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Oil Prices and Public Expenditures Allocation in Kuwait: Understanding the Dynamics

Abstract

Purpose: This study quantifies the dynamics of Kuwait's government resource allocation to real capital and current expenditures in response to global real oil price shocks.
Study design/methodology/approach: A Bayesian Structural Vector Autoregressive model is employed to identify structural real oil price shocks and analyze their effects through impulse response functions and historical decompositions.
Sample and data: The analysis uses quarterly time series data from 1993Q3 to 2015Q4, including real oil prices, Kuwait's real oil revenues, and real public capital and current expenditures.
Results: Evidence indicates that real oil price shocks significantly affect Kuwait's real public expenditures, with a 10% shock resulting in a 5.2% increase in real capital expenditures and a 3.8% increase in real current expenditures over a 2.5-year period. Therefore, real public capital expenditures are about 37 percent more sensitive to real oil price shocks compared to real public current expenditures. From 1993 to 2015, real oil price shocks played a crucial role in driving fluctuations in real public expenditures; however, non-oil-related shocks were also significant, especially after 2006.
Originality/value: This study examines the underexplored connections between public expenditures and the oil market at a disaggregated level, providing valuable insights for policymakers aiming to enhance fiscal management and sustainability.
Research limitations/implications: The study is silent on the welfare consequences of alternative allocations and on the transmission mechanisms of shocks. DSGE models can help address these gaps. Future research should also explore non-oil-related shocks influencing public expenditure fluctuations.

Keywords: Oil Price, Government Expenditures, Capital, VAR, Bayesian.
JEL classification: E60, F41, H50, H54

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الملخص

أسعار النفط وتوزيع النفقات العامة في الكويت: فهم الديناميكيات

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هدف الدراسة: قياس ديناميكيات النفقات الحكومية الرأسمالية والجارية الحقيقية في الكويت؛ استجابةً لصدمات أسعار النفط الحقيقية العالمية.

تصميم/ منهجية/ طريقة الدراسة: نموذج المتجه الذاتي الانحداري الهيكلي البايزي لتحديد الصدمات الهيكلية في أسعار النفط الحقيقية وتحليل آثارها باستخدام وظائف الاستجابة للصدمات والتحليلات التاريخية.

عينة الدراسة وبياناتها: بيانات السلاسل الزمنية الفصلية من الربع الثالث لعام 1993 حتى الربع الرابع لعام 2015، بما في ذلك أسعار النفط الحقيقية، وإيرادات النفط الكويتية الحقيقية، والنفقات العامة الرأسمالية والجارية الحقيقية.

نتائج الدراسة: صدمات أسعار النفط الحقيقية تؤثر بشكل كبير على النفقات العامة الحقيقية للكويت؛ إذ تؤدي صدمة بنسبة 10% إلى زيادة بنسبة 5.2% في النفقات الرأسمالية الحقيقية و3.8% في النفقات الجارية الحقيقية على مدى فترة 2.5 سنة. ومن ثم؛ فإن النفقات الرأسمالية العامة الحقيقية أكثر حساسية لصدمات أسعار النفط الحقيقية بنسبة 37% مقارنة بالنفقات الجارية الحقيقية. من عام 1993 إلى 2015، لعبت صدمات أسعار النفط الحقيقية دورًا حاسمًا في تحريك تقلبات النفقات العامة؛ ومع ذلك، كانت الصدمات غير المتعلقة بالنفط مهمة أيضًا، خاصة بعد عام 2006.

أصالة الدراسة: تبحث هذه الدراسة الروابط غير المستكشفة بين النفقات العامة وسوق النفط على مستوى مفصل؛ مما يوفر رؤى قيمة لواضعي السياسات الذين يهدفون إلى تعزيز الإدارة المالية والاستدامة.

حدود الدراسة وتطبيقاتها: لا تتطرق الدراسة إلى آثار الرفاه البديلة لتخصيصات النفقات أو إلى آليات نقل الصدمات. يمكن لنماذج التوازن العام العشوائي (DSGE) معالجة هذه الفجوات. يجب أن تستكشف الأبحاث المستقبلية أيضًا الصدمات غير المرتبطة بالنفط، التي تؤثر على تقلبات النفقات العامة.

الكلمات المفتاحية: أسعار النفط، النفقات الحكومية، رأس المال، VAR، بايزي.

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Introduction

Kuwait's economy is a small, open economy that heavily relies on government-controlled oil production and revenues. According to the International Monetary Fund (IMF, 2015), between 2011 and 2014, oil accounted for over 80 percent of total public revenue and more than 60 percent of real GDP. The government predominantly manages the allocation of oil revenues, making government expenditures a crucial determinant of Kuwait's macroeconomic structure. A key decision in this allocation process is whether to invest in "capital" goods—such as income-generating projects and infrastructure—or to allocate funds to "current" expenditures, like wages and transfer payments, which mainly drive private consumption. This allocation is often skewed towards current spending rather than capital investment, with Kuwait's public investment significantly below the Gulf Cooperation Council average from 2000 to 2015 (IMF, 2015).

The distinction between current and capital expenditures is crucial because it represents a trade-off between present consumption and future consumption, the latter of which can be enhanced through economic growth driven by capital accumulation (Romer, 1986; Solow, 1956). The government's allocation of resources towards capital expenditures—such as on public universities and transportation networks—stimulates future economic growth and production (Aschauer, 1989; Bom & Ligthart, 2013; Easterly & Rebelo, 1993; Pereira & Andraz, 2013). Therefore, understanding the dynamics of government resource allocation is essential for economic development in both the short and long run.

Given that oil revenues are the primary source of government funding in Kuwait, allocation decisions frequently arise in response to unexpected changes in the oil market. For example, an unexpected increase in oil prices provides the government with additional resources that can be distributed between current and capital expenditures. Conversely, a negative real oil price shock forces the government to make difficult decisions about which types of expenditures to reduce or sacrifice.

This study investigates the government's allocation of oil revenues between capital and current expenditures in response to real oil price shocks. Specifically, it examines the dynamic interactions between the real global price of oil and Kuwait's real government expenditures on capital and current expenditures from 1993 to 2015, utilizing a Bayesian Structural Vector Autoregression (BSVAR) model. The study aims to analyze the magnitude, economic and statistical significance, and duration of the effects of real oil price shocks on real capital and current government expenditures. Additionally, it uses the BSVAR model to historically decompose the contribution of real oil price shocks to fluctuations in capital and current expenditures over the period between 1993 to 2015.

The BSVAR model consists of three main components: the Vector Autoregression (VAR) model, Bayesian estimation, and structural identification. The VAR model captures the simultaneous and dynamic relationships among macroeconomic variables. The Bayesian approach to estimation is particularly advantageous when working with small sample sizes, as is often the case with quarterly macroeconomic data, and it provides a more intuitive framework for probabilistic inference. The structural element of the study "identifies" the BSVAR by isolating real oil price shocks that are independent of other shocks in the model. This isolation allows for a ceteris paribus interpretation, which is crucial for establishing causal relationships in macroeconomic studies. I use the BEAR toolbox developed by Dieppe and Roye (2021) to estimate the BSVAR model using quarterly data from 1993Q3 to 2015Q4, focusing on four variables: real global oil prices, real Kuwaiti oil revenues, real capital government expenditures, and real current government expenditures. The identification strategy employs impact exclusion restrictions based on small open economy macroeconomic theory. This approach isolates real oil price shocks from other domestic shocks, resulting in a set of structural impulse response functions and a historical decomposition of the model data.

This study offers insights for policymakers seeking to enhance fiscal management and sustainability. Moreover, it provides stylized facts that pave the way for a theoretical exploration of the transmission mechanism of real oil price shocks to Kuwait's macroeconomy.

Literature Review and Research Questions

This study broadly fits into the empirical macroeconomic literature that examines the determinants of macroeconomic activity in small open economies. For applications to the Kuwaiti economy, notable examples of such studies include (Alawadhi et al., 2024; Burney et al., 2018; Merza, 2007), all of which employ time series methods to investigate these determinants.

Merza (2007) uses an Error-Corrected Vector Autoregression model (VECM) and Granger's causality tests to analyze the relationship between oil exports and real GDP growth, finding a significant link between oil exports and economic activity in Kuwait. Similarly, Burney et al. (2018) utilize a VAR model of the Kuwaiti economy with weakly exogenous foreign variables to demonstrate that economic activity in Kuwait is primarily driven by oil revenues, which fuel public sector GDP and real output in the long run. Alawadhi et al. (2024) estimate a set of autoregressive distributed lag models for the Kuwaiti economy, concluding that its short-run growth is mainly driven by oil exports.

I extend the aforementioned research by focusing on the relationship between oil prices and government resource allocation. The closest study to this one is by Eltony and Al-Awadi (2001), who apply a VECM model to quarterly data that include oil prices, Kuwait's oil revenue, and public expenditures and other macroeconomic aggregates from 1984Q1 to 1998Q4. They find that public capital expenditures are more sensitive to real oil price shocks than current public expenditures. This study complements their work by using a longer sample period and offering a historical decomposition that spans major events such as the 2007-2009 global financial crisis and the shale oil revolution. This study further contributes to the literature by introducing Bayesian estimation techniques to macro-econometric models of Kuwait's economy, which traditionally rely on frequentist approaches. Bayesian estimation enhances the information content of the model through the use of priors, improves estimation in small samples, and provides a more intuitive framework for interpreting probabilistic statements. Evidence from the Bayesian SVAR model is used to address four research questions:

RQ1: To what extent do real oil price shocks affect real public capital expenditures, and can we quantify the dynamics of this effect?

RQ2: How do real oil price shocks impact real public current expenditures, and what are the magnitude and dynamics of this effect?

RQ3: Are real public capital expenditures more responsive to real oil price shocks than real current public expenditures?

RQ4: What is the contribution of real oil price shocks to the fluctuations in Kuwait's real public capital and current expenditures between 1993 and 2015?

Research Methods

This section begins by presenting the BVAR model specification and outlining the prior distributions and the Gibbs posterior sampler used in the estimation process. For consistency and replicability, the model description, notations, and estimation follow the exact structure in the technical guide of the BEAR toolbox developed in Dieppe and Roye (2021). The Structural Dynamic Analysis subsection then describes the structural dynamic output of the BSVAR, which is later used to address research questions RQ1 through RQ4. The Data and Variables subsection defines the variables and data used in the model, while the Baseline Identification subsection details the baseline identification of shocks and dynamic relationships.

BVAR Model and Estimation

The reduced-form VAR model with P (= 2) lag order can be written compactly as:

$$y_t = \sum_{p=1}^{P} A_p y_{t-p} + Cx_t + \epsilon_t, \text{ where } t = 1,2, \ldots,T. \quad (1)$$

where y_t is an n (= 4) × 1 vector of endogenous variables, A_p is an $n \times n$ matrix of slope coefficients, C is an $n \times (m = 4)$ matrix and x_t is $m \times 1$ vector of exogenous and constant terms. The residuals vector ϵ_t follows a multivariate normal distribution $\epsilon_t \sim Normal\ (0, \Sigma)$ a and is assumed to be uncorrelated across time such that $E(\epsilon_t\, \epsilon_t') = \Sigma$ and $\mathrm{E}(\epsilon_t\, \epsilon_s') = 0$ for $t \neq s$. The residuals variance covariance matrix, Σ, is symmetric positive definite with variance terms on the diagonal. The number of coefficients to be estimated is $k = np + m$ for each equation, and a total of $q = nk$ coefficients for the full model. To facilitate the estimation process, Dieppe and Roye collect the in a vector $\beta = \mathrm{vec}\begin{pmatrix} A'_1 \\ A'_2 \\ C' \end{pmatrix}$.

Priors and Estimation

The core concept of Bayesian analysis is to arrive at a posterior distribution $p(\theta \mid y)$ for a set of parameters θ by combining (or updating) prior information $p(\theta)$ with data embedded in the model's likelihood function $f(y \mid \theta)$,

$$p(\theta \mid y) \propto f(y \mid \theta)p(\theta)$$

For the VAR outlined in this section, the parameters of interest in θ are β and Σ, which represent the VAR coefficients and the model's residual variance-covariance matrix, respectively. The prior distribution on these parameters, p(θ), reflects the researcher's beliefs —derived from previous studies, literature, and macroeconomic theory—about their values before observing the data. This study uses a multivariate normal prior distribution for β and an inverse Wishart prior for

Σ .Together, assuming that Σ is unknown and Ω_0 is arbitrary, they are referred to as the independent normal inverse Wishart prior, where:

$$\beta \sim Normal\ (\beta_0, \Omega_0),$$

and

$$\Sigma \sim Inverse\ Wishart\ (S_0, \alpha_0),$$

where β_0 is a $q \times 1$ vector of values around 1 for own first lag coefficients, and zero for cross variable and exogenous coefficients. The proximity of the own first lag coefficients to 1 captures the unit root behavior often observed in macroeconomic data. The diagonal terms in Ω_0 determine the tightness of the beliefs about the prior mean. α_0 is the inverse Wishart's degree of freedom, set to $n + 2$ and S_0 is an $n \times n$ scale matrix that is a function of α_0 and residual variances of autoregressions, as described in (Karlsson, 2012).

The choice of the independent normal inverse Wishart distribution over other alternatives, such as the Minnesota prior and the normal Wishart distribution, is motivated by the desire to remain relatively agnostic about the values of Σ and Ω_0. For instance, the Minnesota prior treats as known, while the normal Wishart distribution strictly constrains Ω_0 to depend on Σ. In short, the independent normal inverse Wishart prior distribution is chosen for its flexibility and for giving more weight to the data evidence in the posterior distribution.

Table 1 details the main hyperparameters that specify the prior on β. The slope coefficients for the own first lag variables are set to $ar = 0.8$, with relatively high confidence, as indicated by $\lambda_1 = 0.1$. These settings reflect the non-stationary and near-unit-root behavior of Kuwait's macroeconomic data.[1] Additionally, $\lambda_2 = 0.5$ captures the uncertainty around the cross-coefficient lag estimates, while $\lambda_3 = 1$ is a scaling coefficient that controls the speed at which coefficients for lags greater than 1 converge to 0. Finally, $\lambda_4 = 100$ attaches considerable uncertainty to the prior mean of the constant terms.

Finally, these priors are combined with the likelihood of the model in Equation (1) to produce conditional distributions $p(\beta \mid \Sigma, y)$ and $p(\Sigma \mid \beta, y)$, which are required for the Gibbs sampler to obtain draws from the unconditional empirical posterior distribution of β and Σ. The following algorithm represents a general Gibbs sampler for the VAR parameters:[2]

1 See Appendix (A) for the Perron (1997) unit root tests results.

2 See the technical guide in Dieppe and Roye (2021) for a more detailed treatment.

Table 1
Prior's Hyperparameters

Hyperparameter	Value
ar	0.8
λ_1	0.1
λ_2	0.5
λ_3	1
λ_4	100

Note: The hyperparameters adjust the value of β_0 and the confidence in our prior beliefs through Ω_0. For the full construction of Ω_0, see Equation (1.8.4) of Dieppe and Roye 's technical guide.

1- Define the total number of iterations and the burn-in sample.

2- Set initial values: Set an initial value for β_0.

3- Draw from the conditional posterior of Σ: Draw Σ from the Inverse Wishart distribution conditional on the latest value of β.

4- Draw from the conditional posterior of β: Draw a new value of β from the multivariate normal distribution conditional on the latest value of Σ from step 3.

5- Repeat steps 3 and 4 for the total number of iterations, then discard the first burn-in iterations.

To ensure convergence, this study sets the total number of iterations to 100,000 and discards the first 50,000 as burn-in. This procedure provides 50,000 unconditional posterior draws of the model parameters. These posterior draws are then used to conduct the dynamic analysis of the BSVAR model.

Structural Dynamic Analysis

With the unconditional posterior draws of β and Σ at hand, the analysis proceeds by deriving the impulse response functions (IRFs), which are later used to quantify the response of government expenditures to an independent or orthogonal structural shock to the real price of oil in the context of RQ1 through RQ3. This is done by recovering the structural shocks through the structural-form VAR,

$$D_0\, y_t = D_1\, y_{t-1} + D_2\, y_{t-2} + F x_t + \eta_t,$$

where $\eta_t \sim$ *Normal* $(0, \Gamma)$. The mapping between the reduced form VAR in Equation (1) and the structural form VAR in the above equation is given by $\epsilon_t = D\eta_t$.

Therefore, identifying D is sufficient to recover the structural disturbances.[3] In this study, this identification is obtained via lower triangular factorization of the variance covariance matrix of the reduced form errors into $\Sigma = D\Gamma D' = HH'$, where H is the unique Cholesky factor.

The structural IRFs are given by:

$$\frac{\partial y_{t+h}}{\partial \eta_t} = \tilde{\Psi}_h ,$$

such that $\tilde{\Psi}_0 = D$ and $\frac{\partial y_{0,t+h}}{\partial \eta_{j,t}} = \tilde{\phi}_{0,ij}$.[4] For example, the response of the variable i to a *structural* shock to variable j at impact ($h = 0$) can be found in row i column j of the matrix D. The estimated IRFs are used to quantify the effect of structural oil price shocks on government's current and capital expenditures.

Finally, the IRFs and structural errors can be used to determine the historical contribution of each shock to the evolution of all the variables in the model:

$$y_{i,t} = z_i^{(t)} + \underbrace{\sum_{j=0}^{t-1} \tilde{\Phi}_{j,i1}\, \eta_{1,t-j}}_{\text{Contribution of the 1st structural shock}} + \underbrace{\sum_{j=0}^{t-1} \tilde{\Phi}_{j,i2}\, \eta_{2,t-j}}_{\text{Contribution of the 2nd structural shock}} + \cdots + \underbrace{\sum_{j=0}^{t-1} \tilde{\Phi}_{j,in}\, \eta_{n,t-j}}_{\text{Contribution of the nth structural shock}} \quad (2)$$

where $z_i^{(t)}$ captures the deterministic terms of $y_{i,t}$ such as the exogenous constant term and the initial conditions. The Historical Decomposition (HD) analysis addresses RQ4 by focusing on the structural contributions and disregarding the deterministic terms.

Data and Variables

High-frequency, uninterrupted data on Kuwait's macroeconomy are relatively scarce, which limits the selection of model variables. However, VAR models are

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3 Following Dieppe and Roye's description, the complete mapping from the reduced-form VAR to the structural-form VAR is achieved by pre-multiplying both sides of the structural VAR by D, such that $A_i = DD_i$, $C = DF$, $\epsilon_t = D\eta_t$, and $D = D_0^{-1}$. The structural matrix D can be recovered by decomposing the reduced-form residual variance-covariance matrix $\Sigma = E(\epsilon_t\, \epsilon_t') = E(D\eta_t\, \eta_t'\, D') = DE(\eta_t\, \eta_t')\, D' = D\Gamma\, D'$.

4 $\tilde{\Psi}_i = \Psi_i D$, where Ψ_i are the slope coefficients from the moving average representation of the reduced-form VAR.

often estimated with a relatively small number of variables compared to other macro-econometric models, such as traditional Dynamic Simultaneous Equations models (Kilian & Lütkepohl, 2017). Furthermore, the Bayesian approach alleviates the issue of limited data availability. The model is estimated using a set of four variables:

$$y_t \equiv [poil_t \quad orev_t \quad capital_t \quad current_t\,]$$

where $poil_t$ is the global West Texas Intermediate real price of oil, $orev_t$ is Kuwait's real oil revenues, $capital_t$ is Kuwait's real public expenditures on capital and construction, and $current_t$ is real public expenditures on wages and total transfer payments. For consistency, all variables are converted into U.S. dollars and deflated by the U.S. Consumer Price Index. The data enter the model in natural log levels to facilitate interpretation of the results in terms of growth rates, and the sample period runs from 1993Q3 to 2015Q4 (T = 88).[5] See Appendix (B) for more details and notes on data sources and treatment.

Figure 1 plots the data in y_t. A visual inspection of the data shows that real oil prices and revenues move in tandem, with periods of high oil prices often associated with higher oil revenues. Notably, there exist three major episodes of oil price and revenue drops: 1997-1999, 2008-2009, and 2014-2015. The 1997-1998 drop is associated with the Asian financial crisis, which primarily impacted oil demand from fast-growing East Asian economies. The 2008-2009 period corresponds to the global financial and economic crisis, which led to a severe downturn in economic activity and the demand for oil. The 2014-2015 oil price drop coincides with the Federal Reserve's tapering of its unconventional monetary policy and the acceleration of U.S. shale oil supply.

Finally, real public capital expenditures trend upward after 2003 but show three significant drops in 2001, 2002, and 2012. Real public spending on wages and transfer payments shows a notable jump after 2011, which persists to the end of the sample.

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5 The sample period represents the maximum possible range given data availability constraints. While quarterly oil market data are readily available over extended periods, quarterly data for public capital and current expenditures are missing for the periods 2016Q1 to 2019Q4 and 1990Q3 to 1993Q2.

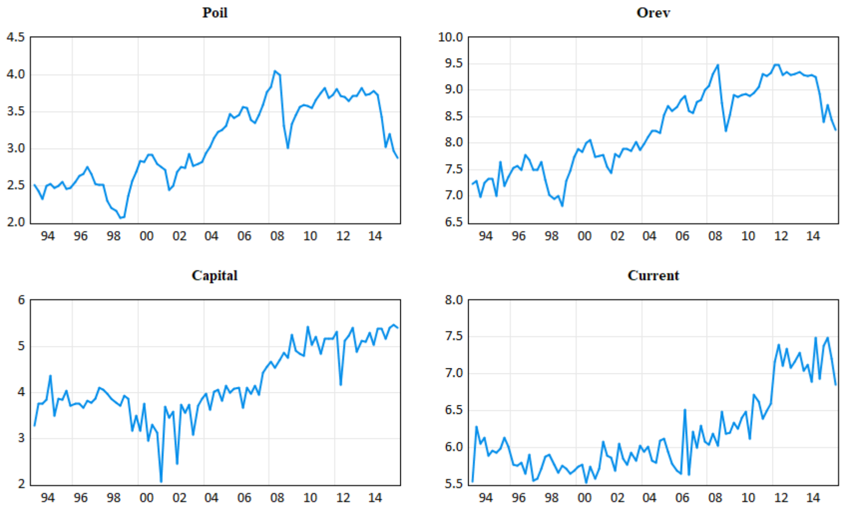

Figure 1: Data Plots, 1993Q3-2015Q4

Note: The data are in natural log levels, covering the sample period from 1993Q3 to 2015Q4. Poil, Orev, Capital, and Current refer to the real price of oil, real Kuwait's oil revenues, real public capital expenditures, and real public current expenditures, respectively.

Baseline Identification

Identifying the structural VAR model transforms statistical reduced-form shocks into independent and uncorrelated structural shocks, allowing for economic interpretation. This study disciplines the BSVAR model with exclusion restrictions (also called zero restrictions), guided by macroeconomic theory and Kuwait's macroeconomic and institutional structure. These recursive restrictions are applied to the structural matrix D in the Structural Dynamic Analysis subsection to govern the interactions between y_t variables and structural shocks at impact. After these restrictions, the structural matrix D takes the form:

$$D = \begin{bmatrix} 1 & 0 & 0 & 0 \\ \chi & 1 & 0 & 0 \\ \chi & \chi & 1 & 0 \\ \chi & \chi & \chi & 1 \end{bmatrix}$$

where equations correspond to rows and structural shocks correspond to columns. For example, element $d_{3,1}$(third row, first column) of D represents the response of the third variable in y_t (which is *capital*$_t$ in the baseline) to the first structural shock (real oil price shock). An element with the value χ indicates that its value is left unrestricted.

This study relies on international macroeconomic theory to achieve identification and isolate the main shock of interest, namely the real oil price shock. A cornerstone assumption of international macroeconomic theory is that small open economies are price takers in the global commodities market (Obstfeld & Rogoff, 1996). Given that Kuwait is a small open economy, I begin with the restriction that the real price of oil does not respond to shocks from Kuwait's domestic economic variables at impact, thus setting $d_{1,2} = d_{1,3} = d_{1,4} = 0$.

Meanwhile, small open economies do react to changes in global prices, such as the global price of oil. Consequently, Kuwait's real oil revenues and government expenditures are directly influenced by real oil price shocks and respond to them contemporaneously. This is particularly important when modeling Kuwait's macroeconomy, as government revenue and expenditures are heavily dependent on global oil prices. Additionally, the response of real current expenditures on wages to capital shocks ($d_{4,3}$) is left unrestricted, as more capital projects can induce increased spending on worker compensation at the extensive and intensive margins. It is important to note that structural identification necessarily implies that capital shocks are driven by forces independent of oil market conditions.

Finally, note that D includes a total of six exclusion restrictions. Following Rubio-Ramirez et al. (2010), these restrictions satisfy the necessary conditions for identification. Since only six restrictions are required, the model is exactly identified. Moreover, the model ensures that the structural parameters are uniquely determined by meeting the sufficient conditions for global identification outlined in Rubio-Ramirez et al. (2010).

Research Results and Discussion

This section presents and discusses the estimation results in the context of the research questions. The IRFs Analysis subsection reports selected estimates from the BSVAR, and addresses RQ1 through RQ3 by examining the IRFs of all variables with respect to a structural real oil price shock. Additionally, the Historical Decomposition subsection explores the evolution of structural real oil price shocks and their historical contribution to fluctuations in real public capital and current expenditures to address RQ4. Finally, the Robustness Checks subsection demonstrates the robustness of the results to changes in prior distributions, lag structure, and structural identification.

IRFs Analysis

This subsection presents the main posterior median estimates for the key matrices outlined in the Research Methods section. More estimation results are available in Appendix (C). The posterior median estimate of reduced-form residual variance-covariance matrix, Σ, is given by:

$$\Sigma = \begin{pmatrix} 0.021 & 0.025 & 0.002 & -0.002 \\ 0.025 & 0.046 & -0.003 & 0.002 \\ 0.002 & -0.003 & 0.143 & 0.018 \\ -0.002 & 0.002 & 0.018 & 0.056 \end{pmatrix}$$

where the diagonal elements represent the variances of the reduced-form shocks. However, conducting the structural dynamic analysis requires converting the correlated reduced-form shocks into structural shocks by factorizing Σ . The factorization yields the structural shocks' variances in Γ:

$$\Gamma = \begin{pmatrix} 0.021 & 0 & 0 & 0 \\ 0 & 0.015 & 0 & 0 \\ 0 & 0 & 0.137 & 0 \\ 0 & 0 & 0 & 0.051 \end{pmatrix}$$

and the structural impact matrix:

$$D = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 1.186 & 1 & 0 & 0 \\ 0.095 & -0.342 & 1 & 0 \\ -0.078 & 0.225 & 0.135 & 1 \end{pmatrix}.$$

These estimates are used to derive the dynamic structural relationship between real oil price shocks and real public capital and current expenditures in the context of RQ1, RQ2, and RQ3.

Figure 2 shows the IRFs for the real global oil price, real Kuwait's oil revenues, real public capital expenditures, and real public current expenditures in response to a 1% structural real oil price shock over a 20-quarter horizon, with 68% credibility bands to indicate statistical significance. Given that all variables enter the model in log levels, the IRFs are interpreted in growth terms.

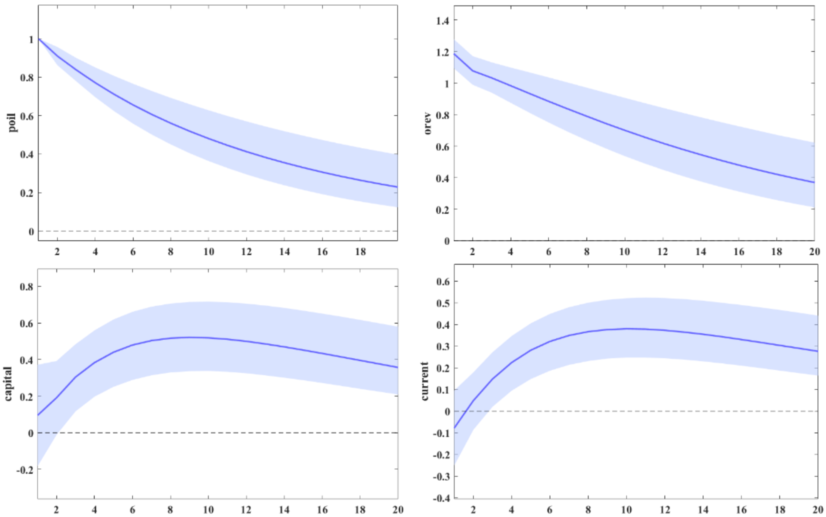

Figure 2: Structural IRFs to Oil Price Shocks

Note: The median IRFs of real global oil price, real Kuwait's oil revenues, real public capital expenditures, and real public current expenditures to a 1% real oil price shock, shown with 68% credibility bands.

In the first panel, a 1% shock to the real price of oil boosts Kuwait's oil real revenues by 1.2% at impact. The growth rate remains positive into the 5-year horizon. Thus, as expected, the positive real oil price shock has an approximately one-to-one effect on Kuwait's real oil revenues. The bottom row in Figure 2 is central to addressing RQ1 through RQ3. The bottom left panel shows the response of real public capital expenditures to the unexpected increase in oil prices. The response gradually builds up and remains statistically indistinguishable from zero for the first two quarters. It then develops into a hump-shaped curve, peaking 2.5 years after the shock.

Quantitatively, a 1% real oil price shock raises real expenditures on capital by 0.52% at the 2.5-year horizon. Given the linearity of the IRFs, a larger real oil price shock, such as 10%, would increase real capital expenditures by 5.2% at the 2.5-year horizon. Conversely, a 10% unexpected drop in real oil prices would result in a 5.2% decrease in real capital expenditures at the 2.5-year horizon. The change in public capital expenditures persists up to five years after the shock. In summary, the results indicate that, after a two-quarter lag, positive real oil price shocks lead to a positive and persistent increase in public expenditures on capital.

The last panel in Figure 2 shows the response of real current public expenditures to unexpectedly higher real price of oil. These expenditures remain unchanged both statistically and economically for the first two quarters after the shock. Subsequently, the wages and transfer payments bill exhibit a hump-shaped response, peaking around the 2.5-year horizon. Quantitatively, a 1% (or 10%) positive shock to the real price of oil generates a 0.38% (or 3.8%) increase in the real government current expenditures. Therefore, surges in real oil prices partly transmit to households’ coffers through increased government spending on wages and transfer payments. Similarly, total real public workers' income is reduced, albeit with a lag, following negative real oil price shocks.

Discussion

These results provide answers to the study’s first three research questions, which explore the magnitude, economic and statistical significance, and duration of the effect of real oil price shocks on real capital and current government expenditures in Kuwait. Positive real oil price shocks stimulate spending on long-term capital projects as well as current spending on wages and transfer payments. This stimulation occurs with a two-quarter lag but persists over a five-year horizon. The increase in Kuwait`s government expenditures following positive real oil price shocks (good times) is a symptom of the procyclical behavior of fiscal policy often observed in developing economies (Gavin & Perotti, 1997; Kaminski et al., 2004; Talvi & Vegh, 2005).

Notably, real capital expenditures are about 37 percent more elastic, or sensitive, to real oil price shocks than real current expenditures at the 2.5-year horizon.[6] In other words, spending on capital increases more during good times than spending on wages and transfer payments, but it also falls more sharply during bad times. This is also in line with the findings of Eltony and Al-Awadi (2001). Also, this volatile nature of capital expenditures aligns with basic economic theory, which predict higher volatility in investment spending compared to spending on wages and transfer payments due to: 1) New investment projects can be postponed, while wages cannot; 2) Wages are rigid in the short run due to legal contracts, as well as political and social constraints; 3) Transfer payments, such as unemployment benefits, often increase following negative real oil price shocks, thereby softening the decline in current expenditures.

6 This calculation is based on a straightforward comparison of the IRFs for public capital expenditures (5.2%) and current expenditures (3.8%) in response to a structural oil price shock at the 2.5-year horizon.

Historical Decomposition

This subsection places the results in a historical perspective to address RQ4 by measuring the importance of real oil price shocks to fluctuations in real public capital and current expenditures from 1993 to 2015.

a. Structural Oil Price Shocks and the Global Oil Market

The historical contribution of a shock to fluctuations in any given variable depends on two factors: (i) the magnitude of structural shocks over time and (ii) the structural IRFs associated with that shock. Figure 3 shows the time path of the estimated structural real oil price shocks, $\eta_{poil,t}$, from 1994Q1 to the end of the sample period. Three prolonged dips are particularly notable: 1997-1998, 2008-2009, and 2014-2015. These periods are associated with significant historical and global events in the oil market.

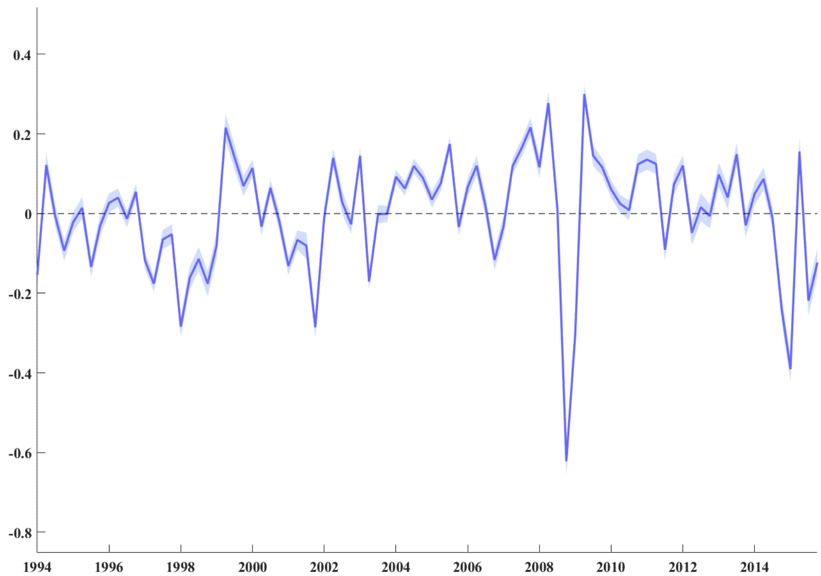

Figure 3: Evolution of Structural Oil Price Shocks, 1994Q1–2015Q4

Note: Estimates of structural oil price shocks, $\eta_{Poil,t}$, for $t = 1,\ldots,88$.

The first significant event in the oil market, as shown in Figure 3, occurred during the Asian financial crisis of 1997. Prior to this, the oil market remained relatively calm and stable from 1994 to 1996. However, the crisis significantly impacted fast-growing economies such as South Korea, Thailand, Malaysia, Indonesia, and the Philippines, leading to a stagnation in oil demand (Mabro, 1998). This decline in demand drove down oil prices and reduced Kuwait’s oil revenues. Additionally, the devaluation of Asian currencies against the dollar further decreased oil demand by making oil more expensive in local currencies. These factors caused a one-third decline in the nominal price of oil within a year, with average nominal WTI crude oil prices dropping from $20 in 1997 to $14 in 1998. By mid-1999, as shown in Figure 3, the impact of these negative real oil price shocks had begun to diminish.

The second significant event in Figure 3 is the sharp negative spike in the third quarter of 2008. This drop coincided with the deepening of the 2007-2009 global financial and economic crisis, during which economic activity and oil demand both stagnated, leading to a sharp decrease in oil prices. Speculative expectations further amplified this decline (Kaufmann, 2011).

The final major shock occurred between 2014 and 2015, marking the second-largest negative shock after the global financial crisis. This period is characterized by a combination of supply and demand factors. On the demand side, the Federal Reserve’s tapering of its unconventional monetary policy triggered capital flight back to the U.S., causing the dollar to appreciate and reducing global oil demand. On the supply side, a surge in shale oil production increased the oil supply, shifting the supply curve to the right and exerting additional downward pressure on prices (Mănescu & Nuño, 2015).

Next, this study explores how these global forces that impacted oil prices contributed to fluctuations in Kuwait's real current and capital public expenditures.

b. Fluctuations in Oil Prices, Capital, and Current Expenditures

The historical contribution of real oil price shocks to fluctuations in real oil prices, public capital expenditures, and current public expenditures is plotted in orange in Figures 4, 5, and 6, respectively. Starting with Figure 4, real oil price shocks are shown to be the sole driver of oil price fluctuations during the sample period. This result confirms the identifying assumption that places oil prices first in , implying that Kuwait's small open economy acts as a price taker in the global commodities market and that global commodity prices are unaffected by Kuwait’s domestic economic forces.

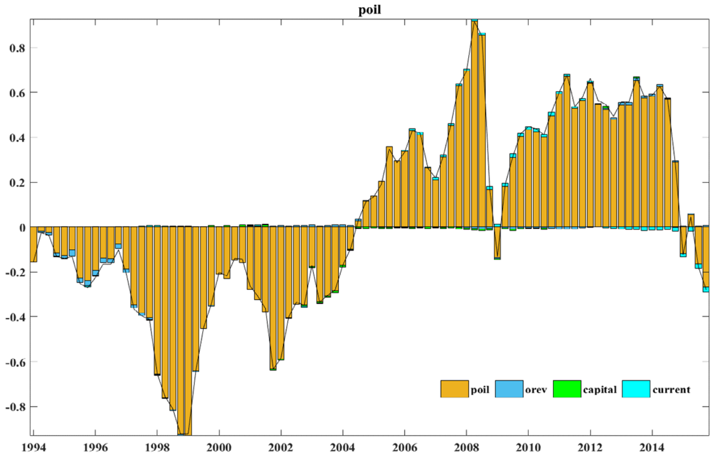

Figure 4: Historical Decomposition of Real Oil Price Fluctuations

Note: The vertical axis shows the total % fluctuations in the real price of oil, excluding deterministic terms (see Equation 2). The orange, blue, green, and light blue colors represent the contributions of structural real oil price shocks, real oil revenue shocks, real public capital expenditure shocks, and real public current expenditure shocks, respectively.

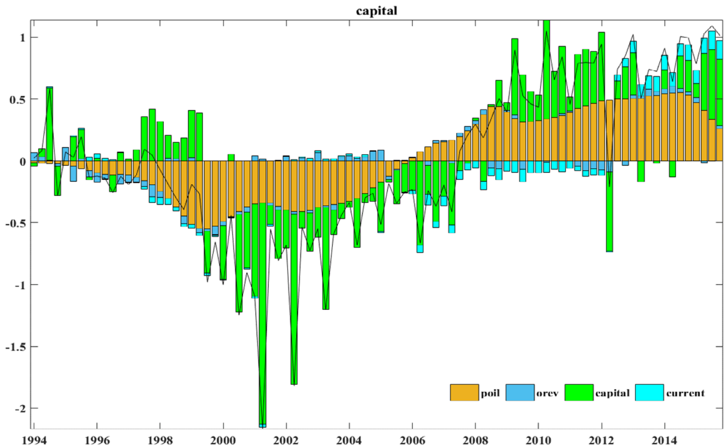

Figure 5: Historical Decomposition of Real Public Capital Expenditures Fluctuations

Note: The vertical axis shows the total % fluctuations in real public capital expenditures, excluding deterministic terms (see Equation 2). The orange, blue, green, and light blue colors represent the contributions of structural real oil price shocks, real oil revenue shocks, real public capital expenditure shocks, and real public current expenditure shocks, respectively.

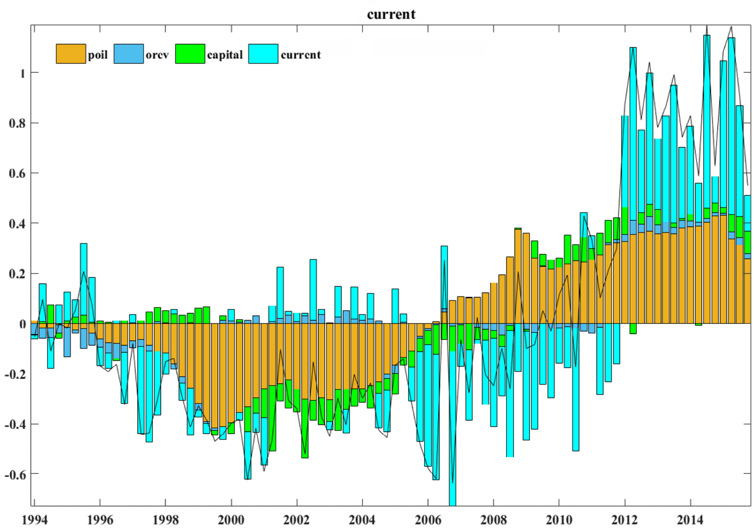

Figure 6: Historical Decomposition of Real Public Current Expenditures Fluctuations

Note: The vertical axis shows the total % fluctuations in real public current expenditures, excluding deterministic terms (see Equation 2). The orange, blue, green, and light blue colors represent the contributions of structural real oil price shocks, real oil revenue shocks, real public capital expenditure shocks, and real public current expenditure shocks, respectively.

Next, Figure 5 addresses the first part of RQ4, showing that real oil price shocks are a major contributor to fluctuations in real public capital expenditures. Notably, the impact of real oil price shocks on real public capital expenditures changed direction after 2006. Before 2006, real oil price shocks suppressed real public capital spending. For example, from 1995 to 1998, real oil price shocks accounted for over half of the negative fluctuations in real public capital expenditures growth, and in 1999, they explained all the fluctuations. However, starting in 2004, this negative effect began to diminish, turning positive from 2006 onward. After 2006, real oil price shocks contributed positively to the growth in real public capital expenditures.

Despite their significance, real oil price shocks are not the only factors influencing capital expenditures fluctuations. Public capital expenditure shocks, shown in green in Figure 5, also play a substantial role throughout the sample period. Given the structural identification, these non-oil-related capital shocks are driven by factors independent of oil market conditions, such as the expected profitability of capital projects, their riskiness, the cost of funding, and their discounted social returns. Disentangling the individual contributions of these additional factors is beyond the scope of this study and is left for future research.

Finally, the contribution of real oil price shocks to fluctuations in current public expenditures is illustrated in Figure 6. Oil price shocks (orange) played a major role in influencing fluctuations in real current public expenditures between 1993 and 2015, although their impact varied over time. Before 2006, real oil price shocks had a negative effect on real current public expenditures. For instance, from 1998 to 2000, they accounted for nearly all of the negative fluctuations in real current public expenditures. After 2006, real oil price shocks continued to account for significant portions of fluctuations in current public expenditures, but other factors also became more influential. These factors (shown in light blue in Figure 6) are independent of capital and oil market conditions and include unexpected changes in public workers' productivity, bargaining power, demographics, labor market participation, political factors, and expectations about future flows of government resources. The influence of these factors was especially strong from 2012 through the end of the sample period in 2015.

Robustness Checks

How robust are this study's findings for RQ1 through RQ4 when subjected to variations in the baseline BSVAR structure? This subsection evaluates the sensitivity of the main estimation results to changes in lag structure, prior distributions, and structural identification.

First, the lag order is set to $P = 2$ in the baseline identification. This selection is favored by the Hannan-Quinn information criterion. Also, this moderate choice helps alleviate the overparameterization issue, where each additional lag order adds n^2 new parameters (a quadratic rate) to be estimated, which can strain the informational content of the limited sample data. However, a small value of P may lead to misspecification errors and reduce the model's ability to capture delayed interactions between oil market variables and public expenditures. For instance, other lag selection criteria, such as the Akaike information criterion, suggest setting P to 3. Therefore, the first robustness test re-estimates the baseline BSVAR with $P = 3$ while keeping all other assumptions unchanged. This exercise reproduces the main results and findings, indicating that the baseline model is robust to the increase in lag order.

Second, the posterior distributions of the model parameters depend not only on the data but also on the prior information introduced via the prior distributions. Specifically, the reduced-form variance-covariance matrix, Σ , plays a critical role in extracting the structural shocks, and the baseline BSVAR has incorporated the researcher's beliefs about it via the inverse Wishart prior. So, would the results and conclusions change if we used a more agnostic or less informative prior for Σ? To explore this possibility, this study experiments with a diffuse (also called Jeffreys) prior for Σ while maintaining all other baseline assumptions:

$$p(\Sigma)\propto|\Sigma|^{-(n+1)/2}$$

This prior is agnostic in the sense that it does not favor any specific value of Σ. After re-running the estimation process and comparing the results to the baseline, the answers to RQ1 through RQ4 remain unchanged.

Finally, given the recursive identification of the structural matrix *D* described in the Baseline Identification subsection, the ordering of the variables in y_t matters. This ordering governs the contemporaneous interactions among real oil prices and revenues, real public capital expenditures, and real public current expenditures. Table 2 outlines five additional estimated models based on all possible permutations, which serve as a final robustness check. Once again, the main results withstand these experiments, and the primary conclusions remain unchanged.

Table 2
Alternative Identifications

Model #	**Variables Order in y_t**
1 (Baseline)	$[poil_t \quad orev_t \quad capital_t \quad current_t]$
2	$[poil_t \quad current_t \quad capital_t \quad orev_t]$
3	$[poil_t \quad capital_t \quad orev_t \quad current_t]$
4	$[poil_t \quad capital_t \quad current_t \quad orev_t]$
5	$[poil_t \quad current_t \quad orev_t \quad capital_t]$
6	$[poil_t \quad orev_t \quad current_t \quad capital_t]$

Note: The table presents five alternative identifications for the model variables in y_t compared to the baseline discussed in the Baseline Identification subsection.

Conclusion

This study applies a BSVAR model to time series data that include the real global price of oil, real Kuwaiti oil revenues, real public capital expenditures, and real public current expenditures from 1993Q3 to 2015Q4, to arrive at the following conclusions: i) Positive (negative) shocks to the real price of oil increase (decrease) both real current and capital government expenditures. At the 2.5-year horizon, a 10% shock to real oil prices generates 5.2% and 3.8% growth in real public capital and current expenditures, respectively. ii) At the 2.5-year horizon, real capital expenditures are about 37 percent more sensitive to real oil price shocks compared to real current expenditures. iii) Between 1993 and 2015, real oil price shocks were fundamental contributors to fluctuations in real public expenditures. iv) While real oil price shocks are key drivers of real government expenditures, the contribution of non-oil shocks to fluctuations in real public capital and current expenditures became increasingly significant after 2006.

These results contribute to the empirical macroeconomic literature on government expenditures, have implications for policymakers, and offer stylized facts to guide theoretical models. It explores the underexamined connections between public expenditures and the oil market at a disaggregated level, offering valuable insights for policymakers looking to enhance fiscal management and sustainability.

There are limitations to this study that suggest promising avenues for future research. The stylized empirical facts on the dynamic effects of real oil price shocks provide a foundation for micro-founded Dynamic Stochastic General Equilibrium models, which can rigorously identify the transmission mechanisms. Additionally, although public expenditures on capital may facilitate higher future consumption through economic growth, this study does not address whether this outcome is necessarily welfare-enhancing (Phelps, 1961). DSGE models can incorporate welfare analysis to assess the welfare-maximizing outcomes of government resource allocation between current and future consumption. Finally, future research should focus on disentangling the sources of the non-oil-related shocks that drive the fluctuations in current and capital public expenditures.

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Appendix (A): Unit Root Tests

Table A1
Unit Root Test for the Real Price of Oil

Null Hypothesis: Poil has a unit root
Trend Specification: Trend and intercept
Break Specification: Intercept only
Break Type: Innovational outlier
Break Selection: Minimize Dickey-Fuller *t*-statistic
Lag Length: 2

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.232972	0.8319
Test critical values:	1% level	-5.347598
	5% level	-4.859812
	10% level	-4.607324

*Asymptotic one-sided *p*-values.

Table A2
Unit Root Test for the Real Oil Revenues

Null Hypothesis: Orev has a unit root
Trend Specification: Trend and intercept
Break Specification: Intercept only
Break Type: Innovational outlier
Break Selection: Minimize Dickey-Fuller *t*-statistic
Lag Length: 2

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.217797	0.8406
Test critical values:	1% level	-5.347598
	5% level	-4.859812
	10% level	-4.607324

*Asymptotic one-sided *p*-values.

Table A3
Unit Root Test for the Capital Public Expenditures

Null Hypothesis: Capital has a unit root
Trend Specification: Trend and intercept
Break Specification: Intercept only
Break Type: Innovational outlier
Break Selection: Minimize Dickey-Fuller *t*-statistic
Lag Length: 2

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.392141	0.1700
Test critical values:	1% level	-5.347598
	5% level	-4.859812
	10% level	-4.607324

*Asymptotic one-sided *p*-values.

Table A4
Unit Root Test for the Current Public Expenditures

Null Hypothesis: Current has a unit root
Trend Specification: Trend and intercept
Break Specification: Intercept only
Break Type: Innovational outlier
Break Selection: Minimize Dickey-Fuller *t*-statistic
Lag Length: 2

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.476437	0.1388
Test critical values:	1% level	-5.347598
	5% level	-4.859812
	10% level	-4.607324

*Asymptotic one-sided *p*-values.

Appendix (B): Data Sources and Treatment

Data on oil revenues, the USD-KWD exchange rate, and public expenditures are collected from the Central Bank of Kuwait's Quarterly Statistical Bulletin (Tables 23, 26, 27, and 28). The total transfer data in Table 28 has five missing (unreported) values spread across the second and third quarters of 2012, 2013, and 2015. These values were interpolated using Piecewise Linear Interpolation (PLI) while preserving the surrounding known data points. PLI is a transparent and appropriate method given the short and sporadic gaps in the data, as it does not make strong assumptions to smooth the data like other methods, such as cubic splines.

The study also applies the X-13ARIMA-SEATS quarterly seasonal adjustment method to remove seasonality from the public expenditures series. The nominal oil price data are based on the spot crude oil price (West Texas Intermediate) series constructed by the Federal Reserve Bank of St. Louis and are converted into real dollars using the Consumer Price Index for All Urban Consumers from the U.S. Bureau of Labor Statistics.

Appendix (C): Posterior Estimates

Table C1
VAR Coefficients (β): Posterior Estimates

Variable	Median	St.dev	Low.bound	Upp.bound
Endogenous: Poil				
poil(-1)	0.865	0.054	0.812	0.918
poil(-2)	0.009	0.040	-0.031	0.049
orev(-1)	0.036	0.028	0.008	0.064
orev(-2)	0.002	0.015	-0.013	0.017
capital(-1)	-0.003	0.016	-0.018	0.013
capital(-2)	0.007	0.009	-0.002	0.016
current(-1)	-0.014	0.023	-0.036	0.009
current(-2)	0.001	0.014	-0.013	0.015
Constant	0.135	0.176	-0.039	0.309
Endogenous: Orev				
poil(-1)	0.154	0.067	0.088	0.221
poil(-2)	0.008	0.037	-0.029	0.045
orev(-1)	0.779	0.059	0.720	0.837
orev(-2)	0.035	0.040	-0.005	0.073
capital(-1)	0.015	0.024	-0.009	0.038
capital(-2)	-0.005	0.014	-0.019	0.009
current(-1)	0.012	0.036	-0.024	0.047
current(-2)	0.000	0.022	-0.022	0.022
Constant	0.936	0.294	0.644	1.227
Endogenous: Capital				
poil(-1)	0.067	0.099	-0.030	0.167
poil(-2)	0.032	0.060	-0.028	0.091
orev(-1)	0.055	0.068	-0.012	0.122
orev(-2)	0.012	0.038	-0.027	0.050
capital(-1)	0.666	0.067	0.601	0.733
capital(-2)	0.063	0.044	0.019	0.108
current(-1)	0.083	0.066	0.018	0.149
current(-2)	0.021	0.038	-0.016	0.059
Constant	-0.352	0.461	-0.804	0.102

Variable	Median	St.dev	Low.bound	Upp.bound
		Endogenous: Current		
poil(-1)	0.045	0.063	-0.018	0.107
poil(-2)	0.011	0.038	-0.026	0.049
orev(-1)	0.047	0.043	0.004	0.090
orev(-2)	0.012	0.024	-0.012	0.036
capital(-1)	0.011	0.028	-0.017	0.038
capital(-2)	0.011	0.015	-0.004	0.027
current(-1)	0.708	0.060	0.649	0.769
current(-2)	0.083	0.044	0.039	0.127
Constant	0.543	0.315	0.230	0.856

Note: The posterior estimates of the BVAR coefficients as outlined in the BVAR Model and Estimation subsection. The number in parentheses indicates the lag order. The endogenous variables correspond to the baseline in y_t.

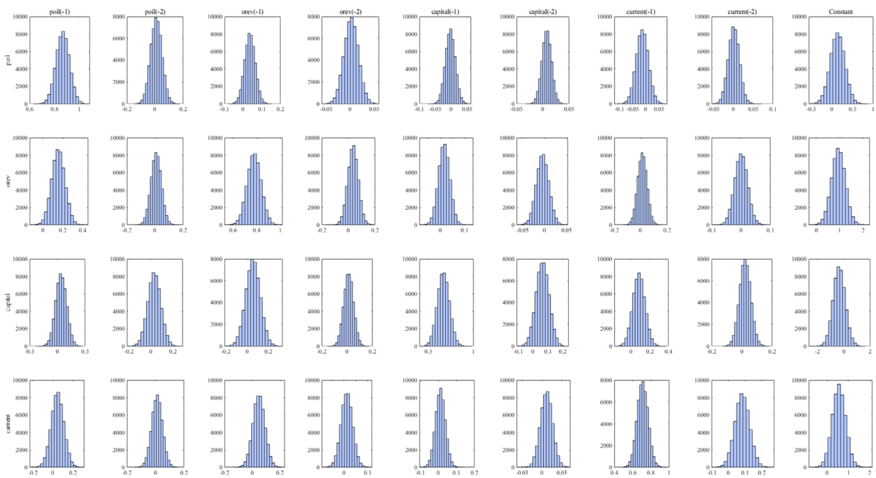

Figure C1: Posterior Distributions of β

Note: Histograms of the posterior distribution estimates of the parameters in β. The number in parentheses indicates the lag order. The endogenous variables correspond to the baseline in y_t .

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