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Evidence from Saudi Arabia

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Fiscal versus Monetary Dominance: Evidence from Saudi Arabia

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Abstract: In this paper, we address the issue of fiscal dominance in the context of oil-dependent countries. The analysis is based on the approach proposed by Costa and Olivo (2008), which proposes that there is a relationship between the fiscal balance and the monetary base by using the vector autoregression (VAR) model and analyzing the impulse response functions, the variance decomposition and the Granger causality test. Another extension of this paper is to examine time-varying interactions between monetary and fiscal policies using the Markov-switching vector autoregression (MS-VAR) model. In conclusion, relevant evidence supports the validity of the oil dominance/fiscal dominance hypothesis in Saudi Arabia. Moreover, policies' behavior varies across regimes, with the "fiscal dominance" regime being more likely to hold during periods of high oil prices. Finally, the fiscal dominance problem has the macroeconomic effect of making monetary policy more accommodating.

Keywords: Oil-dependent countries, fiscal dominance, Saudi Arabia, VAR model, MS-VAR model.

JEL: E5, E62, C22,

1. Introduction

The interaction between fiscal and monetary policies has been one of the key issues in building an optimal macroeconomic policy because there is a risk that the fiscal and the monetary authorities can set conflicting goals and their actions or inactions can have undesirable consequences for macroeconomic stability.

The monetary authorities are asked to seek price stability or low inflation rates. The fiscal authorities, instead, must interpret the desire for public expenditures. This difference in motives makes the fiscal authorities seek as much as possible seigniorage from monetary authorities. The greater the power of fiscal authorities over the monetary authorities that is, the greater the degree of fiscal dominance, and the lower the cost of financing of budget deficit.

Fiscal dominance has been a source of concern since it could result in inflation and macroeconomic instability. It hinders the effective implementation of any monetary policy aimed at controlling inflation. When fiscal dominance holds, conflicting objectives between the monetary and the fiscal authorities often result in the central bank giving up its efforts to achieve price stability (Costa and Olivo 2008).

Governments are financing their expenditures with tax revenues, debt issues, and/or seigniorage. More formally, all governments face an intertemporal budget constraint, which states that debt must be financed by a combination of the present discounted value of current and future primary surpluses and seigniorage revenues. In a Ricardian or "monetary dominance" regime the debt is backed by primary surpluses generated by fiscal adjustment. So, when the debt is backed by seigniorage, the regime is called "fiscal dominance" or non-Ricardian. In this case, the fiscal authorities set primary deficits independently of their liabilities.

The problem of fiscal dominance is the most binding for oil-dependent economies since oil dominance may result in fiscal dominance. Conversely, monetary dominance is mostly required when policymaker looks for a managed exchange rate regime or desire a more independent monetary policy (Elbadawi et al. 2019).

Several reasons cause fiscal and monetary policies to interact differently in oil-dependent countries (Omotosho 2022). First, it is well recognized that oil price shocks have differential and more severe impacts on real and nominal variables (Berument, Basak Ceylan, and Dogan 2010). Second, oil rents usually dominate fiscal and exchange revenues. Such dominance is usually associated with fiscal volatility (Barnett and Ossowski 2002), fiscal procyclicality (Aregbeyen

and Fasanya 2017), and resource curse (Mehlum, Moene, and Torvik 2006). Third, the monetary process is different. The financing of government expenditures with resources obtained from oil revenues may have similar effects as monetizing the deficit, depending on the exchange rate regime. In this case, changes in the monetary base may occur as a result of net international reserves without being reflected in net credit to the government. As a result, the backward-looking approach based on primary surplus and debt dynamics fails to identify the presence of fiscal dominance: fiscal dominance might be present even with fiscal surpluses and relatively low levels of public debt.

Most of the empirical studies that addressed the issue of the interaction between monetary and fiscal policies focused on developed countries (Afonso, Alves, and Balhote 2019; Bianchi and Ilut 2017; Canzoneri, Cumby, and Diba 2001; Sabaté, Gadea, and Escario 2006). The findings provide evidence about the moderate and strong fiscal-monetary interactions and imply that the monetary policy mainly dominates over the fiscal policy.

However, we know little about the interdependence of monetary and fiscal policy in the context of emerging markets and developing countries (Cevik, Dibooglu, and Kutan 2014; Javed and . 2005; Tanner and Ramos 2003; De Resende 2007; Reinhart and Rogoff 2010; Zoli 2005; Catão and Terrones 2003). Most of the results tend to find a higher fiscal dominance and a stronger relationship between debt, fiscal deficit, and inflation. Furthermore, the empirical literature on the coordination between monetary and fiscal policies in oil-exporting countries is very scarce (Chibi, Benbouziane, and Chekouri 2019; Costa and Olivo 2008; Aliyeva and Rahmanov 2019; Omotosho 2022).

Against this backdrop, this study represents an attempt to bridge this gap and extend the empirical literature by examining the interaction between fiscal and monetary policy in oil-exporting countries. To our knowledge, such an issue had not hitherto been analyzed in the context of the Saudi economy.

The motivation for this study arises from the scarcity of research on the interaction of monetary and fiscal policies in oil-exporting countries. Saudi Arabia was an ideal ground for testing since, during the last years, the economy has witnessed a large fiscal expansion fueled by an increase in oil revenues. The boom in public spending coupled with an increase in inflation has formulated an opinion that there is a strong fiscal dominance in the economy. This proposition encouraged us to examine the extent of fiscal dominance in the Saudi economy.

In this context, this study contributes to the empirical literature in several respects. First, to the best of our knowledge, this is the first attempt to analyze the issue of fiscal dominance and its potential macroeconomic effects in the context of Saudi Arabia. Second, motivated by the work of Costa and Olivo (2008), we follow their novel approach to analyze fiscal dominance in oil-exporting countries to overcome the shortages of standard approaches. For this purpose, the methodology is based on the transmission mechanism that takes place from changes in oil prices to fiscal and monetary variables, ultimately affecting domestic prices. Third, as most of the literature does not account for the time-varying interactions, we will test the hypothesis of regime shifts in the interactions between monetary and fiscal policies. Vector Autoregression (VAR) models and Markov-Switching Vector Autoregression (MS-VAR) models are used for empirical analysis.

The main purpose of this study is threefold: i) to test the hypothesis of the presence of oil dominance/fiscal dominance in the case of Saudi Arabia, ii) to examine the potential macroeconomic effects of the oil dominance/fiscal dominance regime, particularly concerning the connection between the monetary base and price, and iii) to verify whether there are regime shifts in the interactions between monetary and fiscal policies in Saudi Arabia.

2. Literature Review

In general, the economic literature has addressed the interaction between fiscal and monetary policy in three main approaches. The first approach analyzes the issue related to the coordination of monetary and fiscal policies (Alesina and Tabellini 1990). The second approach seeks to identify the optimal strategic interaction (Beetsma and Jensen 2005; Blinder 1982). The third approach relies on the fiscal theory of price level and explores how the action from fiscal policy affects monetary variables like interest rates, risk premiums, and exchange rates (Edwards 1998; Ferrucci 2003; Obstfeld 1994).

Sargent and Wallace (1981) formalize the "fiscal dominance" hypothesis in a dynamic framework that considers the government's intertemporal budget constraint and assumes two main cases: i) the monetary policy dominates the fiscal policy ("monetary dominance"); or, ii) the fiscal policy dominates the monetary policy ("fiscal dominance"). In the first case, the monetary policy sets the amount of revenue that it will supply to the fiscal authority through the seigniorage, thus forcing the fiscal authority to limit the financing of its deficits by that seigniorage and bond sales. The monetary authority can control inflation for the long term

because, under monetary dominance, it can independently set the level of the money base. In the second case, the fiscal authority independently sets its budget for current and future surpluses, determining the amount of revenue that must be raised through bond sales and seigniorage. The monetary authority then is constrained to finance with seigniorage a part of the total fiscal deficit that cannot be sold by bond sales. This means creating money and tolerating additional inflation if the fiscal authority relies on seigniorage to finance government spending.

Furthermore, Leeper (1991) suggests that the way policies react to a shock to public debt determines whether they are active or passive. If the amount of public debt does not limit the policy actions required to reach the goal, this case is related to the active behavior of the fiscal authorities. However, this behavior is passive if the government is concerned about the level of public debt as any action it takes will be constrained by the requirement to keep the debt stable.

More recently, Woodford (2011) has explored the Fiscal Theory of the Price Level (FTPL) arguing that fiscal policy, rather than monetary policy, can be the main determinant of inflation. In this regard, Woodford (2011) Canzoneri et al. (2001) consider two regimes. First, if primary surplus responds to the level of debt in a way that assures fiscal solvency, then money and prices are exogenously determined by the supply and demand for money. This regime is called as "Ricardian Regime". Second, if the primary surplus is determined independently of the level of debt, then the path of the money supply and the price level must satisfy the need for fiscal solvency. This regime is called the "Non-Ricardian Regime".

A large number of empirical studies have empirically examined the extent of monetary and fiscal policy interaction in developed countries. Most studies provide evidence that monetary policy mainly dominates over fiscal policy. Meliz (2002) estimates jointly the reaction function of the monetary and fiscal authorities for 19 OECD countries over the period 1960-95 and finds that monetary and fiscal policy have tended to move in opposite directions, giving evidence for a "monetary dominance" regime. Wyplosz (1999) obtained a similar result for the EMU countries. Favero and Monacelli (2003) detect some evidence of fiscal dominance in the USA for limited periods. Canzoneri et al. (2001) give strong evidence of a monetary dominant regime for the USA by using a VAR model. Sabaté et al. (2006) found evidence of fiscal dominance in Sapin by using the same VAR methodology. Afonso et al., (2019) investigate the interaction between monetary and fiscal policies for 28 European countries, using a panel data approach. They found

that the “Ricardian Regime” holds, as the monetary authority determines the stock of money and the price level, while the government follows the intertemporal budget constraint.

However, there is relatively little empirical evidence regarding emerging markets and developing countries. Tanner and Ramos (2003) assess if Brazil's policy regime in the 1990s should be classified as monetary or fiscally dominant. Results show some evidence of a monetary dominant regime for 1995-97, but not for the decade of the 1990s as a whole. De Resende (2007) used a dataset from 18 OECD countries and 20 developing economies from 1949 to 2005 and found that fiscal dominance is more common among developing countries, which implies that debt plays a major role in the determination of the price level for these countries than for developed countries. Reinhart and Rogoff (2010) found a systemic relationship between high debt levels and inflation for emerging countries but not for advanced economies. Zoli (2005) conducts a test of fiscal dominance employing a VAR model to assess whether primary balances are set exogenously, and independently from public sector liabilities, in a sample of six emerging market countries (Argentina, Brazil, Colombia, Mexico, Poland, and Thailand). The author found clear evidence of fiscal dominance regimes in Argentina and Brazil, while in the rest of the countries, the results are mixed. Catão and Terrones (2003), using panel techniques for 107 countries over 1960-2001, found a strong positive relationship between deficits and inflation among high-inflation and developing countries, but not among low-inflation advanced countries.

Furthermore, the empirical literature on the interaction between monetary and fiscal policies in oil-exporting countries is very limited. To our knowledge, such an issue had not hitherto been analyzed in the context of the Saudi economy. Elbadawi et al. (2019) analyze the fiscal foundation of the choice of monetary regimes and the extent of procyclicality of fiscal policies during the post-mid 1990s oil boom in oil-dependent Arab economies. The authors find evidence of the existence of a threshold effect of oil rents per capita, below which countries tend to be subject to fiscal dominance and procyclicality of fiscal policy. Chibi, Benbouziane, and Chekouri (2019) analyze the interaction between fiscal and monetary policies in Algeria for the period 1963-2017, using VAR, MSVAR, and ARDL models. The results provide evidence of non-Ricardian fiscal policy, as a negative correlation between fiscal balances and government liabilities. Sanchez et al. (2018) estimate the Markov-switching DSGE model to analyze the interaction between the monetary and fiscal policy in Mexico, an oil-dependent economy. They conclude that the periods of active monetary policy and passive fiscal policy witness low

inflation and stable debt. Costa and Olivo (2008) analyzed fiscal dominance in Venezuela, a country where the economy is highly dominated by the oil sector. The originality of this paper is to provide a novel framework based on the transmission mechanism that takes place from oil price shocks to fiscal and monetary variables, ultimately affecting domestic prices. Using VAR and VEC models, the main conclusion supports the validity of the oil dominance/fiscal dominance hypothesis.

3. Empirical Methodology and Data

To evaluate empirically the interdependence between fiscal and monetary policies in Saudi Arabia, this study considers the methodology developed by Costa and Olivo (2008) to discriminate between "monetary dominance" and "fiscal dominance" regimes. Accordingly, we follow a two-step empirical methodology. In the first step, we test the oil dominance/fiscal dominance hypothesis by assessing the existence of a close link between oil prices, the overall fiscal balance, and the monetary base. In the second step, we examine the potential macroeconomic effects of the oil dominance/fiscal dominance phenomenon particularly concerning the connection between the monetary base and prices.

To analyze the interactions between monetary and fiscal policies in Saudi Arabia, we use the VAR methodology as it provides enough analytical tools to undertake an in-depth analysis of the relevant regime. It represents a useful tool to test the hypothesis described above, as it allows for simultaneous and dynamic estimation where all relevant variables are treated as potentially endogenous. The VAR results can be interpreted by the response functions (IFRs), and the Variance Decomposition (VD) and completed by the Granger causality test.

However, the VAR approach has a key drawback in that the results vary as the order of the variables changes. This problem has been solved by ordering variables from most exogenous to least exogenous. To identify the order of the VAR we apply a Granger causality test to differentiate the endogenous variables from exogenous ones. The Granger causality test is the Wald test for the joint significance of each of the lagged endogenous variables in each equation except the lags of the dependent variables.

Moreover, because the VAR model is a dynamic structure, a shock to one of the variables impacts not only that variable but also all other variables in the model. Innovations are often correlated, and it is difficult to identify them to specific factors; as a result, the innovations are converted to make them contemporaneously uncorrelated. Accordingly, we complete the

identification scheme via a Cholesky decomposition of the covariance matrix of the VAR residuals. This approach attributes the first shock to the first variable of the VAR model.

The general VAR representation is as follows:

$y_t = A_1 y_{t-1} + \cdots + A_p y_{p-1} + Bx_t + \varepsilon_t$ (1)

Where y_t and x_t are the vectors of endogenous and exogenous variables, respectively, A_1,…. A_p and B are the matrices of the coefficients to be estimated, and ε_t is the vector of innovations.

If all variables included in y_t are *I (1)* and a cointegration relationship among them is found, the VAR model can be converted to the Vector of Error-Correction (VECM) model as follows:

$\Delta y_t = \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-1} + Bx_t + \alpha \hat{e}_{t-1} + \varepsilon_t$ (2)

In addition to VAR estimation, a Marko-Switching (MS-VAR) model is also proposed among the government's policy instruments, such as the overall fiscal balance and the monetary base. Thus, we will verify whether there are regime shifts in the interactions between monetary and fiscal policies in Saudi Arabia.

The MS-VAR model provides tools for the estimation of VAR models with regime shifts s_t. The mean adjusted MS-VAR process of the order p and M regimes may be written as follows:

$y_t - \mu(s_t) = A_1(s_t)\big(y_{t-1} - \mu(s_{t-1})\big) + \cdots + A_p(s_t)\left(y_{t-p} - \mu\big(s_{t-p}\big)\right) + u_t$ (3)

where $u_t \rightarrow NID(0, \Sigma(s_t))$ and $\mu(s_t)$, $A_1(s_t)$,…. $A_p(s_t)$, $\Sigma(s_t)$ are the regime-dependent parameters.

In all MS-VAR specifications, the unobservable regime s_t is governed by a first-order Markov process, which is defined by the transition probabilities:

$\Pr(S_t = j / S_{t-1} = i) = p_{ij}$ with $\sum_{j=1}^{M} p_{ij} = 1 \; i, j = 1 \ldots . M$ (4)

Where p_{ij} is the probability that event i is followed by event j and an element of the transition matrix ,$P = \begin{bmatrix} P_{11} & P_{12} & . & . & P_{N1} \\ P_{12} & P_{22} & . & . & P_{N2} \\ P_{1N} & P_{1N} & . & . & P_{NN} \end{bmatrix}$ (5)

The precise definition of the variables and their sources are presented in Table 1. The sample spans the period from 1994 Q1 to 2022 Q4. We use the quadratic-match sum method to convert the annual series into quarterly data.

Table 1. Data Description

Data	Sources
Overall fiscal balance	Saudi Central Bank Database (Yearly Statistics 2022)
Monetary base	
Consumer price index	
Oil prices	Refinitiv Eikon DataStream database

3.1. Testing the oil dominance/fiscal dominance hypothesis

The first step of the empirical research methodology is to test the hypothesis of oil dominance/fiscal dominance. The rationale behind this empirical estimation is to test whether Saudi Arabia has followed a "fiscal dominance" or "monetary dominance" regime. According to Da Costa and Olivo (2008), we examine the interaction between the overall fiscal balance and the monetary base[1]. All variables are divided by the consumer price index. To test for this relationship the VAR methodology is used. The vector of endogenous variables includes fiscal variables (measured by the overall fiscal balance) and monetary variables (measured by the monetary base). As Saudi Arabia is an oil-dependent country, we include oil prices as an exogenous variable in the model. The use of the overall budget balance is consistent with previous studies of budget deficit sustainability. Trehan and Walsh (1991) argue that the assessment of budget sustainability should be based on the time series properties of the value of the overall budget balance, inclusive of interest payments and seigniorage revenue.

The relationship between the variables can be expressed using a VAR structure of two equations system given by: $FB_t = \alpha_0 + \sum_{j=1} \alpha_j FB_{t-j} + \sum_{j=1} \beta_j MB_{t-j} + \alpha_x X_t + \varepsilon_t$ (6)

$MB_t = \gamma_0 + \sum_{j=1} \delta_j FB_{t-j} + \sum_{j=1} \gamma_j MB_{t-j} + \alpha_x X_t + \mu_t$ (7)

Where FB_t and MB_t denote fiscal balance and monetary base, respectively. X_t is the vector of exogenous variables. Oil price represents the only exogenous variable in the model. Overall, if the oil dominance/fiscal dominance holds, we should identify a connection between oil prices, the fiscal balance, and the monetary base. Particularly, the following results should be observed:

[1] Da Costa and Olivo (2008) include an external sector variable (net international reserve) to control for the potential effect of the different exchange rate regimes. We consider that such circumstances are not relevant for Saudi Arabia, as its fixed exchange rate regime with a dollar peg, has remained unchanged since 1986.

- Impulse-response functions and variance decomposition consistent with a positive response of the monetary base to shocks to fiscal balance and no response of the fiscal balance to shocks to the monetary base.
- One-way Granger-Causality runs from fiscal balance to the monetary base.

Before model estimation, stationary tests are performed for the series under study. More specifically, we perform the Augmented Dickey–Fuller (ADF) test and the Phillips–Perron (PP) test. The results of the unit root tests are displayed in Table 1. The first column reports the test results for all variables in levels, while the second column reports the test results for variables in differences. The results indicate that all variables are stationary at first difference. Hence, for model estimations, we use the log difference for all variables in the model.

Table 2. Unit Root Test Results

Variables	Level		First difference	
	ADF test	**PP test**	**ADF test**	**PP test**
Overall Fiscal Balance	-2.555	-2.601	-7.316***	-11.579***
	(0.105)	(0.156)	(0.000)	(0.000)
Monetary Base	-2.234	-1.819	-5.705***	-8.975***
	(0.195)	(0.588)	(0.000)	(0.000)
Oil Price	-1.430	-1.672	-4.034***	-4.884***
	(0.564)	(0.442)	(0.001)	(0.000)

Note: *, **, and *** denote significant at 10%, 5%, and 1% levels, respectively.

Since all variables in levels contained unit roots, as reported by (ADF) and (PP) tests, it is important to determine if they are cointegrated. If all variables are non-stationary I(1), and a cointegration relationship among them is found, a Vector Error Correction (VECM) should be estimated, otherwise a stationary VAR model should be considered. For this purpose, we apply the Johansen approach to test for cointegration and we realize that the hypothesis that there is no cointegration relationship between fiscal balance and the monetary base could not be rejected at the 5% level. Thus, we estimate the stationary VAR model to answer the question in the hand.

Table 3. Johansen Cointegration Test Results

Trace test				
	Eigenvalue	**Trace Statistic**	**Critical Value 0.05**	**P-Value**
None	0.087350	14.67964	15.49471	0.0661
At most 1 *	0.049834	5.265159	3.841466	0.0217
Maximum Eigenvalue				
	Eigenvalue	**Max-Eigen Statistic**	**Critical Value 0.05**	**P-Value**
None	0.087350	9.414476	14.26460	0.2533

At most 1 *	0.049834	5.265159	3.841466	0.0217

We start our analysis by examining the results of the Granger causality test (Table 4). The results show that there exists only a one-way Granger causal relationship between fiscal balance and monetary base. The past movements in the fiscal balance have a significant effect on the future value of the monetary base. On the other side, the monetary base does not cause the fiscal balance. Accordingly, the order of the given variables in the VAR model is as follows: 1) fiscal balance and 2) monetary base.

Table 4. VAR Granger Causality Test

H0: There is no Granger causality	**Statistic**	**P-value**
Monetary Base → Fiscal Balance	0.225	0.923
Fiscal Balance → Monetary Base	2.278***	0.006

The results of the VAR models are very sensitive to the selection of the lag order. We use automatic lag selection based on three different criteria (AIC, HQC, and BIC) to choose the minimum lag length at which the model is stable and does not suffer from serial correlation. The three criteria usually select four lags (Table 5).

Table 5. Lag Order Selection

Lag	**AIC**	**SC**	**HQ**
0	-0.172166	-0.069846	-0.130723
1	-1.723784	-1.519145	-1.640898
2	-1.990893	-1.683934	-1.866564
3	-2.022100	-1.612822	-1.856328
4	-2.603582*	-2.091984*	-2.39636*
5	-2.972334	-2.190783	-2.656026
6	-2.935833	-2.050075	-2.577351

We include four lags of the variables in the VAR estimation, the results obtained from the estimation are reported in Table 6. The results indicate that both regressions (fiscal balance and monetary base) are significant, and the fiscal balance' coefficients are significant, meaning that fiscal balance is a good explanatory variable for changes in the monetary base, and therefore, the hypothesis of the "monetary dominance" regime could be rejected. On the other hand, the results indicate that the coefficients on the monetary base explaining the fiscal balance are also significant. This means that the hypothesis of the "fiscal dominance" regime could also be rejected.

Table 6. Vector Autoregression Results: Short-Run Effects

Equation	D. Fiscal Balance		D. Monetary Base	
	Coefficient	t-Student	Coefficient	t-Student
$D.Fiscal\ Balance_{t-1}$	1.14	9.761	0.002	0.05
$D.Fiscal\ Balance_{t-2}$	-0.219	-1.234	-0.008	-0.011
$D.Fiscal\ Balance_{t-3}$	-0.314	-0.754	0.006	0.085
$D.Fiscal\ Balance_{t-4}$	−0.129	-1.095	-0.001	-0.303
$D.Monetary\ Base_{t-1}$	-0.626	-0.229	1.070	9.320
$D.Monetary\ Base_{t-2}$	0.070	0.017	0.020	-1.203
$D.Monetary\ Base_{t-3}$	-0.305	-0.075	-0.164	-0.971
$D.Monetary\ Base_{t-4}$	0.540	0.200	0.071	-0.623
$D.Oil\ Price$	0.002	0.019	0.000	1.962

To cut off with the following mixed results, and to validate the oil dominance/fiscal dominance hypothesis we stimulate the accumulated impulse-response functions (IRFs) for the two variables over 10 quarters, as well as the variance decomposition (VD).

Figure 1 shows the impulse response function for an innovation in the fiscal balance, while Figure 2 displays the impulse response function for an innovation in the monetary base. The aim here is to analyze the response of the monetary base (fiscal balance) forward an innovation in the fiscal balance (monetary base). If the fiscal balance shock has a positive effect on the monetary base, we have a "fiscal dominance" regime, if not we have a "monetary dominance" regime. The analysis of accumulated impulse response functions and variance decomposition indicates the following:

- A one standard deviation shock to fiscal balance has a positive effect on the monetary base that explains around 26.5 percent of its forecast error variance in the ten-period horizon.
- The response of the monetary base to shocks to fiscal balance is not statistically significant and close to zero according to the variance decomposition analysis.
- In addition, the Granger-causality test indicates one-way Granger-causality running from the fiscal balance to the monetary base.

All the following results provide relevant evidence to support the validity of the oil dominance/fiscal dominance hypothesis in Saudi Arabia.

Figure 1. Accumulated Response of Monetary Base to Fiscal Balance Shock

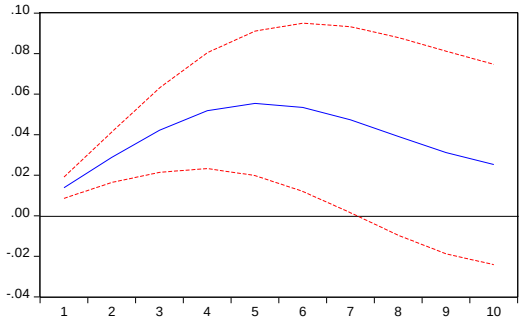


Figure 2. Accumulated Response of Fiscal Balance to Monetary Base Shock

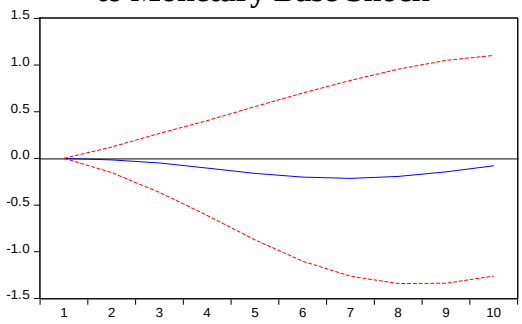


Table 7. Variance Decomposition of Fiscal Balance

Period	S.E.	Fiscal Balance	Monetary Base
1	0.682	100.000	0.000
2	1.030	99.976	0.023
3	1.261	99.915	0.084
4	1.380	99.771	0.228
5	1.410	99.621	0.378
6	1.411	99.536	0.463
7	1.427	99.539	0.461
8	1.470	99.545	0.454
9	1.520	99.469	0.530
10	1.557	99.319	0.680

Table 8. Variance Decomposition of Monetary Base

Period	S.E.	Fiscal Balance	Monetary Base
1	0.028	23.258	76.741
2	0.042	23.517	76.482
3	0.050	23.751	76.248
4	0.053	24.163	75.836
5	0.053	24.237	75.762
6	0.053	24.271	75.728
7	0.054	24.642	75.357
8	0.056	25.371	74.628
9	0.057	26.111	73.888
10	0.058	26.570	73.429

3.2. Markov Switching VAR Model Estimation

The second step of the empirical strategy is to test the hypothesis of regime shifts in the interaction between monetary and fiscal policies. For this purpose, we estimate a Markov-Switching Vector Autoregression (MS-VAR) model with parameters varying across regimes. As in the estimation of the VAR model, we take the first difference of the logarithm of the fiscal balance and the monetary base and analyze the time-varying relationships of these variables in the selected period.

In the first stage, we specify the lag length of the VAR model. For this purpose, the Schwarz information criterion (SIC) and the Hannan-Quinn (HQ) information criterion are used, which support a first-order VAR model. Concerning the information criteria and the log-likelihood ratio statistic, the MS model was estimated with two regimes that allowed changes in the intercept (I) and autoregressive parameters (A). Therefore, the chosen kind of MS-VAR specification is the MSIA (2)-VAR (1). Specifically, this study is concerned with VAR models with one lag where autoregressive parameters and intercept follow a Markov process in two regimes.

Estimation results of the MSIA (2)-VAR (1) model are reported in Table 9. The findings show that, at the 1% significance level, the log-likelihood ratio test for linearity rejects the linear VAR model's hypothesis in favor of the MSIA specification. Therefore, compared to a linear model, the MSIA-VAR model appears to fit the data better.

The probability that Regime 1 is followed by Regime 1 is 0.948, and the probability that Regime 2 is followed by Regime 2 is 0.929; therefore, both regimes are very persistent as we can see in the transition probabilities matrix in Table 9. Additionally, the expected duration of Regime 1 is higher than that of Regime 2. The low ergodic probability value suggests that there are comparatively fewer periods in Regime 2 than there are in Regime 1. Specifically, regime 1 would last around 36 quarters, whereas regime 2 would prevail for around 17 quarters. Put otherwise, the economy spends about 75 percent of the time in Regime 1 and 25 percent in Regime 2.

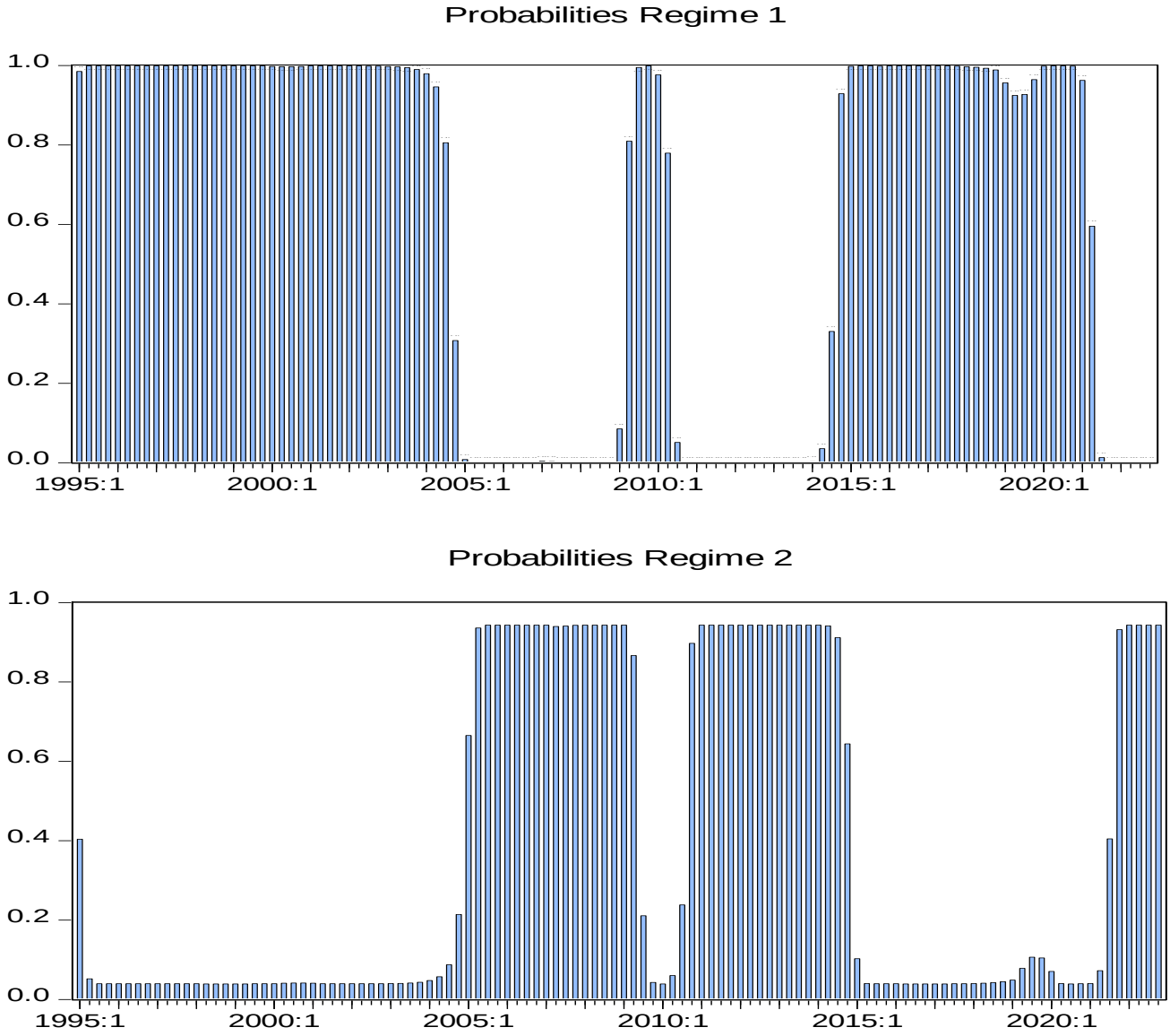
The meaning of each regime may be determined by analyzing the signs assumed by the means of the model. The estimated mean in Regime 1 is negative and positive for Regime 2. This finding gives evidence that the interaction between fiscal and monetary policies has been the subject of different (positive and negative) regimes. We label the negative regime-dependent mean (regime 1) as a “monetary dominance” regime and the positive regime-dependent mean (regime 2) as a

"fiscal dominance" regime. The filtered probabilities for each regime are plotted in Figures 3 and 4. We observe that Regime 1 predominates throughout the sample, except in the period that spreads from 2005 Q1 to 2008 Q1, and from 2009 Q3 to 2014 Q3. Regime 2 perfectly matches the global oil price spikes during the 2005-2008 period and 2010-2014 period. This finding strongly supports the validity of the oil dominance/fiscal dominance hypothesis in Saudi Arabia. During oil price booms, oil revenue windfall adds to government deposits without any impact on domestic liquidity. However, when the government decides to inject these revenues into the domestic income stream through its domestic expenditure, the inflow of foreign exchange is translated into domestic liquidity. Therefore, the behavior of the monetary policy in Regime (2) would be just a response to positive oil shocks instead of an independent policy that varies according to a change in the macroeconomic paradigm.

Table 9. Estimate Results Using MSIA (2)-VAR (1) Specification

	Regime 1	
Coefficients	**Fiscal Balance**	**Monetary Reserve**
Constant	-8.768	-4.123
	(3.324)	(0.076)
Fiscal Balance$_{t-1}$	-0.163	-0.039
	(0.319)	(0.003)
Monetary Base$_{t-1}$	-0.784	0.279
	(0.268)	(0.076)
	Regime 2	
Constant	11.149	4.297
	(3.392)	(0.269)
Fiscal Balance$_{t-1}$	0.881	0.321
	(0.102)	(0.193)
Monetary Base$_{t-1}$	0.632	1.146
	(0.483)	(0.036)
	Standard Errors	**Mean**
Regime 1	0.560	-0.483
Regime 2	0.262	0.632
Transition probabilities Matrix	**Regime 1**	**Regime 2**
Regime 1	0.948	0.051
Regime 2	0.070	0.929
Regime properties	**Regime 1**	**Regime 2**
Erg. Prob.	0.7487	0.2513
Duration	36	17
Log Lik	-270.972	
LR linearity test	553.563	Chi= (0.000)

Figure 3. Regime Probabilities: MSIA(2)-VAR(1)



3.3. The Macroeconomic Effects of the Oil Dominance/Fiscal Dominance Phenomenon

In this section, we present the potential macroeconomic effects of the oil dominance/fiscal dominance phenomenon, particularly concerning the relationship between the monetary base and prices. Costa and Olivo (2008) suggest that while the oil dominance/fiscal dominance hypothesis holds, it is also necessary to find a strong correlation between the price level and the monetary base in addition to the link between oil prices, fiscal balance, and the monetary base. To test for this relationship a four-lag VECM vector is estimated with monetary base and price level

(measured by the CPI) as endogenous variables and oil prices as an exogenous variable in the model.

To begin with, the Augmented Dicky-Fuller and Phillips-Peron tests show that the hypothesis that the logarithms of the monetary base and price level have unit roots cannot be rejected. Then, for the first difference, the hypothesis is rejected (Table 10).

Table 10. Unit Root Test Results

Variables	Level		First difference	
	ADF test	PP test	ADF test	PP test
CPI	-1.228	-1.475	-4.428***	-5.725***
	(0.135)	(0.105)	(0.000)	(0.000)
Monetary Base	-2.234	-1.819	-5.705***	-8.975***
	(0.195)	(0.588)	(0.000)	(0.000)
Oil Price	-1.430	-1.672	-4.034***	-4.884***
	(0.564)	(0.442)	(0.001)	(0.000)

Given that the logarithm of the monetary base and the price level are *I (1)*, the Johansen cointegration test between them is performed. We realize that the null hypothesis that there is no cointegration relationship between monetary base and price level can be rejected at the 5% level. Accordingly, the Johansen test indicates the existence of one cointegrating equation.

Table 11. Johansen Cointegration Test Results

Trace test				
	Eigenvalue	**Trace Statistic**	**Critical Value 0.05**	**P-Value**
None*	0.165264	23.94761	15.49471	0.0021
At most 1 *	0.050539	5.341660	3.841466	0.0208
Maximum Eigenvalue				
	Eigenvalue	**Max-Eigen Statistic**	**Critical Value 0.05**	**P-Value**
None*	0.165264	18.60595	14.26460	0.0097
At most 1 *	0.050539	5.341660	3.841466	0.0208

From a long-run perspective, the finding of a cointegrating relationship is supportive of the statement that the monetary base and the price level are closely linked. Another satisfactory result is that the coefficient of the price level exhibits a statistically significant and negative sign, as predicted (Table 12).

Table 12. Vector Error Correction Results: Long-Run Effects

Equation	D. Monetary Base	
	Coefficient	**t-Student**
Price Level	-0.3657**	-4.311

Table 13. Vector Error Correction Results: Short-Run Effects				
	Coefficient	**t-Student**	**Coefficient**	**t-Student**
CointEq	-0.0106	-0.658**	1.620	3.969
$D.Monetary\ Base_{t-1}$	0.230*	3.031	-0.494	-0.257
$D.Monetary\ Base_{t-2}$	0.103*	1.304	-0.747	-0.372
$D.Monetary\ Base_{t-3}$	0.062*	0.784	-0.725	-0.360
$D.Monetary\ Base_{t-4}$	-0.685*	-9.099	-0.669	-0.351
$D.CPI_{t-1}$	-0.009***	-0.232	0.203	1.992
$D.CPI_{t-2}$	-0.001***	-0.254	0.287*	2.891
$D.CPI_{t-3}$	-0.001***	-0.345	0.313*	3.190
$D.CPI_{t-4}$	-0.003***	-0.911	-0.486*	-5.186
$D.Oil\ Price$	-0.003***	-0.823	-0.066*	-0.674
Constant	0.012**	0.789	0.255	0.647

Figure 3 shows the impulse response function for an innovation in the monetary base, while Figure 4 displays the impulse response function for an innovation in the price level. The analysis of accumulated impulse response functions and variance decomposition indicate the following:

- A one standard deviation shock to the monetary base produces a positive response in the level of price, explaining approximately 7 percent of its forecast error variance.
- A one standard deviation shock to the price level affects positively the monetary base but explaining marginally its forecast error variance.
- In addition, the Granger causality test indicates a two-way causality between the monetary base and the price level (Table 16).

These results are interpreted as evidence of an accommodative monetary policy, which in turn may be the consequence of the oil dominance/fiscal dominance problem that affects the implementation of an independent monetary policy in Saudi Arabia

Figure 3. Accumulated Response of Price Level to Monetary Base Shock

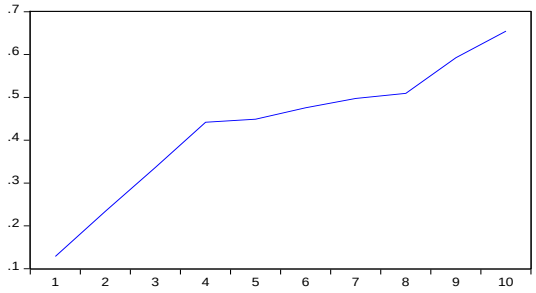


Figure 4. Accumulated Response of Monetary Base Price Level Shock

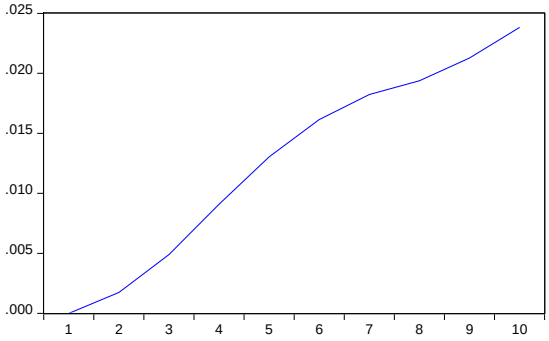


Table 14. Variance Decomposition of Monetary Base

Period	S.E.	Monetary Base	Price Level
1	0.023	100.000	0.000
2	0.038	99.790	0.209
3	0.050	99.494	0.505
4	0.062	99.212	0.787
5	0.065	98.934	1.065
6	0.067	98.770	1.229
7	0.067	98.695	1.304
8	0.068	98.670	1.329
9	0.069	98.638	1.361
10	0.071	98.602	1.397

Table 15. Variance Decomposition of Price Level

Period	S.E.	Monetary Base	Price Level
1	0.604	4.535	95.464
2	0.711	5.470	94.529
3	0.768	6.466	93.533
4	0.804	7.608	92.391
5	0.860	6.659	93.340
6	0.875	6.526	93.473
7	0.889	6.384	93.61
8	0.902	6.221	93.778
9	0.938	6.540	93.459

10	0.947	6.847	93.152

Table 16. VECM Granger Causality Test

H0: There is no Granger Causality	Statistic	P-value
Monetary Base → Price Level	2.997062***	0.0102
Price Level → Monetary Base	3.348913***	0.0074

4. Conclusion

This paper follows the methodology provided by Costa and Olivo (2008) to analyze fiscal dominance in the context of oil-dependent countries. The novelty of this approach is that it addresses the issues associated with the backward-looking approach based on primary surplus and debt. The framework is based on the transmission channels that occur between oil price shocks and fiscal and monetary variables, which eventually impact domestic prices.

The main hypothesis of this study is that economies that exhibit oil dominance─ a situation in which oil revenue largely affects the macroeconomic environment─ may also exhibit fiscal dominance. The main purpose of this study is threefold: i) to test the hypothesis of the presence of oil dominance/fiscal dominance in the case of Saudi Arabia, ii) to examine the potential macroeconomic effects of the oil dominance/fiscal dominance regime, particularly concerning the connection between the monetary base and price, and iii) to verify whether there are regime shifts in the interactions between monetary and fiscal policies in Saudi Arabia.

Based on the empirical results provided in the previous section, it can be concluded that the oil dominance/fiscal dominance hypothesis is valid in Saudi Arabia. Furthermore, a bidirectional close relationship between the monetary base and the price level was found in the short and long run. This result gives evidence of an accommodative monetary policy caused by the oil dominance/ fiscal dominance problem that affects the implementation of an independent monetary policy. Another important result of the analysis is that the interaction between fiscal and monetary policies has been the subject of different (positive and negative) regimes, with the "fiscal dominance" regime being more likely to hold during periods of high oil prices.

Our results have important policy insights, as the study offers the first comprehensive assessment of the interaction between monetary and fiscal policies in Saudi Arabia. The monetary policy aimed at controlling inflation faces several challenges considering the presence of a "fiscal dominance" regime. Generally, when fiscal dominance is present, conflicting objectives between

the monetary and fiscal authorities often result in the Central Bank giving up it is efforts to achieve price stability. It is thus straightforward to recommend that the conduct of monetary policy should be coordinated well with the fiscal stance of the government if monetary policy is to be effective. In addition, while discouraging monetary financing of the deficit, we underline the need to promote financial development to strengthen the conduct of monetary policy.

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