is deflated by the U.S CPI (index 1982–1984 = 100).

Figure 1. The stochastic volatility series identified from the real oil price from Q1 2010 to Q3 2024.



Source: Authors' analysis using data from FRED and authors' calculation.

A Bayesian Vector Autoregression Model

06

To explore the effects of oil price uncertainty, we use a Bayesian approach. We estimate a standard Bayesian VAR (BVAR) with the Minnesota prior:

$$B_0 Y_t = c + B_1 Y_{t-1} + \ldots + B_p Y_{t-p} + \in_t \quad (5)$$

where Y_t is a vector of n model variables, ϵ_t is a vector of mutually uncorrelated disturbances, B_i is an n-by-n matrix of model coefficients corresponding to each Y_{t-l}, and B_0 governs the contemporaneous relationship between model variables. Finally, c is a vector of constants and linear trends. The reduced-form version of the structural VAR (SVAR) model in Equation 5 is given by:

$$Y_t = B_0^{-1} c + B_0^{-1} B_1 Y_{t-1} + \ldots + B_0^{-1} B_p Y_{t-p} + B_0^{-1} \in_t \quad (6)$$

where A_i are matrices of reduced-form parameters. The covariance matrix of structural shocks is normalized such that:

$$E(\in_t \in_t') \equiv \sum_w = I_w \quad (7)$$

where I_w is an n x n identity matrix. The normalization of $E(\in_t \in_t')$ allows us to write the reduced-form covariance matrix in the following form:

$$E(\in_t \in_t') \equiv \sum_w = B_0^{-1E} (\in_t w_i') B_0^{-1'} = B_0^{-1} B_0^{-1'} \quad (8)$$

The decision to implement a BVAR derives from its effectiveness in handling identification issues, mixed-frequency data, model misspecification, and parameter uncertainty. To determine the lag order, we rely on both the Bayesian information criterion (BIC) and the Akaike information criterion (AIC). We adopt a Cholesky decomposition. We list the order of variables following the Cholesky order. We follow Jo (2014) and Abiad and Qureshi (2023) for the transmission channel through oil price and world oil production for our baseline specifications:

$$Y = (Vol_t, Poil_t, Oilprod_t, GDP_t, \Pi_t, R_t)' \quad (9)$$

Results

07

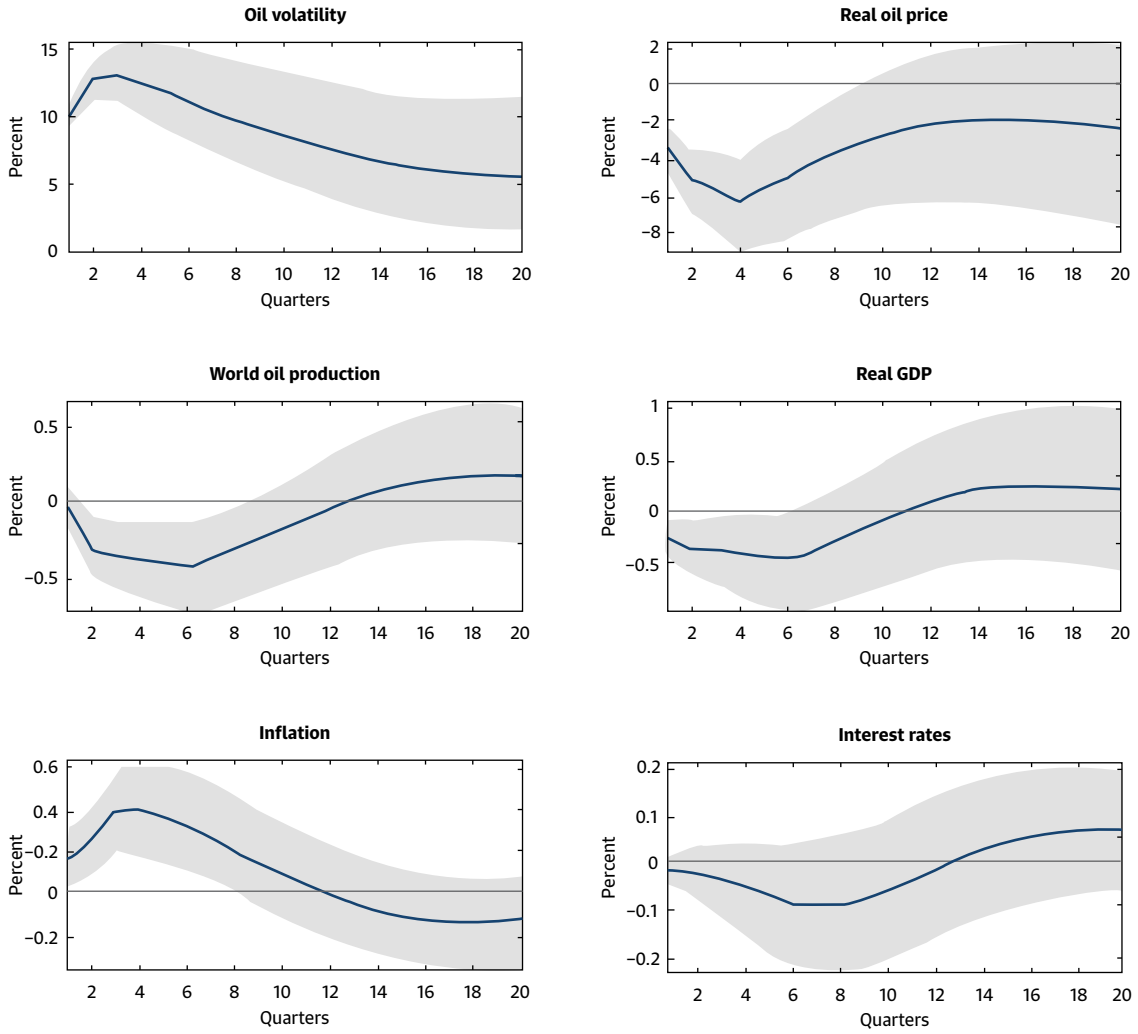
7.1 Main Findings

In Figure 2, we present the baseline results. We find statistically strong evidence of the recessionary effects associated with oil price uncertainty. Specifically, an increase in oil price uncertainty leads to a decline in world oil prices and a simultaneous reduction in oil production (a finding that is consistent with many other studies: see Śmiech et al. 2021, Abiad and Qureshi 2023, and Jo 2014, among others), reflecting the uncertainty-driven contraction in global demand. At the domestic level, this translates into lower real GDP, as reduced oil revenues constrain government activities and private investment.

Because the Riyal is pegged to the U.S. dollar, Saudi policy rates move with the Federal Funds Rate. An oil-price-uncertainty shock typically lowers oil prices and U.S. inflation, prompting the Federal Reserve to ease. Saudi Arabia then imports that easier stance, even though the domestic inflation channel is muted (administered energy prices limit pass-through from cheaper oil), while uncertainty raises risk premia and import-price volatility. The result is a policy mismatch: interest rates fall when Saudi Arabia's core problem is a negative income/terms-of-trade shock rather than slack demand, and inflation pressures can persist. Under the peg, monetary autonomy is limited; stabilization must therefore rely more on fiscal and macroprudential tools.

Taken together, our findings highlight the dual challenge posed by oil price uncertainty: it not only undermines output growth but also generates inflationary pressures, thereby complicating macroeconomic management.

Figure 2. The impulse response of an oil price uncertainty shock with the baseline model (Equation 9).



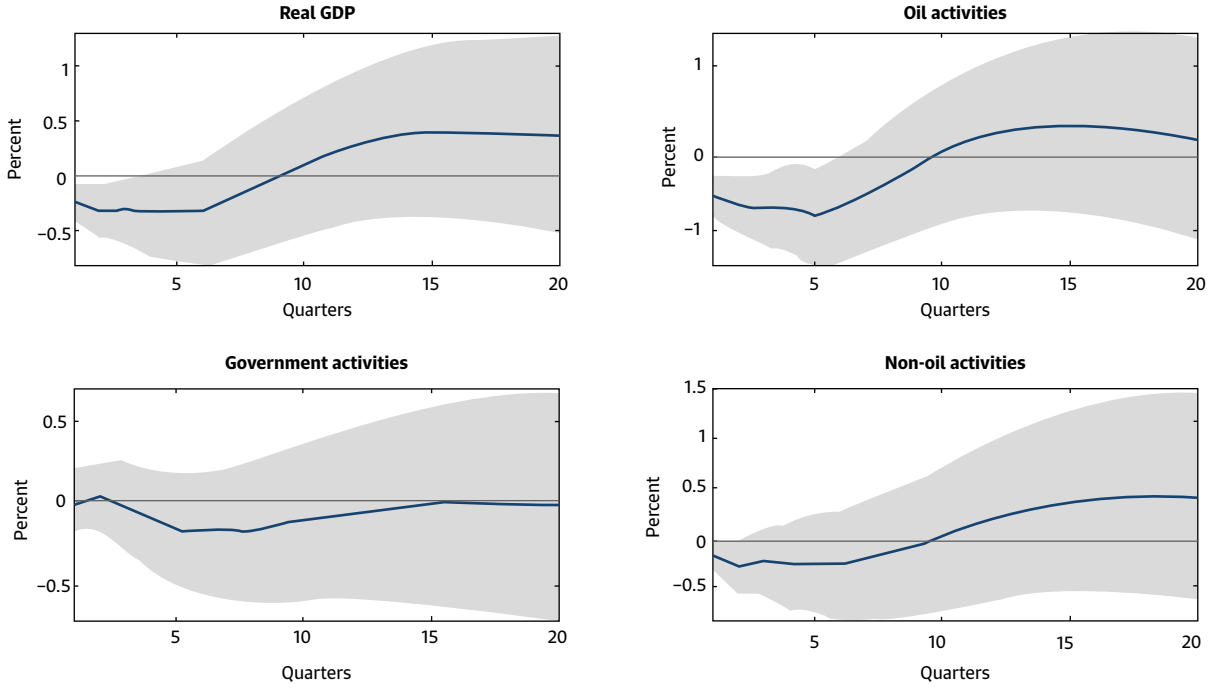
Notes: We scale the shock by a 10% increase in the oil price uncertainty on impact. All variables are expressed in percentage deviation. The plots show the point-wise median (solid line) and 16th and 84th quantiles (shaded) of the posterior distribution, computed from 10,000 draws.
Source: Authors' calculation.

We extend the VAR to incorporate additional variables. It is natural to ask how oil price uncertainty affects government activities, given that government spending is widely regarded as the main driver of Vision 2030 and that oil revenue remains the primary source of funding. Since fiscal policy in Saudi Arabia is closely linked to oil market dynamics, and understanding this transmission channel is critical for evaluating the sustainability of the Kingdom's diversification strategy.

To address this question, in Figure 4, we incorporate government activities, oil GDP, and non-oil GDP into our baseline VAR model (Equation 10), ordering them after the real GDP (Equation 10). As we conduct Cholesky identification, we order the oil GDP before the government activities under the assumption that the oil GDP can be affected first by the oil price uncertainty. This specification allows us to capture both the direct impact of oil price uncertainty on output and the indirect effects operating through fiscal and price dynamics. By doing so, we aim to provide a more comprehensive view of how oil-related shocks shape macroeconomic outcomes in the Saudi economy, particularly in relation to government activities, which are mainly financed with oil revenue.

$$Y = (Vol_t, Poil_t, Oilprod_t, GDP_t, Oilgdp_t, Gov_t, NonOilgdp_t, \Pi_t, R_t)' \quad (10)$$

Figure 3. The impulse response of an oil price uncertainty shock with oil, non-oil, and government activity (Equation 10).



Notes: We scale the shock by a 10% increase in the oil price uncertainty on impact. All variables are expressed in percentage deviation. The plots show the point-wise median (solid line) and 16th and 84th quantiles (shaded) of the posterior distribution, computed from 10,000 draws.
Source: Authors' calculation.

The results show a persistent negative effect on government activities arising from the decline in oil revenues. As expected, the oil-dependent sector contracted roughly twice as much as the non-oil sector, reflecting the economy's continued reliance on hydrocarbon revenues to sustain government spending and investment.

Finally, we examine the dynamics of consumption and investment in Figure 4. Therefore, we extend the baseline model (see Equation 9) and include real consumption and investment in Equation (11):

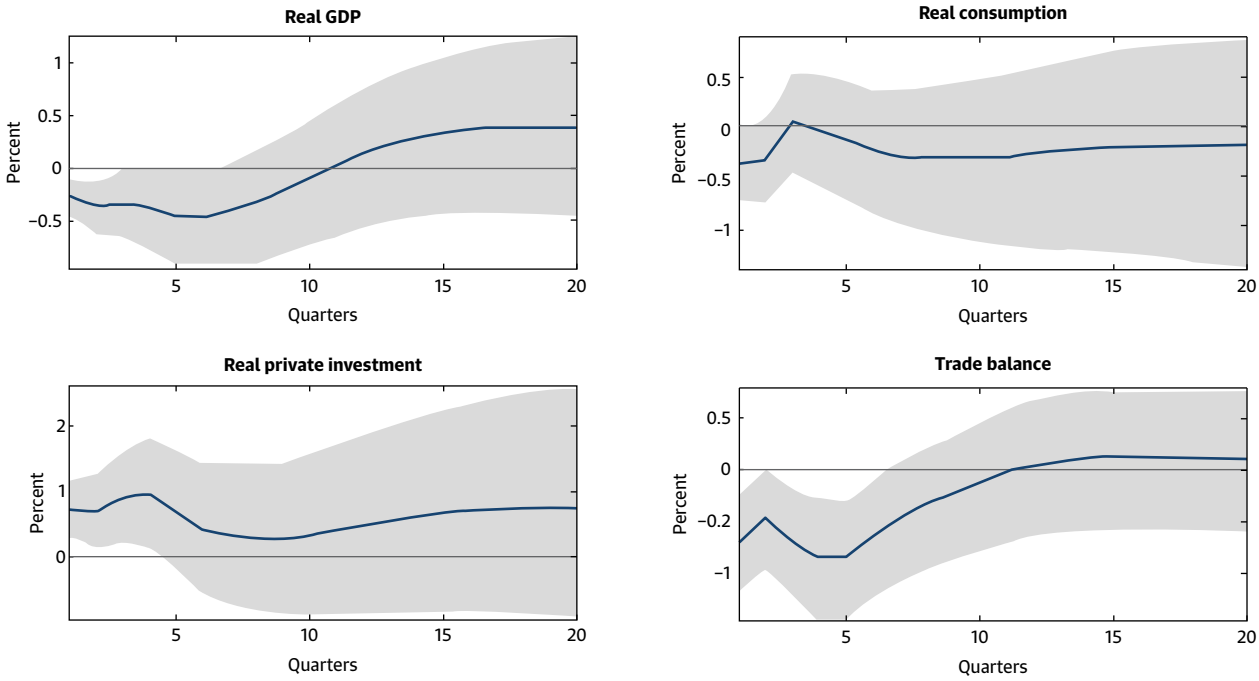
$$Y = (Vol_t, Poil_t, Oilprod_t, GDP_t, C_t, I_t, \Pi_t, R_t, TB_t)' \quad (11)$$

Interestingly, the contractionary impact on GDP appears to stem primarily from a deterioration in the trade balance, driven by lower oil prices, rather than from a collapse in domestic demand. This finding highlights a degree of resilience within the Saudi economy to oil price uncertainty shocks, challenging the common belief that it is uniformly vulnerable to oil price movements. Our results suggest that domestic fundamentals, particularly consumption and investment, remain relatively robust, enabling the economy to absorb part of the external shock and maintain a measure of stability even under heightened oil market uncertainty. We also conduct additional robustness checks in the Appendix.

Interestingly, we do not find a contractionary effect on real investment. Our analysis implies that investment remains strong even though the oil price drops following the high uncertainty in the oil market. This might imply that high uncertainty about oil revenue can slightly boost investment in the country to accelerate investment.

We follow the literature to order investment behind GDP and consumption. However, we also try to change the order of investment, including before GDP and consumption, and order it last. Nonetheless, the findings on investment remain robust. The findings are not in line with the findings in the literature, which usually imply a dampening in investment. The effect is usually referred to as "wait and see."

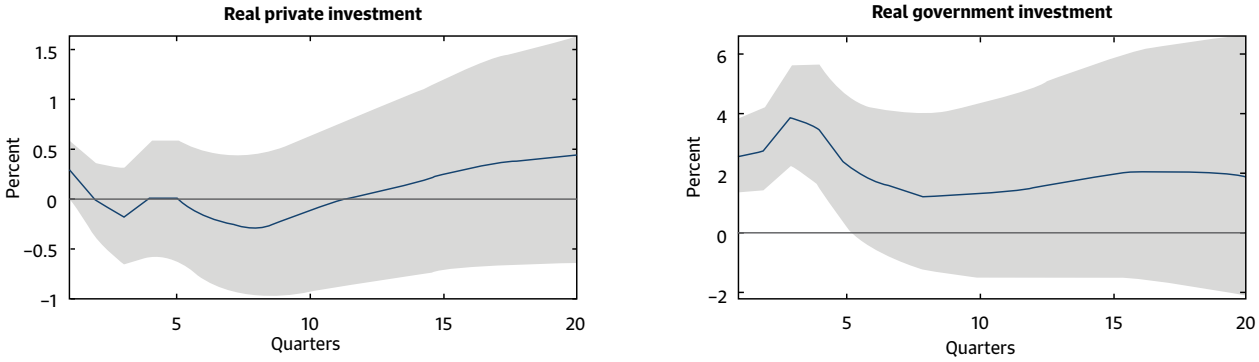
Figure 4. The impulse response of an oil price uncertainty shock with consumption and investment (Equation 11).



Notes: We scale the shock by a 10% increase in the oil price uncertainty on impact. All variables are expressed in percentage deviation. The plots show the point-wise median (solid line) and 16th and 84th quantiles (shaded) of the posterior distribution, computed from 10,000 draws.
Source: Authors' calculation.

To further investigate, we replace the total investment in Equation 11 with private investment and government investment, and we estimate the model for each type of investment separately. In Figure 6, we plot the impulse responses of both types of investment. Interestingly, the rise in oil price uncertainty seems to dampen private investment slightly. However, government investment increases significantly and leads to a countercyclical investment response. This reflects the stabilizing role of the government.

Figure 5. The impulse response of an oil price uncertainty shock on private and government investment.



Notes: We scale the shock by a 10% increase in the oil price uncertainty on impact. All variables are expressed in percentage deviation. The plots show the point-wise median (solid line) and 16th and 84th quantiles (shaded) of the posterior distribution, computed from 10,000 draws.
Source: Authors' calculation.

Conclusion

08

In this paper, we examined the macroeconomic consequences of oil-price uncertainty for Saudi Arabia using quarterly data for 2010-2024 and a BVAR augmented with a Bayesian stochastic-volatility measure of real oil prices. First, an uncertainty shock lowered the real oil price and world oil production, reducing Saudi real GDP, and raising inflation together with the policy rate as the peg transmitted external tightening.

The second result extended the model to trace fiscal channels. We showed that government activities fall persistently after uncertainty shocks, which is consistent with tighter oil revenues; the oil sector contracts roughly twice as much as the non-oil sector, underscoring the economy's residual hydrocarbon dependence even amid diversification (Figure 5). Domestic demand proved more resilient than often assumed: investment held up relative to the external account, with the trade balance the primary result of the downturn. First, because monetary policy autonomy is constrained, additional stabilization must lean on fiscal institutions, with rules that smooth expenditure over multi-year oil-price bands, well-calibrated sovereign-wealth-fund drawdown and saving rules, and explicit protection of high-multiplier public investment within Vision 2030's pipeline. Second, strengthening automatic stabilizers and non-oil revenue mobilization can reduce pro-cyclicality without derailing investment.

Third, transparency around investment sequencing and contingency plans can mitigate the "wait-and-see" behavior that uncertainty provokes in the private sector.

Finally, continued development of model-based policy frameworks (e.g., integrating our uncertainty block into a Saudi DSGE with a fiscal rule and an investment authority module) would help test trade-offs between stabilization and delivery of strategic projects.

Taken together, the results underscore the need for a structured framework to evaluate fiscal policy under oil-price uncertainty. A DSGE model tailored to Saudi Arabia would enable counterfactual experiments – that is, alternative fiscal rules, sovereign wealth fund drawdowns, and investment sequencing – while accommodating the exchange-rate peg. Given KSA's role as an active market participant whose production can influence global oil prices, future work should embed endogenous oil supply and price dynamics. We will leave the development and estimation of such a DSGE model for future research.

Endnotes

[1] An uncertainty shock is an exogenous rise in the variance of oil-price innovations, representing a surge in oil price uncertainty as those observed.

[2] We also use the Abiad and Qureshi (2023) Oil Price Uncertainty index as a proxy for uncertainty and discuss its distinct features.

[3] Bernanke (1983), Bachmann and Bayer (2011), Gilchrist, Sim, and Zakrajšek (2014), Stokey (2016), Xiaowen, Dong, and Kasa (2020), among others, find that the investment – wait and see – channel is the main propagation mechanism of uncertainty schocks.

[4] While stochastic volatility captures the *t+1* uncertainty about oil price changes the OPU index averages uncertainty over longer horisons.

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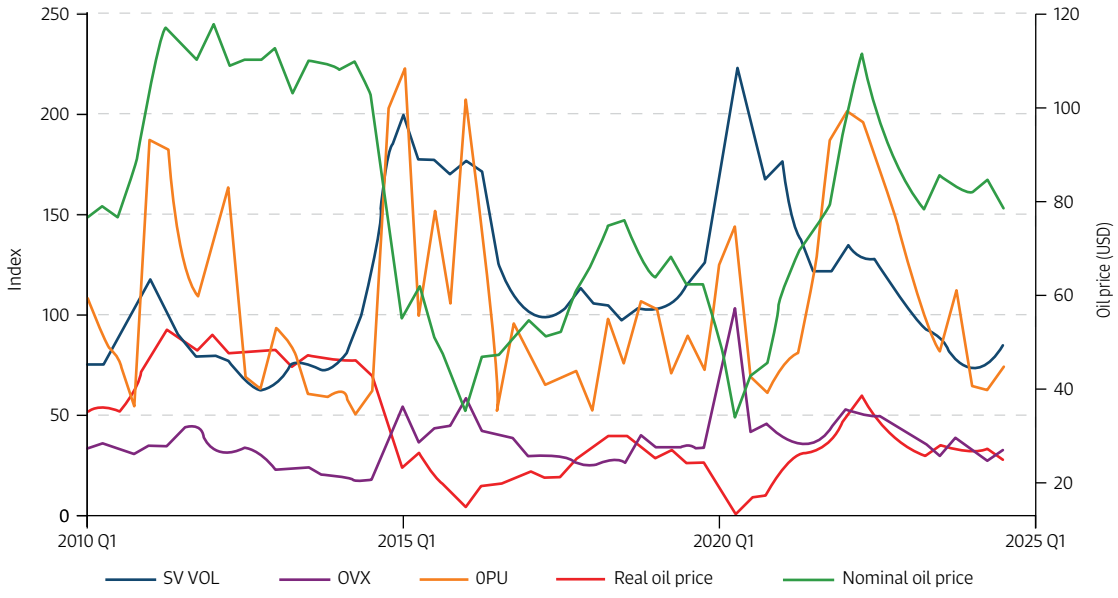
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Appendix: Additional Results and Robustness Check

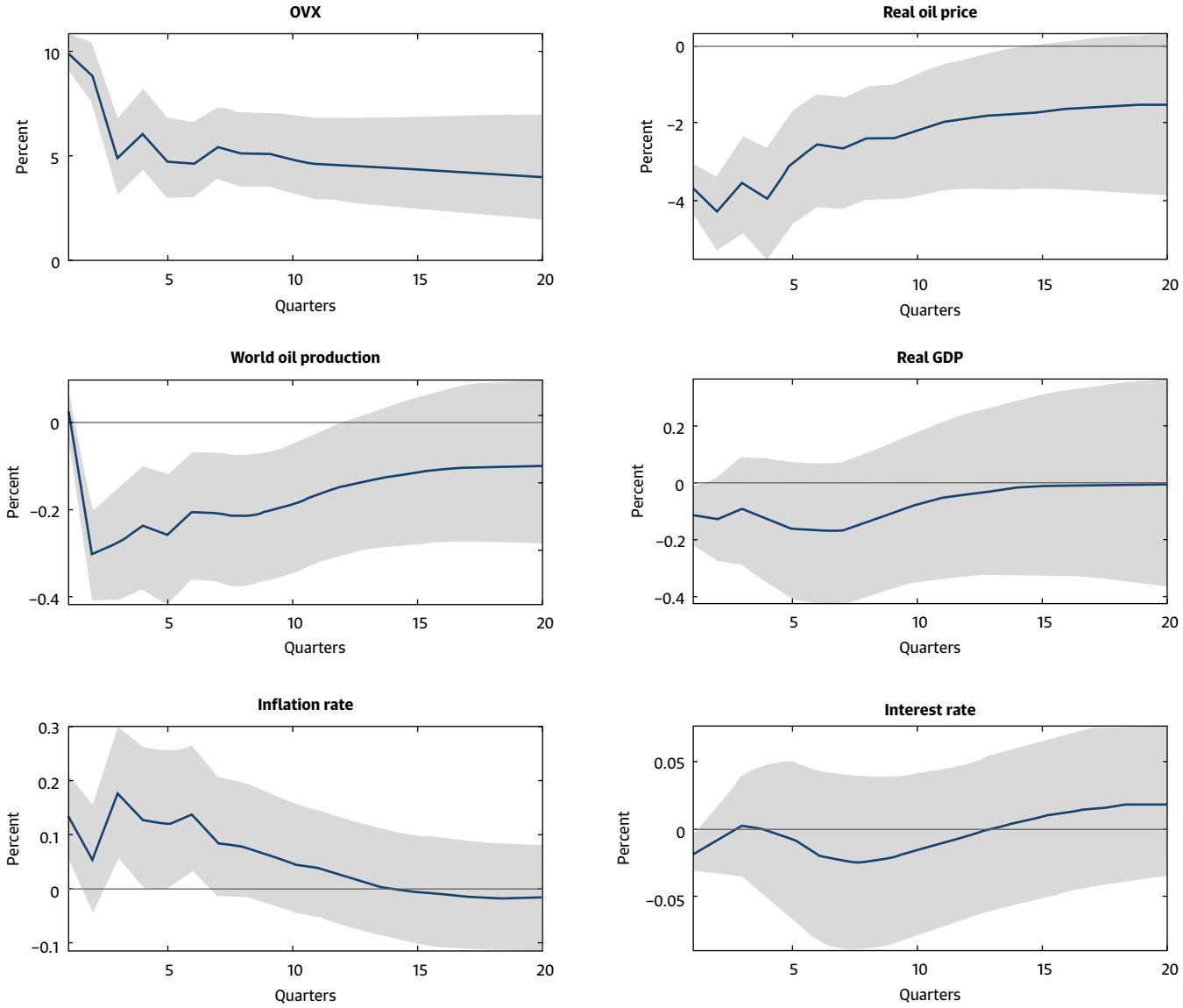
In this part, we provide additional results. First, we compare our estimation with OPU (Abiad and Qureshi 2023) and the CBOE Crude Oil ETF Volatility Index (OVX). The results show that our estimation behaves similarly to the latter. We also show that KSA oil production is affected due to the demand of the global market.

Figure A1. Comparison between OPU (Abiad and Qureshi 2023), the CBOE Crude Oil ETF Volatility Index (OVX), oil price, and our measurement.



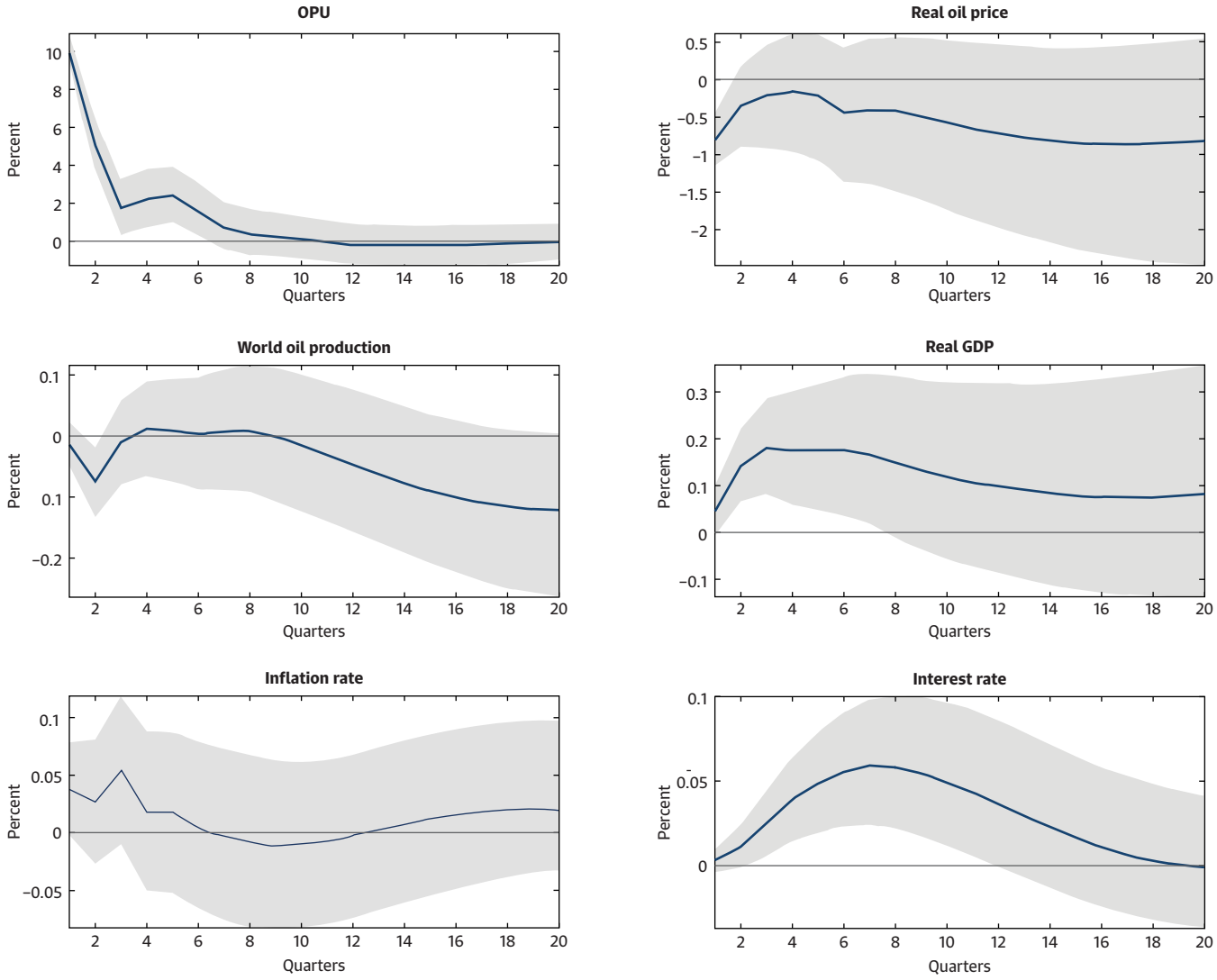
Source: Authors' analysis using data from Abiad and Qureshi (2023), CBOE Crude Oil ETF Volatility Index (FRED), oil price (FRED), and authors' calculation.

Figure A2. The impulse response of an oil price uncertainty shock using the CBOE Crude Oil ETF Volatility Index (OVX).



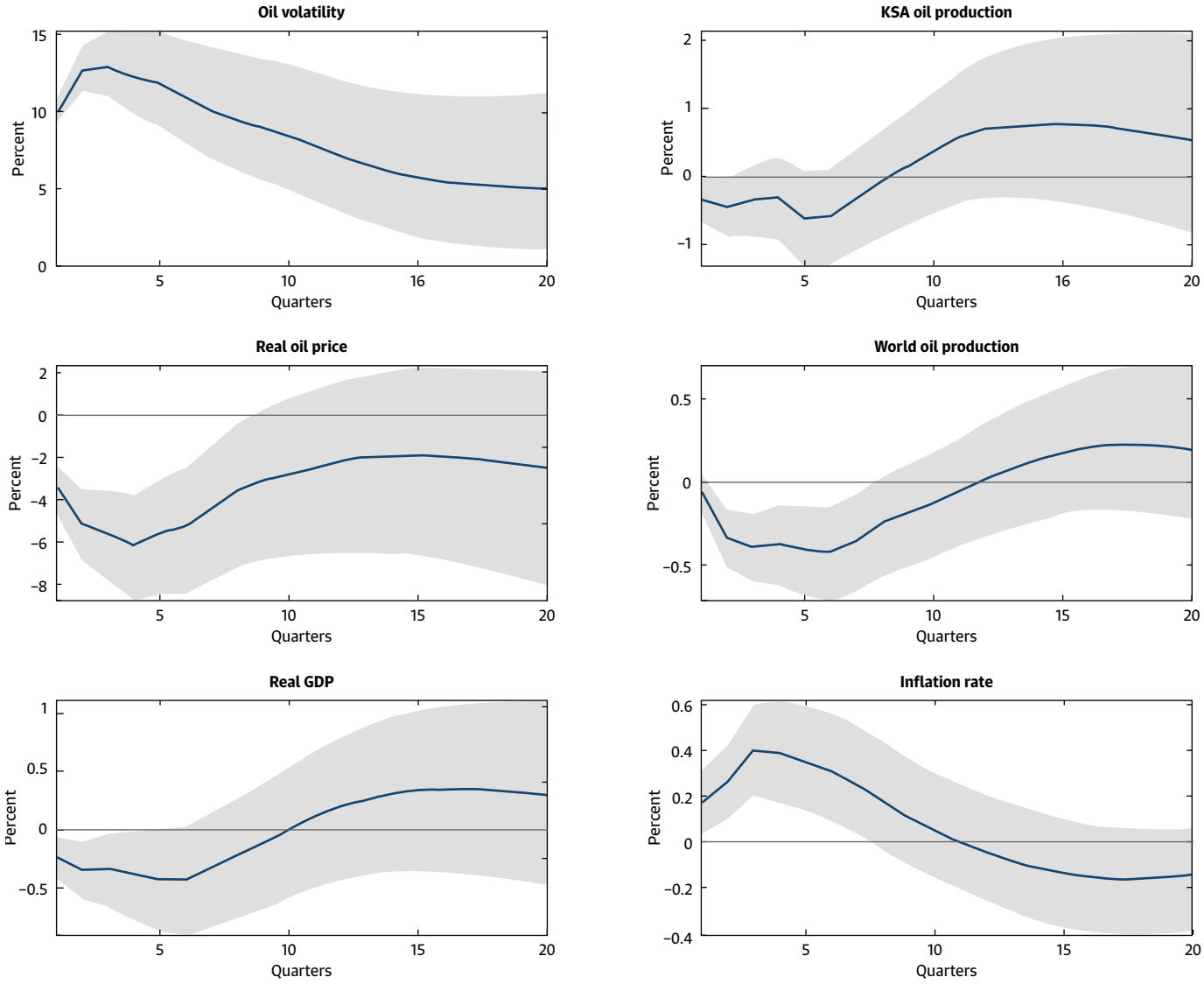
Notes: We scale the shock by a 10% increase in the oil price uncertainty on impact. All variables are expressed in percentage deviation. The plots show point-wise median (solid line), and 16% and 84% (shaded) quantiles of the posterior distribution computed from 10,000 draws.
Source: Authors' calculation.

Figure A3. The impulse response of an oil price uncertainty shock using OPU (Abiad and Qureshi 2023).



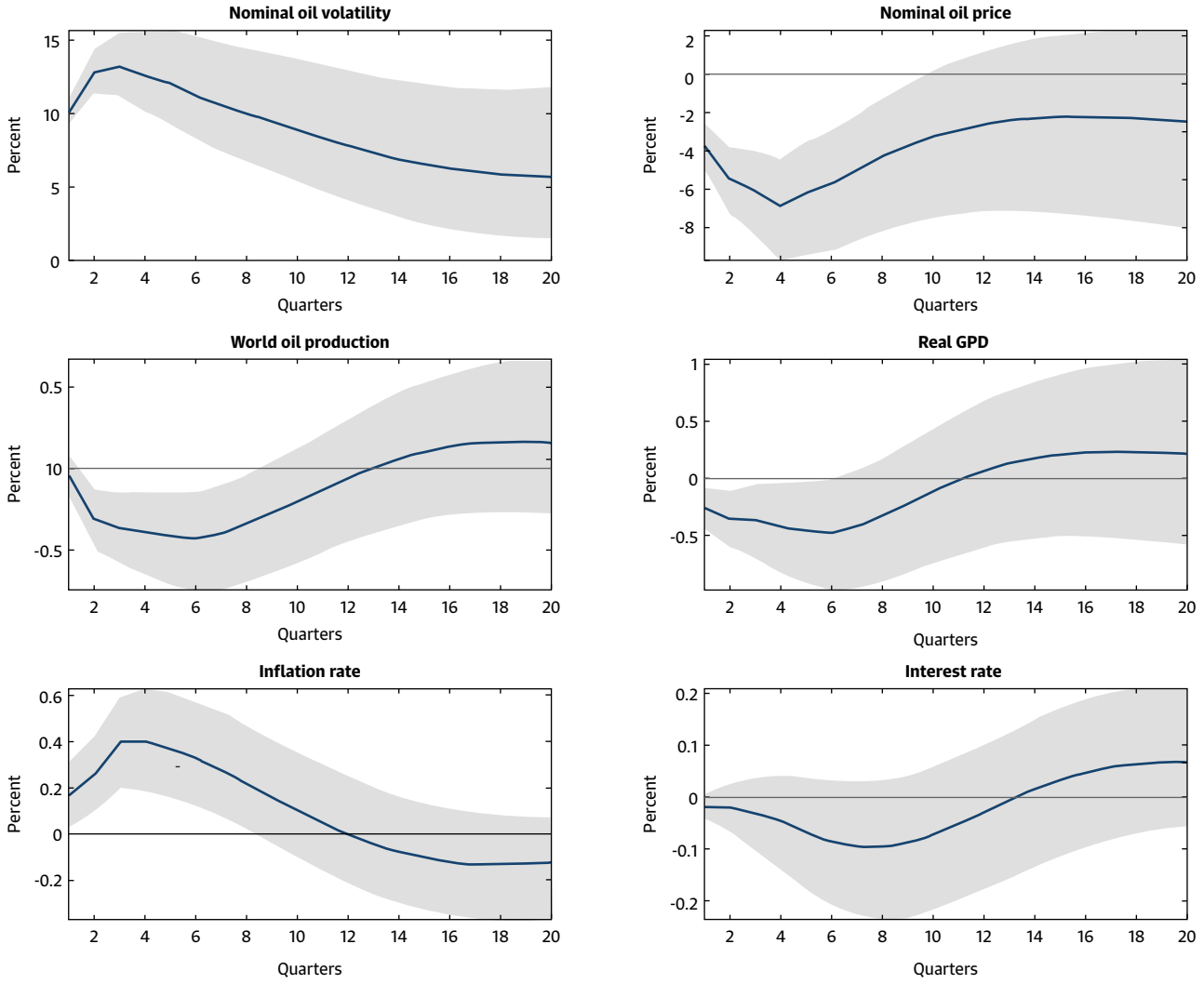
Notes: We scale the shock by a 10% increase in the oil price uncertainty on impact. All variables are expressed in percentage deviation. The plots show point-wise median (solid line), and 16% and 84% (shaded) quantiles of the posterior distribution computed from 10,000 draws.
Source: Authors' calculation.

Figure A4. The impulse response of an oil price uncertainty shock using nominal SV volatility.



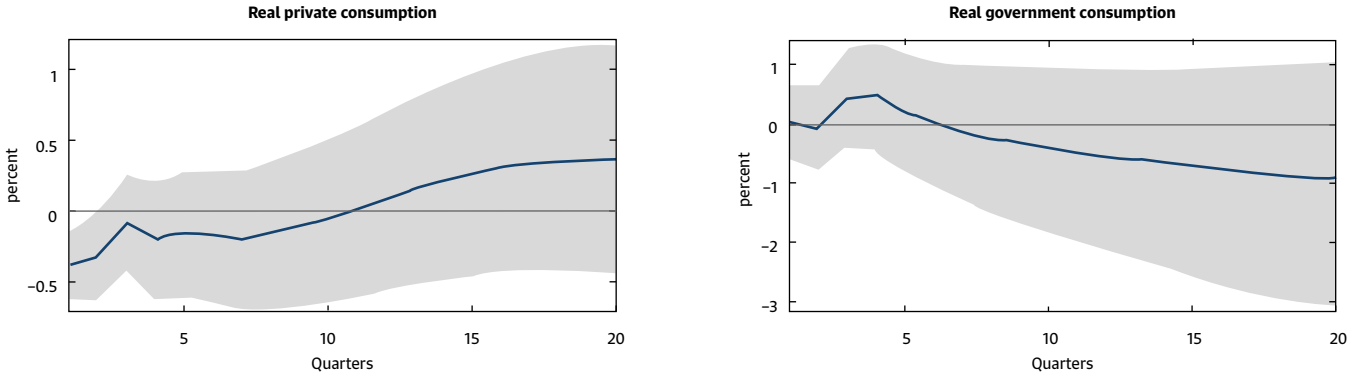
Notes: We scale the shock by a 10% increase in the oil price uncertainty on impact. All variables are expressed in percentage deviation. The plots show point-wise median (solid line), and 16% and 84% (shaded) quantiles of the posterior distribution computed from 10,000 draws.
Source: Authors' calculation.

Figure A5. The impulse response of an oil price uncertainty shock using nominal SV volatility.



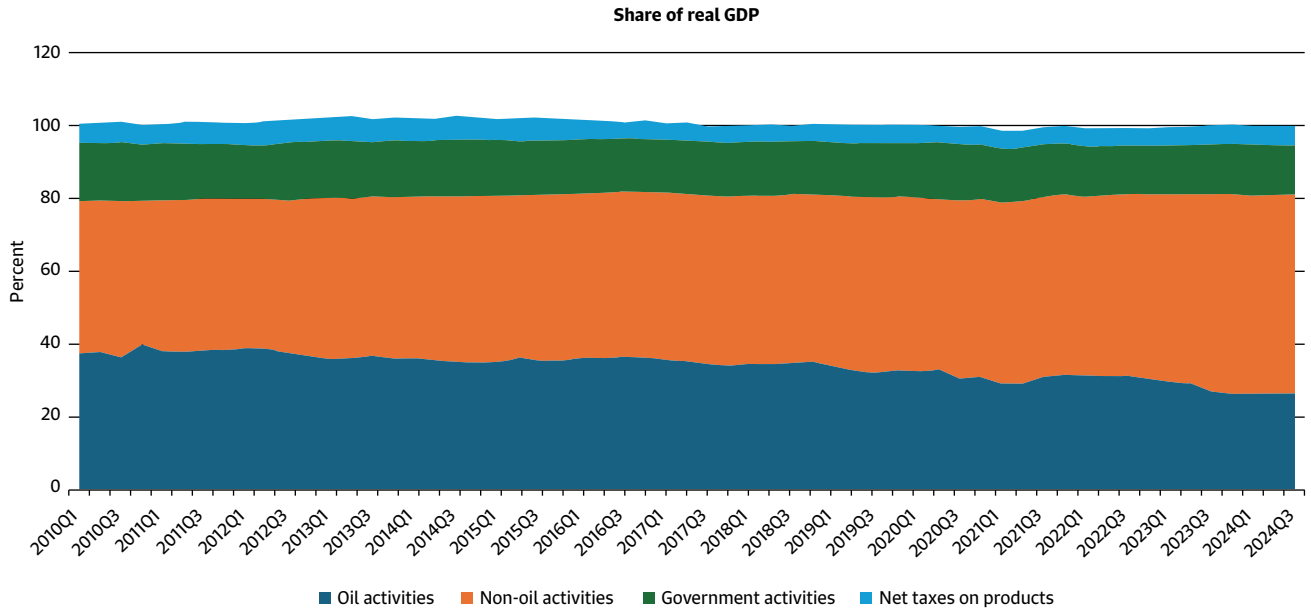
Notes: We scale the shock by a 10% increase in the oil price uncertainty on impact. All variables are expressed in percentage deviation. The plots show point-wise median (solid line), and 16% and 84% (shaded) quantiles of the posterior distribution computed from 10,000 draws.
Source: Authors' calculation.

Figure A6. The impulse response of an oil price uncertainty shock for government and private consumption.



Notes: We scale the shock by a 10% increase in the oil price uncertainty on impact. All variables are expressed in percentage deviation. The plots show point-wise median (solid line), and 16% and 84% (shaded) quantiles of the posterior distribution computed from 10,000 draws.
Source: Authors' calculation.

Figure A7. The KSA real gross domestic product shares by main economic activities.



Source: Authors, based on GASTAT (Chain-linked, 2023=100).

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Ha Anh Le is a Postdoctoral Researcher with the Energy Macro and Microeconomics team. His research focuses on macroeconomics, general equilibrium models, monetary and fiscal policy, and environmental macroeconomics. He has a particular interest in the implications of digital money and the design of environmental policies to address both transition and physical risks. He earned his M.Sc. in Quantitative Economics and Ph.D. from the Graduate School of Economics, Finance and Management (GSEFM) at Goethe University Frankfurt. Prior to joining KAPSARC, he worked at the Institute for Monetary and Financial Stability (IMFS) and was a Research Intern at the International Monetary Fund (IMF).



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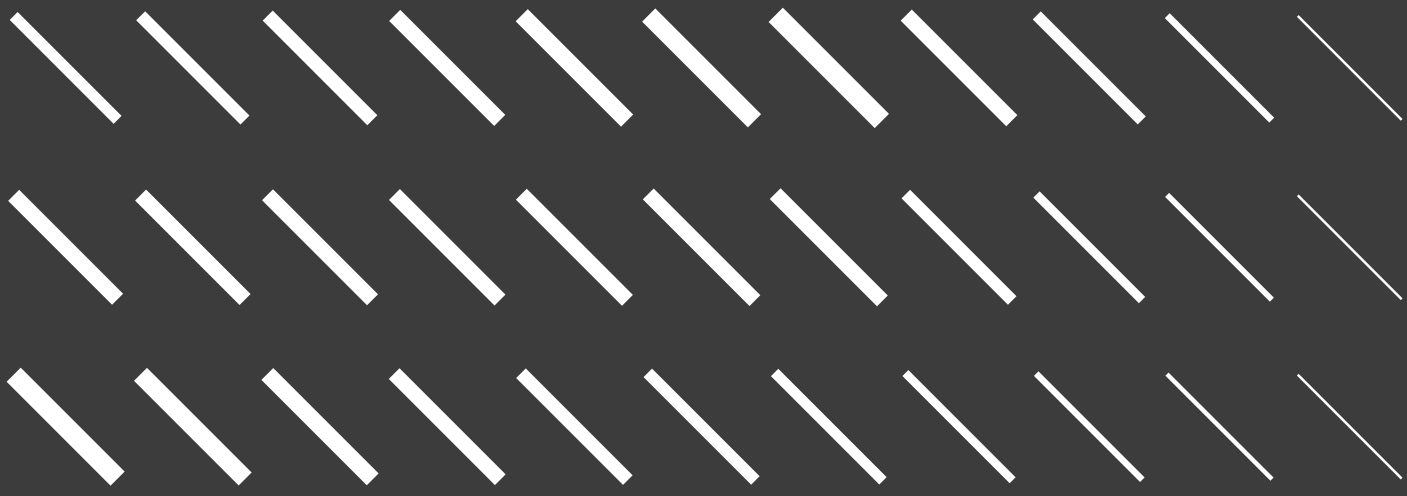
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About the Project

This project studies how oil price uncertainty affects Saudi Arabia's macroeconomy. Using quarterly data for 2010-2024 and a Bayesian VAR with stochastic volatility, the analysis identifies uncertainty shocks separately from oil price levels and global activity, and then traces their effects across output components, trade, prices, and the public sector. The results show that spikes in oil price uncertainty lower real GDP, worsen the trade balance via falling oil exports, and raise domestic prices. The contraction is twice as large in oil GDP as in non-oil GDP, and private consumption declines markedly. In contrast, total investment rises, driven by countercyclical public investment, while private investment is not significantly responsive. These patterns are robust to alternative uncertainty proxies and to changes in specification. Policy implications follow from the riyal-dollar peg's limits on monetary autonomy: stabilization should prioritize households – via rules-based transfers and countercyclical credit guarantees – while preserving continuity in public investment and strengthening volatility-aware fiscal buffers keyed to uncertainty bands rather than to point price forecasts. Together, the results argue that managing oil-price uncertainty requires protecting household demand and institutionalizing rules that keep strategic investment on track.





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