The Effects of Oil Shocks on Total Government Expenditure: A VAR Approach

Thomas Mullally[a]

Abstract

This paper aims to examine the relationship between oil price and oil revenue shocks and government expenditures in Venezuela. In order to analyze the relationship between these variables, this study uses a VAR approach. This study aims to find a positive relationship between oil revenues and government expenditures, which will show how countries adjust their public sector spending activities in order to account for changes in demand for oil.

Keywords: Oil Prices, Government Expenditure, Public Spending

JEL Classification: C32, H54, H61

Introduction

Government budgeting is an arduous process that requires lawmakers to have an understanding of the needs of the nation, but also what the country can reasonably afford. Budgets are published on a yearly basis, which unfortunately opens the doors to unforeseen changes in economic conditions during the year that may need to be addressed in order for the country to function effectively. One shock in particular can carry weight on future government spending, especially in nations that have relatively few exports. This shock is in oil revenues. Small to medium sized countries that rely on oil revenues in conjunction with taxes to fund their activities are expected to be adversely effected when there are shocks in the oil industry.

Given the recent turmoil in oil prices, investors in conjunction with governments have had to alter future strategies. Since the shock does not only affect these two factions of the economy, the shock ripples throughout the entirety of the system, flowing from producers to consumers and infiltrating all parties in between, it is clear that changes in government spending have to be planned cautiously, but implemented boldly. Any hesitation from the hand of the government has the potential to increase the duration that the shock in revenues affects the economy. This study aims to investigate the effect of oil revenue shocks on overall government spending.

Government spending includes social welfare programs, education, military, investment, and much more. Unfortunately, for Venezuela, there are many gaps in the reporting of the data for individual elements of government spending. This study will be performed using a VAR model to understand the lasting impact of oil revenue shocks on government spending. This study differentiates itself from previous research because Venezuela has not been extensively researched previously.

The goal of this research is two-fold. On one hand, this studies aims to find that there is a negative relationship between oil prices and government expenditure. By highlighting this relationship, there will be significant policy implications. The obvious effect will be regarding how governments plan their budgets, as the use of a VAR approach to the data is able to show the duration of the effects of the shocks on current spending levels.

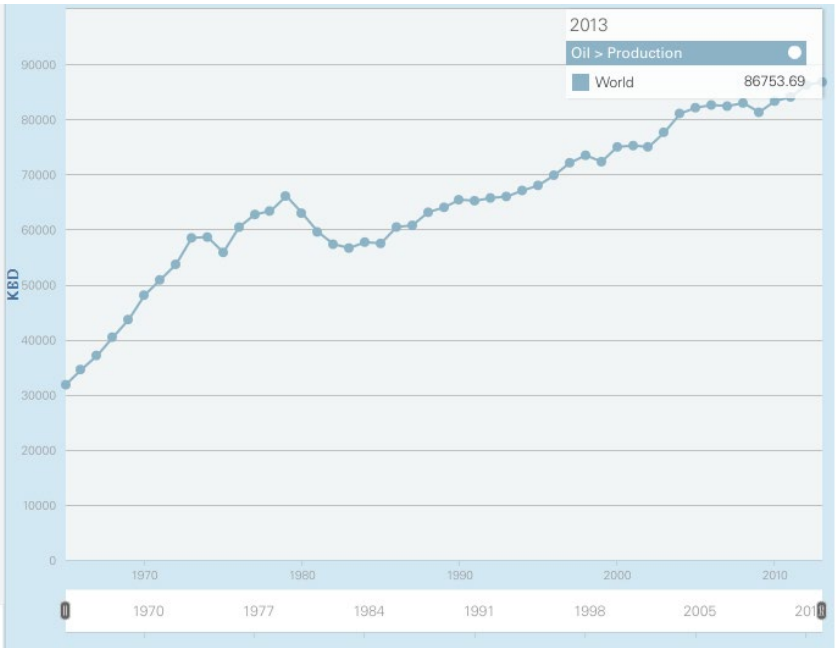
This paper will progress as follows: section 2 will cover the current trends within the oil industry. Section 3 will be a literature review of previous studies that are used as reference and basis for this study. Section 4 will discuss the empirical model that will be used along with the dataset being analyzed. Section 5 will be the empirical results, and section 6 will be the conclusion and suggestions for further research.

2.0: Trends

Current trends in the oil industry, particularly when considering the production of crude oil, show that production has steadily increased over the period 1965-2012. The price of oil over the same period has increased as well, although recent events have seen record low oil prices. However, due to the availability of data, the most recent shocks in oil prices are not accounted for in this study.

The steady increase in oil prices has been caused by a handful of factors. For one, there has been more sources of oil found, increasing the supply available for companies to drill for and refine. The increase in drilling and refining requires new technologies to be develop and capital to be purchased, further increasing the costs of crude oil. Prices also generally increase over time for all products as a result of inflationary factors. Oil is no exception to this trend.

Figure 1: Oil Production Worldwide in Thousands of Barrels



Source: BP Energy Charting Tool

As is evident in Figure 1, the production of oil has generally increased, aside from short periods where there is evidence to the contrary. When examining the production trends for South America, which is the region that this study focuses on, it is clear that over the period 1990-2000 there is a 60% growth in production for the region. This is highlighted in Figure 2 below.

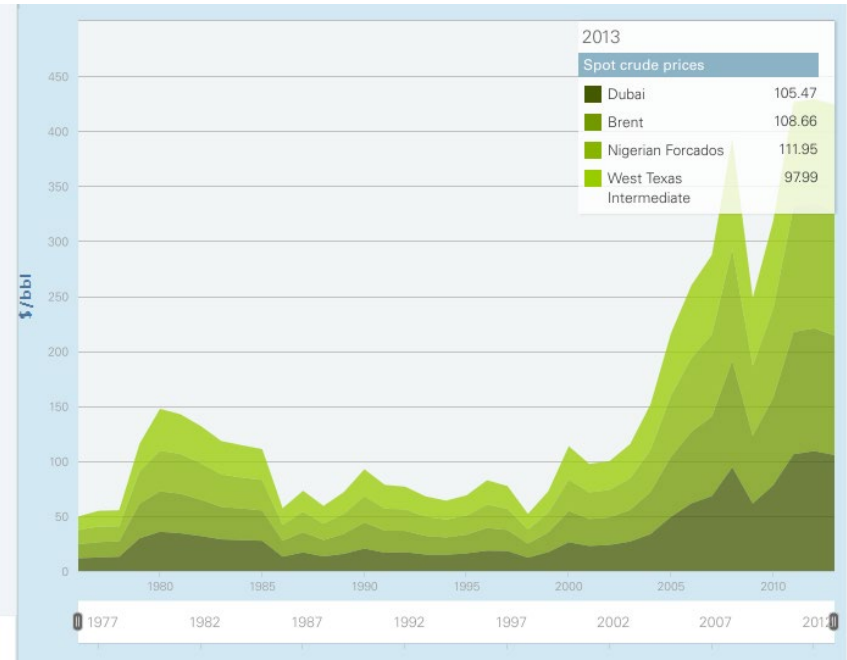
Growth in oil production has also allowed countries to further their development, as increases in energy consumption can often show advances in economic development. For Venezuela, the barrels of oil consumed have been steadily increasing over the period studied, but the nation's growth during this period has not paralleled this trend. For 2014, Venezuela experienced -3% GDP growth for the year; however, the nation has entered a recessionary period in the past three years.

Source: BP Energy Charting Tool

A deeper investigation into the dramatic increase in oil production in South America yields the conclusion that production levels dropped in the early 1980s as a result of the oil price drop and recession that occurred during this time. The slight increase in oil production seen in 1965 is due to Venezuela rising in prominence as an OPEC producer after joining the organization in 1960. Production followed a steep increase from around 1985-1998, and has leveled off in the early 2000s.

Visualizing the changes in oil prices over time, it is clear that there is a relationship between the production of oil and its price. As time progresses, the price of oil has been increasing consistently, with prices plummeting in 2008 but rebounding to pre-2008 levels in 2009 as well as another decrease from 2012 to the present time. Obviously, in 2008 the

recession period began worldwide, which had major impacts on all sectors of the economy, not just in energy.



Source: BP Energy Charting Tool

Oil prices remained relatively stable and constant through the late 1980s into 2000. There are slight changes during this period, but nothing compares to the extreme increases in price that is seen between 2000 and 2012. Even during the 2008 recession oil prices are much higher than they had ever been in the pre-2000 era. These price increases have proved to be extremely beneficial to nations that rely on oil as their primary revenue source, but has placed strain on consumers worldwide who struggle to keep up with the rapidly increasing prices of energy.

3.0: Literature Review

There has much research performed on the subject of the impact of oil revenue on government spending patterns. The primary focus of the existing research tends to be how revenue shocks affect different aspects of the government's allocation of funds over time. The studies that have been published in recent years primarily discuss the affects in Iran, since there have been numerous international sanctions placed on the country's oil exports.

Farzanegan (2011) suggests that the primary impact of oil revenue shocks is on military spending in Iran, but the impact on all other aspects of government spending is not statistically significant. In his study, he utilized a VAR method to analyze the changes that occurred to various factions of government spending in response to changes in oil revenues. This study is useful for understanding that depending on the nation studied, there will be differences in how governments spend their money. It is surprising that Farzanegan concluded that only military spending changes were statistically significant, and not changes in health or education spending. However, when considering that Iran's infrastructure is not conducive to social welfare and the nation is constantly at war, this begins to make more sense. Iran differs from Venezuela because of the ongoing violence in the Middle East that is constantly destroying the infrastructure of nations.

Adding to the research about Iran's government expenditures, Dizaji (2014) found that oil revenue shocks are more significant than oil prices in explaining the variations in government expenditure. According to this piece of literature, the economic sanctions imposed on Iran's oil industry can potentially influence the standard of living by having negative effects on government expenditures for social welfare programs. Dizaji used multiple VAR models in order to achieve the results of this study. A structural VAR, a VAR, and a restricted VEC were

used to analyze the effects of oil consumption, oil price, and oil revenue on government spending. The results of this study are significant because Dizaji examined not only the data, but also the impacts that other institutions can have on government expenditures by discussing the externalities involved with the sanctions placed on Iran by many powerful nations.

Cologni and Manera (2011) analyze data for the Gulf Corporation Council member countries using a Real Business Cycle model, which a theoretical model designed to fit the data for an average oil producing country. This study asserts that the crowding-out effects of public over private investments is useful in explaining most of the negative effects of shocks to oil revenues in the private sector of the economy. According to Jbir and Zouari- Ghorbel (2009), oil shocks affect economic activity indirectly, with the most significant channel of impact being government spending. Using data from Tunisia over the period 1993 Q1 to 2007 Q3, the researchers analyzed the variance decomposition and found that oil price is the largest source of government spending changes. It was also concluded that there is no evidence of an asymmetric relation between oil price and economic activity. Both of these studies differ from other literature referenced in this study because of the models that were used. Typically, standard VAR models are implemented to address changes, but by using other types of models, Jbir and Zouari-Ghorbel (2009) and Cologni and Manera (2011) are able to create the basis for the hypothesis that oil revenue shocks, especially in countries that primarily export crude oil, leads to statistically significant changes in government expenditures.

4.0: Data and Empirical Methodology

4.1: Data

This study uses annual time series data from 1965-2012 for the country of Venezuela. Data were obtained from the World Bank Database of Development Indicators and the BP Statistical Review of World Energy: June 2013.

4.2: Empirical Model

This study followed the model used by Dizaji (2014) in that a VEC was run using logs of ratios of oil revenues to GDP, oil consumption to GDP, and government expenditure to GDP. Using the econometric tools that VEC models lend themselves to is vital to the analysis this study wished to achieve. These tools include impulse response functions along with testing for Granger causality.

To discuss the variables in greater detail, it should first be noted that since all the variables are non-stationary, it is best to run the VEC using the first differences of the variables. This is because differencing the variables leads to neglecting the potential long-run relationship shared among the variables and therefore requires the use of an error correcting model to account for the long run relationship experienced amongst the variables. VECMs include cointegrating equations that account for potential long-run relationships among the variables. A structural VAR (SVAR) is not used either as often these models tend to be misspecified according to Tijerina-Guajardo and Pagán (2003).

The data source, acronyms, and descriptions can be found in the appendices. *fdLgdprev* is the log of the ratio of oil revenues to GDP, *fdLgdpte* is the log of the ratio of total government expenditures to GDP, and *fdLgdpco* is the log of the ratio of barrels of oil consumed to GDP. The *fd* prior to all variable names denotes first difference. All the variables are created using data from the World Bank database and the BP Statistical Review of World Energy.

4.3: Empirical Results

The first results that must be discussed when using a VEC model is the output of the tests used to determine whether the variables are stationary. For this study, the Augmented Dickey-Fuller test was used. On the 5% and 10% critical levels for all three variables, the tests concludes that the variables are non-stationary and thereby exhibit a unit root. The output of the tests can be seen in Table 2 below. Since all of the variables have a unit root, they cannot be used in a basic OLS regression. However, the variables are used in an OLS regression in order to predict the residuals and test for cointegration of the variables, as is called for in the Engle-Granger test for cointegration. The Engle-Granger test concluded that the variables are cointegrated. These results can be seen in Table 3 below.

Table 2: Dickey-Fuller Test

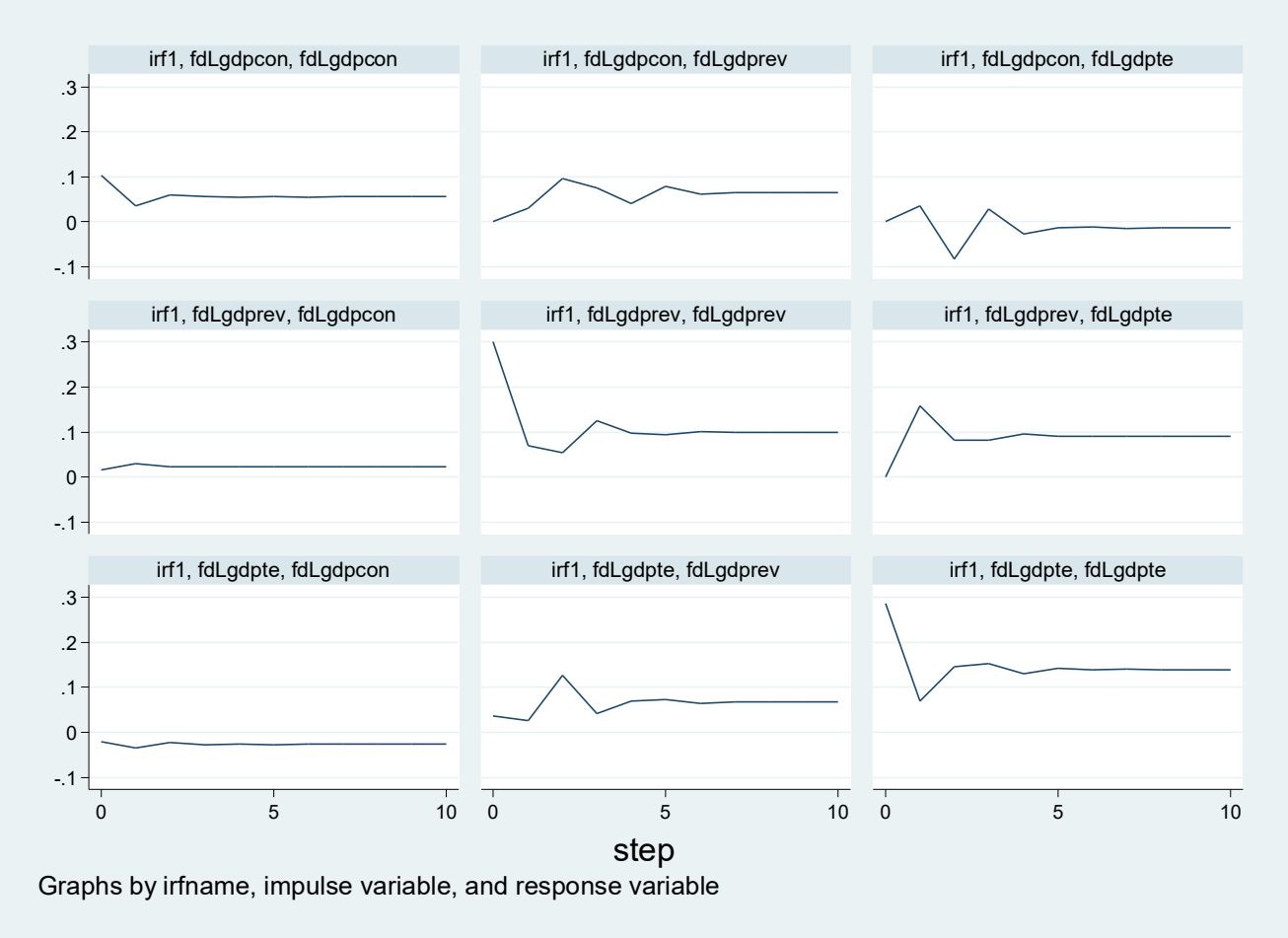
Variable	Test Statistic	5% Critical Level	10% Critical Level
Lgdpte	-0.999	-2.938	-2.604
Lgdprev	-2.123	-2.938	-2.604
Lgdpco	-2.011	-2.938	-2.604
fdLgdpte	-7.588	-2.941	-2.605
fdLgdprev	-6.662	-2.941	-2.605
fdLgdprev	-7.135	-2.941	-2.605

Table 3: Engle-Granger Test

Model	Test Statistic	5% Critical Level	10% Critical Level
res	-2.587	-1.950	-1.609

After running the VEC, impulse response functions are created. The orthogonalized impulse response function is used in this study. The computed IRFs can be seen below in figure 4.

Figure 4: Impulse Response Functions



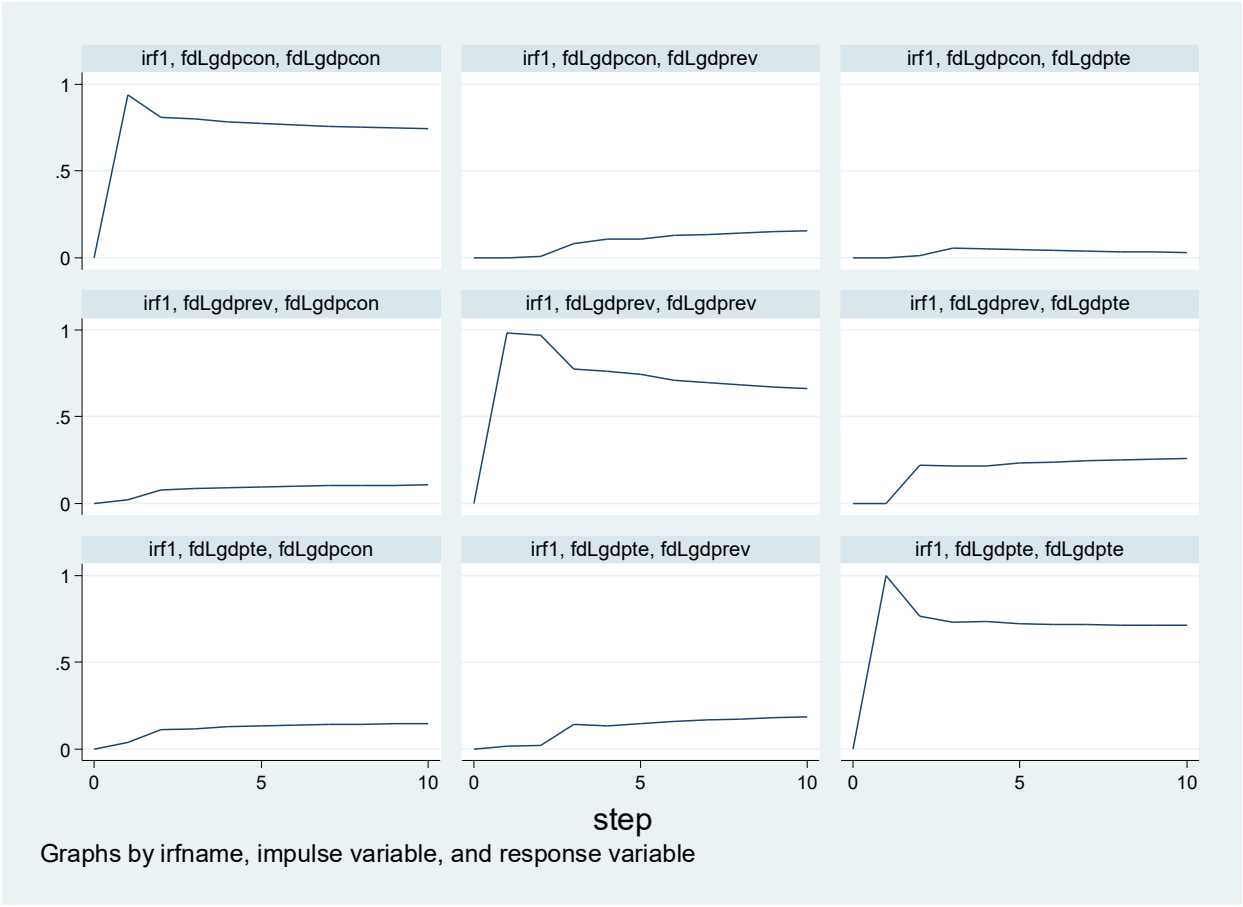
Analyzing these functions leads to some interesting conclusions. First, it seems that there is a positive and statistically significant response to the ratio of expenditure to GDP due to

shocks in the ratio of oil revenue to GDP. A one standard deviation change in the revenue yields an increase in expenditure over the first period, with a decline in the second period that does not go back to zero, but instead remains at 0.1 for the remaining lags. This shows that shocks in revenue have a lasting effect on expenditure and that even when ten years have expired since the shock, the lasting effect is still felt.

The effects that consumption of oil has on total expenditure were extremely not statistically significant based on the *p*-values generated in the model. When looking at the impulse response function where expenditure responds to shocks in consumption, there is an interesting result. The first period following the one standard deviation increase in consumption yields an increase in expenditure, the second period decreases to a negative response, and the third increases back to the level of the first period. It is not until the fourth period that the shock is reduced to zero and the effects are no longer felt on expenditures.

Figure 5 shows the forecast error variance decomposition functions for this model. Forecast error variance decomposition functions show the degree to which shocks in each variable contribute to the overall forecast error variance within the model. The functions show that the greatest effects of the impulses are when one variable is an impulse to itself, such as when consumption is the impulse variable that elicits a response from consumption. This is not surprising because a change in consumption in the previous period will definitely influence the consumption of oil in the coming periods. For the response of expenditure to an impulse in revenue, only 20-20% of the variance in expenditure can be explained by the impulses in revenue. The variance explained increases from 20% in the first period to 25% in the tenth period. A more descriptive table of the forecast error variance decomposition can be found in Appendix B.

Figure 5: Forecast Error Variance Decomposition



5.0: Conclusion

This paper has concluded that there is a relationship between oil revenues, oil consumption, and the total government expenditure within Venezuela. This study shows that changes in oil revenue have a statistically significant impact on the government expenditure of Venezuela and the impulse response functions show that there are adjustments made in the years following a revenue shock. This has significant policy implications for governments, as it shows that if governments can manage the fluctuations of shocks to revenue within their country, less dramatic changes will need to be made to annual government budgets. By maintaining

consistent budgets from year to year, governments can make their country more appealing to foreign investors and ultimately create economic growth.

Venezuela is in a unique predicament since it is a member of OPEC. For as long as OPEC, and in particular Saudi Arabia, refuses to lower production quotas, Venezuela will be forced to continue to produce oil at a rate which is not profitable. This will cause a profound deepening in the recession that the country is currently facing because oil accounts for 95% of the nation's exports. While a recommendation to Venezuela would be to diversify their exports so that the nation is less reliant on the sale of crude oil, in light of the current recession, this simply is not feasible. Until Venezuela emerges from the recession, the only policies that the government can pursue are ones that will assist in lowering the inflation rate, adding value back into their economy, and beginning to manage governmental affairs in an efficient and productive manner.

The results of this study complement previous studies findings, showing that there is a definite response to shocks in oil revenues on the total government expenditures. It adds to the literature by examining Venezuela using a VAR approach that analyzes the impact of domestic oil consumption and revenue generated by the sale of crude oil. Further studies should focus on expanding the data to use quarterly data, as well as testing the hypothesis that oil revenue does directly affect government expenditures in other countries throughout the world to determine if a trend exists amongst oil producing nations.

Appendix A

Variable	Definition	Data Source
Lgdprev	The log of the ratio of annual oil revenues to yearly GDP	BP Statistical Review of World Energy, World Bank Database of World Development Indicators
Lgdpcon	The log of the ratio of the barrels of oil consumed annually to the yearly GDP	BP Statistical Review of World Energy, World Bank Database of World Development Indicators
Lgdpte	The log of the ration of total yearly government expenditures to yearly GDP	World Bank Database of World Development Indicators

Appendix B

Results from irf

step	(1) fevd	(2) fevd	(3) fevd	(4) fevd	(5) fevd	(6) fevd	(7) fevd	(8) fevd	(9) fevd
0	0	0	0	0	0	0	0	0	0
1	1	.014787	.037732	0	.985213	.019912	0	0	.942356
2	.767842	.020516	.113097	.220992	.970865	.075122	.011167	.008619	.811781
3	.730642	.142006	.114339	.214659	.777278	.083203	.054699	.080717	.802458
4	.735571	.131306	.126962	.214539	.762326	.08829	.04989	.106368	.784748
5	.721639	.14755	.131841	.231385	.74641	.093897	.046976	.10604	.774263
6	.720034	.159543	.137271	.238079	.712298	.097864	.041887	.128158	.764865
7	.717553	.166234	.140722	.244353	.698847	.100574	.038094	.134919	.758704
8	.715792	.173302	.143383	.249071	.684263	.102729	.035137	.142435	.753888
9	.713937	.178855	.145789	.253464	.672065	.104606	.032599	.14908	.749605
10	.712613	.183883	.147603	.256834	.661605	.106066	.030553	.154511	.746332

(1) irfname = irf, impulse = fdLgdpte, and response = fdLgdpte
(2) irfname = irf, impulse = fdLgdpte, and response = fdLgdprev
(3) irfname = irf, impulse = fdLgdpte, and response = fdLgdpcon
(4) irfname = irf, impulse = fdLgdprev, and response = fdLgdpte
(5) irfname = irf, impulse = fdLgdprev, and response = fdLgdprev
(6) irfname = irf, impulse = fdLgdprev, and response = fdLgdpcon
(7) irfname = irf, impulse = fdLgdpcon, and response = fdLgdpte
(8) irfname = irf, impulse = fdLgdpcon, and response = fdLgdprev
(9) irfname = irf, impulse = fdLgdpcon, and response = fdLgdpcon

Bibliography

Cologni, A., & Manera, M. (2013). Exogenous Oil Shocks, Fiscal Policies, and Sector Reallocations in Oil Producing Countries. *Energy Economics*, 42-57.

Dizaji, S. (2014). The Effects of Oil Shocks on Government Expenditures and Government Revenues Nexus (with an application to Iran's sanctions). *Economic Modeling*, 299-313.

Farzanegan, M. (2011). Oil Revenue Shocks and Government Spending Behavior in Iran. *Energy Economics*, 1055-1069.

Jbir, R., & Zouari- Ghorbel, S. (2009). Recent Oil Price Shock and Tunisian Economy. *Energy Policy*, 1041-1051.

Oh, W., & Lee, K. (2004). Causal Relationship Between Energy Consumption and GDP Revisited: The Case of Korea 1970-1999. *Energy Economics*, 51-59.

Tijerina-Guajardo, J., & Pagan, J. (2003). Government Spending, Taxation, and Oil Revenues in Mexico. *Rev. Dev. Econ.*