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The effects of oil shocks on government expenditures and government revenues nexus in Iran (as a developing oil-export based economy)

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ABSTRACT

The main purpose of this study is to investigate the dynamic relationship between government revenues and government expenditures in Iran as a developing oil export based economy. Moreover, I want to know how government expenditures and revenues respond to oil price (revenue) shocks. I use two different groups of the variables with two different time periods (quarterly and annually) to investigate the robustness and reliability of the results and to provide a more comprehensive base for comparison against different methodologies. For the first group of the variables (including oil price, oil revenues to GDP ratio, government total expenditures to GDP ratio and a dummy variable for capturing the effects of war with Iraq) I apply an SVAR model using annual data for the period 1970-2008. The results of the impulse response functions and variance decomposition analysis indicate that the causality is running from oil revenues to GDP ratio to government total expenditures to GDP ratio. Moreover the contribution of oil revenue shocks in explaining the government expenditures to GDP ratio is stronger than the contribution of oil price shocks. For the second group of the variables (oil revenues, government total revenues, government current expenditures, government capital expenditures, money supply and CPI) unrestricted VAR and VEC models have been applied using quarterly data for the period 1990:2-2009:1. The results of the impulse response functions and variance decompositions analysis for both VAR and VEC models indicate that the strong causality is running from government revenues to government expenditures (both current and capital) in Iranian economy while the evidence for the reverse causality is very weak. The results show that in the VEC model which the long-run behavior of endogenous variables is restricted to converge to their co-integration relationships, oil revenue shocks can affect the other macroeconomic variables more directly while in the VAR model this changes and works through the total revenues channel. Moreover the findings indicate that government revenues, government expenditures and money supply are important determinants of domestic price level in Iranian economy.

Overall my results support the revenue-spending hypothesis for Iran. In this context Iran should enhance the effectiveness of fiscal policy by making budget expenditure less driven by revenue availability. This policy can help to avoid the costs and instability that variations in public spending generate mostly due to the fluctuations in oil revenues.

Keywords

Iran, government expenditures, government revenues, oil shocks, vector autoregression (VAR), sanctions.

JEL Classification: C 32; H 27; H 53; H 61.

The effects of oil shocks on government expenditures and government revenues nexus in Iran [1]
(as a developing oil-export based economy)

1 Introduction

The unique role of oil revenues in the structure of government budgets and expenditures is a special characteristic of the developing oil export economies like Iran. The Iranian economy largely depends on income from oil. Oil revenues are the main source of financing government expenditures and imports of products. Since on average 60% of government revenues come from oil and gas, the budget is especially affected by sudden negative or positive shocks in oil prices. Economic performance has been affected by oil revenue volatility and "stop-go" policies, resulting in boom and bust cycles. Transitory oil price increases have caused the spending to increase, often maintained even after oil revenues had decreased again. Despite higher oil prices and revenues in recent years, the Iranian government budget deficits are still a challenging issue, in part due to the huge amount of state subsidies on energy and comestible goods.

Table 1 presents the shares of various sources of financing the budget deficits in Iran over the past fiscal years. The table shows that a very big portion of annual budget deficits in Iran is financed through withdrawals from OSF. This is similar to spending the oil revenues directly and has strong inflationary effects through increasing money supply in the economy.

TABLE 1
Financing budget deficit (Iranian fiscal year (FY))

	2005-2006 (FY)		**2006-2007(FY)**		**2007-2008(FY)**		**2008-2009(FY)**		**2009-2010(FY)***	
	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual
State bond	6.1	8.2	5.1	3.1	3.2	3.8	1.8	0.0	0.0	0.0
Foreign borrowing	2.7	0.8	3	0.4	2.1	0.0	1.6	0.0	1.4	0.1
Privatization	26	2.1	4.5	0.5	30.9	3.1	20.6	5.0	43.7	15.3
Oil Stabilization Fund	**61**	**83.3**	**83.6**	**88.5**	**57.5**	**85.6**	**71.5**	**83.1**	**49.8**	**70.6**
Others	4.3	5.6	3.7	7.5	6.2	7.5	4.5	11.8	5.1	14.0
Total	100	100	100	100	100	100	100	100	100	100

*: Only for the first nine months of the fiscal year.

Source: Survey of the Iranian Economy, Karafarin Bank, Online E-library, accessed on April 10, 2012.

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Moreover, the most recent challenge for Iranian economy consists of the US and UN sanctions which mostly have focused on restricting oil exports (boycott) and investment (embargo) in the oil related projects of Iran. It is likely that the sanctions will exacerbate the amount of oil revenues and consequently the budget deficit. This shows a dilemma to the policy makers who are trying to keep up the momentum into the economy by injecting more government expenditure into domestic economy while at the same time the oil revenues are uncertain and expected to decrease (compare Van Marrewijk and Van Bergeijk 1993).

If policymakers understand the relationship between government expenditure and government revenue, continuous government deficits can be prevented. In the past decades the relationship between government expenditure and government revenue has attracted significant interest. Indeed this is because; the relationship between government revenue and expenditure has an impact on the budget deficit (Eita & Mbazima, 2008).

Narayan and Narayan (2006) provide three reasons why the nature of the relationship between government expenditure and government revenue is important. First, if the revenue-spend hypothesis- which indicates that the causality runs from government revenue to government expenditure- holds, budget deficits can be avoided by implementing policies that stimulate government revenue. Second, if the spend-revenue hypothesis- which states that the causality runs from government expenditure to government revenue- holds it suggests that the government spends first and pay for this spending later by raising taxes. This will result in the fear of paying more taxes in the future and encourage the outflow of capital. Third, if the fiscal synchronization hypothesis- which states that the causality runs from both directions- does not hold, it suggests that government revenue decisions are made independent from government expenditure decisions. This can cause high budget deficits should government expenditure rise faster than government revenue.

The causal relationship between government revenue and expenditure has remained an empirically debatable issue in the field of public finance. Many studies have considered links between government expenditures and government revenues but most have been conducted for countries where oil is not a major concern. In this paper I investigate the dynamic interrelationship between the government revenues and government expenditures in Iran as a developing oil export based economy. This study wants to take a different approach to the fiscal policy issue as it deals with the government revenues and government expenditures for a petroleum economy where income, government revenue and exports are linked with oil revenue.

Oil revenues in most oil-exporting countries are paid directly to the government as the guardian of the natural resources. Hence, the government becomes the conduit for the oil revenues into the economy. If the revenue is unstable and/or transitory, then the other macroeconomic variables will be unstable and the natural resource blessing could become a curse. Fiscal policy is therefore a key element, for most countries, in causing or preventing the resource curse (Devlin and Lewin, 2004).

It seems that it will be more interesting if we consider the role of oil shocks on the government expenditures and government revenues link when we are going to investigate their relationship in an oil exporting country like Iran. Moreover in this study I want to investigate how oil price (revenue) shocks are affecting the other major macroeconomic variables like money supply and domestic price levels through influencing the government revenues and government expenditures. Interestingly, the relationship between oil prices and levels of economic activity has been the subject of much attention for some time. Since the Arab oil embargo of 1973–1974 economists have been attracted by the relationship between oil price fluctuations and macroeconomic performance. Generally, the current literature on the impact of oil price fluctuations on the macroeconomy appears to be contradictory.

Levin and Loungani (1996) argue that a country's response to oil prices is determined by the choices of rules adopted by the country and those followed by its trading partners. Berument and Ceylan (2005) state that the impact of oil price changes depends on the structure of the economy and whether the country is a net oil exporter or importer; the net exporters of oil should benefit from the windfall profits and fiscal revenues created by oil price hikes, while the net importers of oil will experience this situation as additional burdens on their economies, and vice versa.

However, Abeysinghe (2001) maintains that even net oil exporters cannot escape the negative influence of high oil prices. He states that while the direct impact of high oil prices on net oil exporters is positive, a negative effect is transmitted indirectly through a trade matrix. Hence, net exporters cannot escape the contractionary effect which is passed on through their trading partners and in the long run, the positive effects of high oil prices is mitigated.

Generally, the current literature suffers from a paucity of research on the macroeconomic impact of oil price (revenue) fluctuations on a net oil exporter. Most of the empirical studies carried out have focused on the oil importing economies, particularly the developed economies. This study intends to fill this gap as well. In summary the purpose of this study is twofold. First, it investigates the government expenditure-government revenue nexus, I want to examine which of the three hypotheses, spend-and revenue, revenue-and-spend or fiscal synchronization, is applicable to Iran. Unlike the previous studies I do not do this in a bivariate framework as is the usual approach; rather, given the characteristics of the Iranian economy, I consider how government expenditures and government revenues respond to an oil price (revenue) shock. Furthermore, while most of the existing researches in this area use only total government expenditures, this study will employ disaggregate government expenditures (current expenditures and capital expenditures) in addition to total expenditures. Second, I want to investigate how and to what extend the government expenditures and government revenues nexus can transfer the effects of oil shocks to the other Iranian key macroeconomic variables such as money supply and CPI.

From the political view and regarding the current challenges of the Iranian economy for passing the negative effects of the international sanctions on its oil exports and foreign direct investment, the findings of this study are very important. In fact the results of this study helps to understand how sanctions via Iranian oil revenues, influence the government expenditures and thereby the wage bills of government employees, interest payment, employer contribution including social security and pensions, subsidies and all other payments which are related to the government functions.

Reviewing the literatures on the government expenditures-government revenues nexus and also the effects of oil price shocks on the economy reveals that the results of the previous studies have been very sensitive to the type of the variables, the time periods and econometric techniques. For avoiding this problem and in order to get robust support for the findings of this study I use two different groups of variables for two different time periods with three different econometrics models. For the first group of the variables (including oil prices, oil revenues to GDP ratio and government total expenditures to GDP ratio) I use a Structural Vector Autoregression (SVAR) model with imposing three long run restrictions to investigate the dynamic relationships of these variables with employing annual data for the period 1970-2008. For the second group of the variables (including oil revenues, government total revenues, government current and capital expenditures, money supply and CPI) I use the unrestricted Vector Autoregression (VAR) and Vector Error Correction (VEC) models with employing quarterly data for the period 1990:2-2009:1. Furthermore techniques such as impulse response functions and variance decomposition analysis are used to trace the dynamic interactions of the variables. Such effects may not be captured in a static analysis.

Section 2 reviews the previous studies on the relationship between government expenditures and government revenues and also some studies on the effects of oil shocks on the economy. Section 3 introduces the methodology of this research. Section4 includes the models which have been used in this study and also the results of their estimations. A discussion on the effectiveness of the sanctions on the Iranian economy based on the findings of this study has been included in section 5, and finally section 6 contains the summery and conclusions.

2 Literature review

The literature review is comprised of two parts. First part considers theories and empirical studies on the relationship between government revenues and government expenditures. In the second part I review some studies which have examined the effects of oil shocks on macroeconomic variables in some developing and developed countries.

2.1 Literature on the relationship between government revenues and government expenditures

There are different hypotheses regarding the relationship between government revenue and expenditure. The first of these is the **revenue (tax)-spending hypothesis** which maintains that a unidirectional causality runs from revenues to expenditures. This hypothesis is supported by Friedman (1978) and Buchanan and Wagner (1978). According to this hypothesis, the rise in tax revenues leads to an increase in government expenditures and consequently worsens the governmental budgetary balance. The view here is that if taxes are raised they will propel a growth in government spending. In other words, government would spend all of its revenues, and therefore raising government revenues would lead to higher government expenditures. Friedman (1982) suggests cutting taxes as a remedy to budget deficits, since taxes have a positive causal impact on government expenditure. (Moalusi, 2004).

Buchanan and Wagner (1978) stated that there is a negative causality from revenues to expenditure. They propose an increase in taxes revenue as remedy for budget deficits. Their point of view is that with a cut in taxes the public will perceive that the cost of government programs has fallen. As a result they will demand more programs from the government which if undertaken will result in an increase in government spending (Moalusi, 2004).

The second hypothesis known as **spend-and- revenue (tax) hypothesis** has been proposed by Peacock and Wiseman (1961, 1979). Under this hypothesis empirical results will show unidirectional causality running from government expenditures to government revenues. This view is based on their observation that any large-scale exogenous disturbances like wars and other unstable political conditions or natural disasters, will induce an increase in government spending and therefore an increase in tax revenues. The solution suggested here to problems of budget deficits is that government spending should be reduced, (Moalusi, 2004; Narayan, 2005).

The **fiscal synchronization hypothesis** is the third school of thought. It argues that governments may change expenditure and taxes concurrently (Meltzer & Richard, 1981; Musgrave, 1966). This means that there is bidirectional causality between government expenditure and revenue. Under the fiscal synchronization hypothesis, citizens decide on the level of spending and taxes. This is done through comparing the benefits of government to citizen's marginal cost, (Narayan, 2005).

Finally, the **fiscal neutrality school or institutional separation hypothesis**, proposed by Baghestani and McNown (1994) argues that none of the above hypotheses describes the relationship between government revenues and expenditure. Government expenditure and revenues are each determined by the long run economic growth reflecting the institutional separation between government revenues and expenditure.

Considerable empirical works have been done with respect to the above mentioned hypotheses. Using different econometric methods, studies have reached to different results.

Fasano and Wang (2002), examine the direction of causality between total government expenditure and revenue in oil-dependent GCC countries for the period 1975-2000. A cointegration and error-correction modelling framework has been used. Their results show that government spending follows oil revenue, suggesting a pro-cyclical expenditure policy to variations in oil revenue. They suggest that to make budget expenditure less driven by revenue availability, the authorities could resort to a medium-term expenditure framework, so that expenditures can be planned and insulated from volatile short-term revenue availability.

Narayan (2004), uses bounds testing approach to cointegration and the conventional F-test to examine causality between government revenue and government expenditure for nine Asian countries: India (1960-2000), Indonesia (1969-1999), Malaysia (1960-1996), Nepal (1960-1996), Pakistan

(1960-2000), Philippines (1960-2000), Sri Lanka (1960-2000), Thailand (1960-2000), Singapore (1963-1995). His results on the direction of causation are mixed: (a) for Indonesia, Singapore, Sri Lanka in the short-run and for Nepal in both the short- and long-run he finds support for the tax-and-spend hypothesis; (b) Indonesia and Sri Lanka are in conformity with the spend-and-tax hypothesis in the long-run; and (c) for other countries there is evidence of neutrality. He concludes that in these countries 'fiscal synchronization hypothesis' is rejected and these Asian countries made expenditure decisions in isolation from revenue decisions.

Moalusi (2004), examined the causal relationship between government spending and government revenue in the case of Botswana using annual data for the period 1976 to 2000. In addition to the bivariate model, he specifies a multivariate model incorporating GDP and interest rates. His estimations show that there is a negative unidirectional causal link running from revenue to spending, therefore he concludes that government budget deficit can be corrected by raising taxes.

Eita and Mbazima (2008), investigate the relationship between government revenue and government expenditure in Namibia using Granger causality test through cointegrated vector autoregression (VAR) methods for the period 1977 to 2007. The results show that there is unidirectional causality from revenue to expenditure. This suggests that unsustainable fiscal imbalances (deficit) can be mitigated by policies that stimulate government revenue.

Mehrara et al. (2011), study the relationship between government revenue and government expenditure in 40 Asian countries for the period of 1995 to 2008. They use GDP as a control variable into the model. They find a cointegration relationship between government revenue and government expenditure by applying Kao panel cointegration test. The causality tests indicate that there is a bidirectional causal relationship between government expenditure and revenues in both the long and the short run and fiscal synchronization hypothesis is confirmed. They recommend that the fiscal authorities of these countries with budget deficits should raise revenues and decrease spending simultaneously in order to control their budget deficits.

Elyasi and Rahimi (2011), use annual data from 1963 to 2007, to investigate the relationship between government revenue and government expenditure in Iran by applying the bounds testing approach to cointegration, ARDL (autoregressive distributed lag) and the causality test. They find a cointegration relationship between government revenue, expenditure and GDP. However, applying the ECM version of the ARDL model shows that the error correction coefficient, which determines the speed of adjustment, has an expected and highly significant negative sign. Moreover, their results show that there is bidirectional causality from government revenue to government expenditure. So, these result consistent with the fiscal synchronization hypothesis.

Some more studies on the relationship between government expenditures and government revenues have been listed in table 2 by authors, periods, countries, methodologies and empirical results.

TABLE 2
Summary of some empirical studies
on the government expenditures and revenues nexus

Authors	Countries studies	Method	Causality Direction
Von Furstenberg *et al.* (1986)	USA (Quarterly Data 1954-1982)	VAR	E → R
Baghestani and McNown (1994)	USA (Quarterly Data 1955-1989)	ECM	No
Darrat (1998)	Turkey (1967-1994)	Engle-Granger and Johansen (1988) Cointegration test, CM	R → E
Nyamongo *et al.* (2007)	South Africa (monthly data, October 1994 - June 2004)	Seasonal Unit Roots, Johanson Cointegration and VECM For Causality	R ↔ E in long-run No in short-run
Chang and Chiang (2009)	15 OECD countries (1992-2006)	Panel Cointegration and Panel Granger Causality	R ↔ E
Li (2001)	China (1950-1997)	Cointegration and ECM	R ↔ E
Barua (2005)	Bangladesh (1974-2004)	Johansen test and VECM	No in short run
Hong (2009)	Malaysia (1970-2007)	Johansen cointegration and ECM	E→ R
Ho and Huang (2009)	31 Chinese provinces (1999 to 2005)	multivariate panel error correction model	No in short run R ↔ E
Afonso and Rault (2009)	EU countries(1960-2006)	panel analysis	(Italy, France, Spain, Greece and Portugal (E→R)) (Germany, Belgium, Austria, Finland and the UK (R→E))

Note: Abbreviations are defined as follows: VAR=Vector Autoregressive Model, VEC=Vector Error Correction Model, ECM=Error Correction Model, R=government revenues, E=government expenditures.

In this study I investigate the dynamic relationship between government expenditures and government revenues in Iran. Government expenditures in both aggregate and disaggregate form will be used moreover I will try to include other variables like money supply and CPI in my VAR model. In addition I consider the effects of oil shock on the mentioned relationship as an important factor in Iranian economy. I try to assess the contribution of the shocks to oil revenues and total revenues to the variations in government expenditures and vice versa.

2.2 Literature on the effects of oil shocks on the economy

Oil price (revenue) shocks receive considerable attention for their presumed macroeconomic consequences. As the main focus of research directed towards net oil importers and developed economies, there is a paucity of such studies for developing, oil- exporting countries. Generally, there appears to be little consensus in the current literature on the macroeconomic impact of oil fluctuations. Pioneering work on oil price effects carried out by Darby (1982) and Hamilton (1983) focused on the US economy. While Darby was not able to identify a significant relationship between oil prices and macroeconomic variables, Hamilton found that oil price shocks were an important factor in almost all US recessions from 1949 to 1973. He concludes that changes in oil prices Granger-caused changes in unemployment and GNP in the US economy.

Hess (2000) observes that oil price shocks led to lower real gross domestic product (GDP) prior to the 1980s. Since that time, changes in oil prices had no effect on US economic activity. He concludes that oil price spikes are generally short-lived and may not even have a direct effect on US economic activity. Furthermore, Hess notes that oil prices became more volatile in the 1980s and 1990s relative to real GDP. Blanchard and Gali (2007) claim the main reasons behind the weak response of economies to oil shocks in recent years are smaller energy intensity, a more flexible labor market, and improvements in monetary policies.

Jimenez-Rodriguez and Sanchez (2004) assess empirically the effects of oil price shocks on the real economic activities in a sample of seven OECD countries, Norway and the Euro area as a whole. Their results show that oil price increases have a larger impact on GDP growth than oil price declines. They emphasized the difference between oil importing and oil exporting countries. They conclude that oil price increases have a negative impact on economic activity for oil-importing countries, while the relationship for oil-exporting countries is mixed. UK's economy, according to them exhibits a surprising behavior: while it is expected that an oil price shock has positive effects on the GDP growth for a net oil exporting country, an oil price increase of 100% actually leads to a loss of British GDP growth rate of more than 1% after the first year in all specifications.

The transmission mechanisms of oil shocks to the economy mostly in the advanced, oil importing countries are the supply effect, the demand effect and the terms of trade effect (Brown et al., 2004; Schneider, 2004; Lardic and Mignon, 2006; Sill, 2007; Jbir and Zouari-Ghorbel, 2009). On the supply side, increased oil prices result in a reduction of an input for production and this leads to higher production costs, thus leading to a slowdown of output and productivity. On the demand side, higher oil prices increase the general level of prices and with a reduction in real income available for consumption, demand falls (Farzanegan and Markwardt, 2009). On the terms of trade side, oil-importing countries face worsening terms of trade conditions as demand falls in these countries and this results in wealth transfer from oil-importing to oil-exporting countries (Iwayemi and Fowowe, 2010).

For oil-exporting countries, different conclusions are expected because oil price hikes will increase foreign exchange earnings and lead to higher domestic demand although it has been argued that slower global demand will dampen the benefits to oil-exporting countries (Schneider, 2004). Recently, a few studies have attempted to examine the role of oil shocks on the economies of oil-exporting countries.

El-Anashasy (2006) examined the effects of oil price shocks on Venezuela's economic performance over 1950 to 2001. He used a cointegrated vector autoregression (CVAR) approach to analyze the short run dynamics and the long run relationships among oil prices, government revenues, government consumption, investment and output. His findings show that oil prices and investment are the main determinants of GDP level in the long run and that public investment is the only avenue through which fiscal policy could affect long run GDP level or growth. He argues that oil price shocks may have a secondary, indirect effect on the level of output via the fiscal channel because investment responds to any fiscal disequilibrium caused by an initial shock.

Eltony and Al-Awadi (2001), use quarterly data for the period 1984-1998 to examine the impact of oil price fluctuations on key macroeconomic variables for the Kuwaiti economy. The results of the vector autoregression (VAR) and vector error correction (VEC) models indicate that oil price shocks and hence oil revenues have a notable impact on government expenditure, both development and current. However, government development expenditure has been influenced relatively more. The results also point out the significance of the CPI in explaining a notable part of the variations of both types of government expenditure. On the other hand, the variations in value of imports are mostly due to the oil revenue fluctuations and also the fluctuation in government development expenditures. The results from the VECM approach indicate that a significant part of LM2 variance is explained by the variance in oil revenue.

Olomola and Adejumo (2006), examined the effect of oil price shock on output, inflation, the real exchange rate and the money supply in Nigeria using quarterly data from 1970 to 2003. Using a VAR model they indicate that oil price shocks do not have substantial effects on output and inflation rate in Nigeria. However, oil price shocks do significantly influence the real exchange rates. The implication is that a high real oil price may give rise to wealth effect that appreciates the real exchange rate. This may squeeze the tradable sector, giving rise to the "Dutch Disease ".[2] They conclude that oil price shock is an important determinant of real exchange rates and in the long run money supply, while money supply rather than oil price shocks that affects output growth in Nigeria.

Farzanegan and Markwardt (2009), analyze the dynamic relationship between oil price shocks and major macroeconomic variables in Iran by applying a VAR approach. Their full sample comprises quarterly observations for the 1975:II-2006:IV period. Their main results examine the post-war period (1989:I–2006:IV) and for the robustness check, they compare these results with the pre-1989 period (1975:II–1988:IV). They analyze the effects of oil price shocks in three different channels: the supply side, the demand side, and the terms of trade. Their results on the supply side of economy reveal that positive oil price shocks stimulate Iranian industrial production and real imports. On the other hand, negative shocks on oil prices undermine the process of real industrial production and play a significant role in lowering the real level of imports. On the demand side, both positive and negative oil price shocks have inflationary effects and drive up the general level of prices. Their

[2] Economist use the term "Dutch disease" to describe a reduction in a country's export performance as a result of an appreciation of the exchange rate after a natural resource such as oil has been discovered (See Barder, 2006).

results show just a marginal impact of oil price fluctuations on real government expenditures. They conclude that increasing oil prices improves the terms of trade and appreciates the real effective exchange rate.

Mehrara and Oskoui (2007), study the sources of macroeconomic fluctuations in four oil-exporting countries using annual data: (Iran, 1970–2002; Indonesia, 1970–2002; Kuwait, 1972–2002; Saudi Arabia, 1971–2002). They use a structural VAR approach and by imposing long-run restrictions on a VAR model, four structural shocks are identified: nominal demand, real demand, supply, and oil price shocks. Their results show that oil price shocks are the main source of output fluctuations in Saudi Arabia and Iran, but not in Kuwait and Indonesia. They claim this is because of the relatively successful experience of Kuwait in the use of stabilization and savings fund and the right structural reforms particularly diversifying away from resource-based production in Indonesia.

Regarding to the differences in the results of the previous studies in this study I use two different groups of variables with two different time periods (quarterly and annually) to investigate the robustness and reliability of the results and to provide a more comprehensive base for comparison against different methodologies. For this purpose I use a variety of econometrics models (SVAR, VAR, VEC) to investigate the dynamic relationships and interactions among the variables.

3 Methodology

To reach the purposes of this study some helpful econometrics techniques such as vector autoregression model (VAR), vector error correction model (VECM) and structural vector autoregression model (SVAR) and some useful tools on these techniques such as impulse response functions and variance decomposition are used.

The linear dynamic vector autoregression (VAR) method has presented by Sims (1980). Sometimes, economic theory may not be adequate to determine the specific relationship between variables. According to Pindyck and Rubinfeld (1991), there are times when it is more logical to allow the data to specify the dynamics in a relationship. VAR makes little or no theoretical demands on the structure of the relationships in a model. VAR helps researchers to understand interrelationships among economic variables (Enders, 1996). Maddala (1992) notes that the VAR model is a critical starting point in the analysis of interrelationships among different time series. Darnell and Evans (1990) observe that the VAR model provides a straightforward method of producing forecasts that do not discern on how the variables in the model affect one another. The mathematical representation of a VAR is:

$$y_t = A_1 y_{t-1} + ... + A_p y_{t-p} + Bx_t + \varepsilon_t \qquad 1$$

Where y_t is a k vector of endogenous variables, x_t is a d vector of exogenous variables, $A_1,...,A_p$ and B are matrices of coefficients to be estimated, and ε_t is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right-hand side variables. Since only lagged values of the endogenous variables appear on the right-hand side of the equations, simultaneity is not an issue and OLS yields consistent estimates. Moreover, even though the innovations ε_t may be contemporaneously correlated, OLS is efficient and equivalent to GLS since all equations have identical regressors.

In the standard VAR, disturbances are generally characterized by contemporaneous correlations which it causes the response of the system to an innovation in one of the variables be the response of all those variables that are contemporaneously correlated with it. However, this contemporaneous correlation is purged by the Cholesky orthogonalization procedure.

For the first group of the variables in this study I use a Structural Vector Autoregressive (SVAR) modelling approach while for the second group of the variables, unrestricted Vector Autoregressive (VAR) and Vector Error Correction (VEC) models are used. The advantage of the SVAR over the other classes of vector autoregressive models is that it has better empirical fit and allows identifying structural shocks with respect to economic theory. Furthermore, SVAR also makes it possible to examine the net effects of unexpected change in one or more variables on other variables in the system (Chukuet al., 2011). SVAR models are more suited to track and identify structural shocks with respect to underlying economic theory (Chukuet al., 2011). Hence, sometimes it is necessary to impose relevant restrictions on the system of equations to retrieve structural shocks of the model. On the other hand, the unrestricted VAR models are sometimes superior to the structural VAR models since the latter models are "very often misspecified" (Tijerina-Guajardo and Pagán, 2003). The VAR model is a dynamic simultaneous equation system which is free of a prior restriction on the structure of the model. The VECM is basically a VAR system that builds on Johansen's test for cointegration and is usually referred to in the literatures as the restricted VAR. Indeed a vector error correction model (VEC) is a restricted VAR designed for use with non-stationary series that are known to be cointegrated. The VEC has cointegration relations built into the specification so that it restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. The main applied tools in the VAR and SVAR models estimation are the impulse response functions (IRFs) and the variance decomposition analyses (VDC).

The dynamic response of macroeconomic variables to innovations in a particular variable can be traced out using the simulated responses of the estimated VAR system (Impulse Response Functions (IRF)). Thus, the IRF allows us to examine the dynamic effects of shocks to a particular variable (for example oil revenues) on the other macroeconomic variables. Through IRF we can observe the magnitude and statistical significance of such responses to one standard deviation increase in oil market related variable error (see Stock and Watson, 2001 for more details on IRF). An examination of the entire system is studied by analyzing the variance decomposition of the system. A variance decomposition assigns the variance of forecast errors in a given variable to self-shocks, as well as those of the other variables in the VAR (Brown and

Yücel, 1999). The Choleski decomposition method is adopted, in order to construct the variance decompositions.

For the most part, the Cholesky procedure implicitly assumes recursivity in the VAR model as it is estimated. Although theoretical considerations may help in determining the order of the variables in the VAR model and ex-post sensitivity analysis may further help provide insights regarding appropriate ordering, it remains largely at the discretion of the modeller (Eltony and Al-Alwadi, 2001). To determine the appropriate number of lag length of the VAR model, following Judge at al. (1988) and McMillin(1988), I use the Akaike Information Criterion (AIC). The chosen lag length is one that minimizes the following:

$$AIC(n) = In \;\; \det \sum_{n} \; + (2d^2 n)/T \qquad 2$$

Where d is the number of variables in the model, T the sample size and $\sum_n$ an estimate of the residuals' variance-covariance matrix $\sum_n$ obtained with a VAR (n).

Furthermore in this study I use Augmented Dickey-Fuller and Phillips-Perron unit root tests in order to establish the order of integration of the variables.

4 Modeling and empirical results

In this study I will use two different groups of the variables. For the first group of the variables (including oil prices, oil revenues to GDP ratio and government total expenditures to GDP ratio) I use a Structural Vector Autoregression (SVAR) model and for the second group of the variables (including oil revenues, government total revenues, government current and capital expenditures, money supply and CPI) I use the unrestricted Vector Autoregression (VAR) and Vector Error Correction (VEC) models.

4.1 An SVAR model for the first group of the variables

By constructing a Structural Vector Autoregression model I want to know how oil revenues and government expenditures to GDP ratios respond to oil price shocks, and moreover hove government expenditures to GDP ratio responds to oil revenue shocks. My SVAR model for Iran contains three variables: oil prices (LOP_t), the ratio of the oil revenues to GDP (LOILRGDP) and the ratio of the government total expenditures to GDP (LTEGDP). All data are transformed to logarithms to eliminate the problem of heteroskedasticity (L represents the Log).

Three structural shocks are considered: oil price shocks ε_t^{OP} , oil revenue shocks ε_t^{OILR} and government total expenditure shocks ε_t^{TE}.

The three-component structural VAR model can be written as:

$$\begin{bmatrix} \Delta(LOP) \\ \Delta(LOILRGDP) \\ \Delta(LTEGDP) \end{bmatrix} = \begin{bmatrix} a_{11}(L) & a_{12}(L) & a_{13}(L) \\ a_{21}(L) & a_{22}(L) & a_{23}(L) \\ a_{31}(L) & a_{31}(L) & a_{33}(L) \end{bmatrix} \begin{bmatrix} \varepsilon^{OP} \\ \varepsilon^{OILR} \\ \varepsilon^{TE} \end{bmatrix} \qquad 3$$

Where A_i are matrices in the lag operator, L; a_{ij}'s are the estimated coefficients and L indicates a lag operator such that $L^k y_t = y_{t-k}$; $A_{ij}(L) = \sum_K A_{ijk} L^k$ denotes the sum of the moving average coefficients for (k=1,……,p) where p is the degree of the polynomial $A_{ij}(L)$ or the optimal lag order of the VAR model; and $\overline{\varepsilon}_t = \begin{bmatrix} \varepsilon^{OP} & \varepsilon^{OILR} & \varepsilon^{TE} \end{bmatrix}$ are the structural shocks.

Changes in our three variables of interest are functions of present and past values of the structural shocks. If all the variables are non-stationary integrated I (1) variables, stationary is obtained by taking first differences. A reduced form moving average (MA) representation can be written as:

$$\Delta Z_t = C(L) e_t \qquad 4$$

where Zt is a 3x1 vector containing oil prices, the ratio of the oil revenues to GDP and the ratio of the government total expenditures to GDP; $C(L) = \sum_{t=0}^{\infty} C_t L^t = C_0 + C_1 L + C_2 L^2 + ...$ is a 3x3 matrix of polynomials in the lag operator L and e_t is a 3x1 vector of the residuals.

With $e_t = A_0 \varepsilon_t$ I can identify the model with knowledge of A_0. There are nine elements in A_0. The variance-covariance matrix of $E(e_t e_t')$ provides six equations to solve for these nine unknowns and therefore, three restrictions are needed to be imposed on the model. I use the following three long-run restrictions:

1. Oil prices in the long-run are determined by world demand and supply. Thus, both oil revenues and government expenditures have no long run impact on oil prices:

$$a_{12} = a_{13} = 0 \qquad 5$$

$a_{12} = 0$ means oil revenues shocks have no long run effect on the oil price.

$a_{13} = 0$ means government expenditures shocks have no long run effect on the oil price.

2. Also oil revenues are exogenously determined. As a member of OPEC, Iran has no control over the price of its crude oil and at least theoretically

speaking cannot exceed its assigned production quota. Thus government expenditures have no long run effect on oil revenues[3]:

$$a_{23} = 0 \qquad 6$$

$a_{23} = 0$ means government expenditures shocks have no long run effects on oil revenues.

Equation (3) can be rewritten as:

$$\begin{bmatrix} \Delta(LOP) \\ \Delta(LOILRGDP) \\ \Delta(LTEGDP) \end{bmatrix} = \begin{bmatrix} a_{11}(L) & 0 & 0 \\ a_{21}(L) & a_{22}(L) & 0 \\ a_{31}(L) & a_{31}(L) & a_{33}(L) \end{bmatrix} \begin{bmatrix} \varepsilon^{OP} \\ \varepsilon^{OILR} \\ \varepsilon^{TE} \end{bmatrix} \qquad 7$$

Which is lower triangular.

By using the model 7, I will calculate variance decompositions. From variance decomposition results, I can examine how shocks to oil revenues affect the government expenditures. Moreover, I can see how both respond to oil price shocks.

In order to capture the effect of the Iran/Iraq war period (1980-1988) as an important structural break in Iran's economy an intercept shift dummy variable D(80) has been included in the model which D(80) is equal to 1 if (t>1980) and zero otherwise.

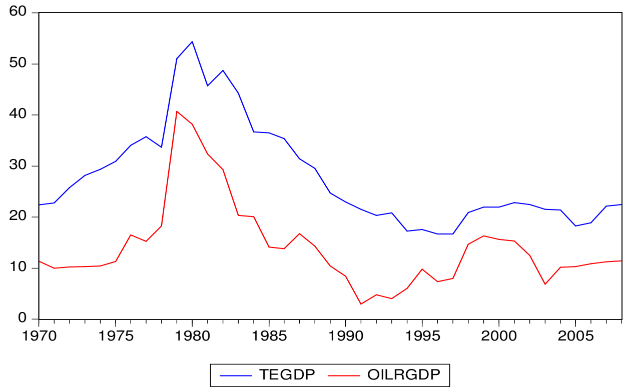
4.1.1 The results of the SVAR model for first group of the variables

Contingent on availability and quality of data for my SVAR model, I use annual data for the period 1970-2008 to investigate the short and long run relationship between oil revenues to GDP ratio (OILRGDP) and government total expenditures to GDP ratio (TEGDP) and also the effects of oil price shocks on this relationship in Iran. The data is obtained from the Central Bank of Iran (CBI) and the Energy Information Administration (EIA).

Figure 1 shows the ratios of government oil revenues to GDP and government total expenditures to GDP in Iran.

3 - Oil revenues depend on the production of oil and global oil prices. Global oil prices are determined to a great extent on international markets, but the level of oil production in Iran depends to some deal on the amount of domestic and foreign investments in oil fields, new extractions and the increasing capacity of current production. But I assume that in fact the amount of oil export is determined by OPEC and therefore oil revenues to a large extent are determined exogenously.

FIGURE 1
Ratios of Government total expenditures and oil revenues to GDP in Iran



The calculated raw correlation between government total expenditures and government oil revenues is about 0.88, indicating that oil revenues and government expenditures are highly correlated with each other in Iranian economy.

Unit root tests

I use the ADF (Dickey and Fuller, 1981) and Phillips-Perron tests in order to establish the order of integration of the variables. These tests include a constant but not a time trend, as recommended by Dickey and Fuller (1979). As illustrated in table 3, all of the variables are non-stationary in their level at five per cent and one per cent confidence levels. According to the results of Phillips-Perron and ADF tests all of the variables are integrated of order 1, i.e. I(1).

TABLE 3
ADF and Phillips-Perron unit root tests

Variable	ADF		Phillips-Perron	
	Level	1st diff	Level	1st diff
LOP	-2.24	-6.37***	-2.21	-6.37***
LOILRGDP	-1.88	-6.12***	-2.07	-6.12***
LTEGDP	-1.08	-5.19***	-1.36	-5.28***
Critical Value 1%	-3.61	-3.62	-3.61	-3.62
Critival Value 5%	-2.94	-2.94	-2.94	-2.94

***: Null hypothesis rejection at 1%

However, usually the question arises whether one should use the variables in the VAR (or SVAR) system in levels or in their differences. Generally speaking, if all the variables in the system are non-stationary, it is better to use a VAR in levels. On the other hand, estimating a VAR in the levels in the case of cointegration may lead to the neglect of important constraints. Doan et al. (1984) noted that differencing a variable is important in the case of Box-Jenkins ARIMA Modelling. Doan et al. also observed that it is not desirable to do so in VAR models. Fuller (1976) has also shown that differencing the data may not produce any gain so far as the asymptotic efficiency of the VAR is concerned even if it is appropriate. Moreover, Fuller has argued that differencing a variable throws information away while producing no significant gain. Therefore following the mentioned discussion in this study I use the level of the variables rather than their differences.

Variance Decompositions (VD)

Variance decomposition allows researchers to attribute the variation of different macroeconomic variables to the underlying shocks. Thus, VD provides information about the relative importance of each shock in affecting the variable in the VAR (SVAR).

According to Akaike Information Criterion (AIC), I choose 1 as the order of the SVAR model. Since the estimates of individual coefficients in VAR (SVAR) models do not have a straightforward interpretation, they are not reported here. For stability of my model the figure 2 shows the AR graph which reports the inverse roots of the characteristic AR polynomial (see Lütkepohl, 1991). The estimated VAR (SVAR) is stable (stationary) if all roots have modulus less than one and lie inside the unit circle. If the VAR is not stable, certain results (such as impulse response standard errors) are not valid (QMS, 2010). Figure 2 represents that my SVAR model is stable.

FIGURE 2
Inverse roots of AR characteristic Polynomial

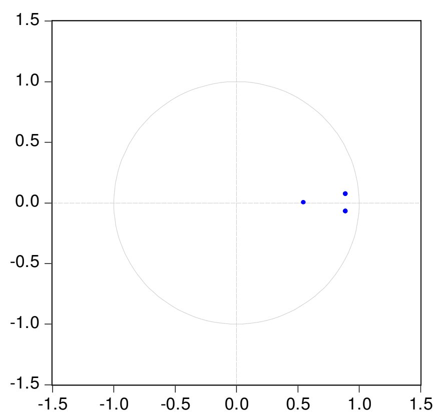


Table 4 shows the per cent of forecast error variance attributable to each shock. From this table we can see that for the most part, after ten years, about 83 per cent of the variance in oil prices and about 64 per cent of variation in oil revenues to GDP ratio are explained by the variables themselves that are inductive of their exogenous nature. Table 4 shows that for government total expenditures to GDP ratio in the first two years and for oil prices and oil revenues to GDP ratio in all years, the biggest portion of variations is typically explained by variables' own trend. This implies that the historical trend of each variable explains a large part of its own variations.

TABLE 4
Variance decomposition

	LOP	LOILRGDP	LTEGDP
Variance decomposition of LOP			
1 Year	100.00	0.00	0.00
2 Years	97.54	2.05	0.39
5 Years	88.37	9.07	2.54
8 Years	83.7	11.9	4.39
10 Years	82.18	12.52	5.28
Variance decomposition of LOILRGDP			
1 Year	5.95	94.04	0.00
2 Years	4.13	95.84	0.01
5 Years	15.56	83.79	0.64
8 Years	27.98	70.02	1.98
10 Years	33.28	63.82	2.88
Variance decomposition of LTEGDP			
1 Year	1.48	14.39	84.14
2 Years	1.19	26.88	71.91
5 Years	15.12	48.24	36.63
8 Years	31.73	47.52	20.73
10 Years	38.98	44.29	16.71

Oil price shocks play an important role in explaining the variation of oil revenues to GDP ratio and also the variation of government expenditures to GDP ratio in the long run (Its contributions in explaining the shocks to LOILRGDP and LTEGDP are about 34 and 39 per cent in 10th year).

Oil revenue shocks explain relatively big parts of the variations in the government expenditures to GDP ratio both in the short run and long run (almost 15 per cent after 1 year and 45 per cent after 10 years) indicating that government expenditure movements in Iran are heavily depended on oil revenue shocks so that in the long run the contribution of oil revenues in explaining the variations in government expenditures to GDP ratio is more than its own contribution in explaining its variations. Therefore a strong causality is running from LOILRGDP to LTEGDP.

Logically the contribution of government expenditure shocks in explaining the variations of the oil revenues to GDP ratio is very marginal. This implies that as I discussed before oil revenues in Iranian economy are determined exogenously.

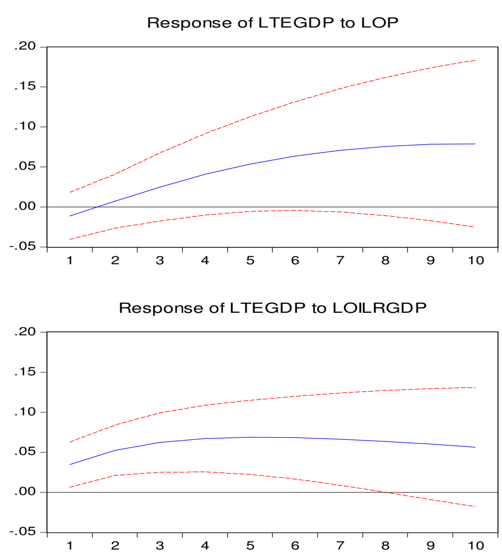
Also the results of the table 4 show that the contribution of oil revenue shocks in explaining the government expenditure variations is stronger than the contribution of oil price shocks in explaining government expenditure variations (in all periods). This means that oil revenue shocks are better contributors in explaining the variations in government expenditures. Therefore because of this reason and also because of the consistency of my time series data for the second group of the variables in this study I will use the oil revenue shocks as a proxy for oil shocks rather than oil price shocks.

Impulse response functions

In figure 3, the impulse response functions trace out the response of current and future values of the government expenditures to GDP ratio (LTEGDP) to a one standard deviation increase in the current value of oil prices and oil revenues errors. Runkle (1987) emphasizes the construction and report of confidence bands around the impulse responses in the VAR models. Following Sims and Zha (1999), 68% confidence intervals for the IRFs are estimated in this study. To build these confidence bands, 1000 Monte Carlos simulations are employed. The middle line in IRFs displays the response of each variable to a one standard deviation shock in impulse variable. The dotted lines represent confidence bands. When the horizontal line in the IRFs falls between confidence bands, the impulse responses are not statistically significant. In other words, the null hypothesis of "no effects of impulse variable shocks" on the specific variable cannot be rejected (Berument et al., 2010). The horizontal line in IRFs shows the time period after the initial shock. The vertical line in IRFs shows the magnitude of response to shocks. Figure 3, shows that the innovations to oil revenues are found to have statistically significant and positive effects on the government expenditures to GDP ratio (LTEGDP) for the first 8 years after shock. But the shocks to the oil prices can not affect LTEGDP significantly.

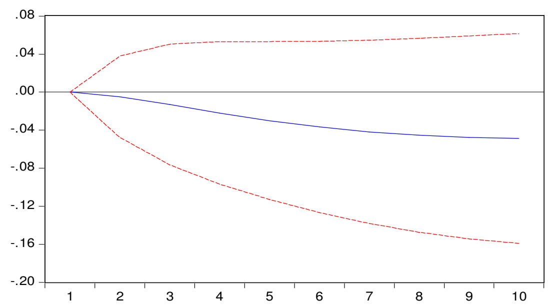
Most of the studies for considering the effects of oil shocks on the other macroeconomic variables have used the oil price as an impulse variable but sometimes their results are not consistent. In one hand some studies like Mork (1989), Hamilton (1996), Cunado and Perez de Garcia (2003) could find the significant effects of the oil price shocks on the macroeconomy, but on the other hand some other studies such as Darby (1982) and Hooker (1996) show the insignificant effects of oil price shocks on macroeconomic variables. According to the figure 3, my results show that in the case of a developing oil export based economy like Iran, using the oil revenue shocks for explaining the government expenditures variations can be better contributor rather than using oil price shocks.

FIGURE 3
Response of LTEGDP to Cholesky one S.D. Innovations



Furthermore, figure 4 represents the shocks to the government total expenditures don't have significant effect on the government oil revenues to GDP ratio. Therefore according to the results of figures 3 and 4, I can say that there is unidirectional causality from oil revenues to GDP ratio (LOILRGDP) to government total expenditures to GDP ratio (LTEGDP) in Iranian economy.

FIGURE 4
Response of LOILRGDP to Cholesky one S.D. LTEGDP Innovation



4.2 A VAR model for the second group of the variables

With considering the availability and the consistency of the existent data, I use a VAR model with six variables to examine the impact of oil shocks on the relationship between government revenues and government expenditures. I use the government expenditures in its disaggregated form by dividing it into two categories: government capital expenditures and government current expenditures[4]. The variables in the second model consist of one external shock measured by innovations in oil revenues (OILR), three policy variables, money supply (M2), government current expenditures (CURE) and government capital expenditures (CAPE) and two other key macroeconomic variables, government total revenues (TR) and the consumer price index (CPI). I use the logarithmic form of the variables; this can reduce the scale of the variables, which is a desirable quality when analyzing the time-series properties of the variables before their relationship can be established. In the VAR model, I will adopt the following ordering of the variables (L represents the Log); LOILR, LTR, LCURE, LCAPE, LM2, LCPI. The first variable in the Cholesky ordering is usually the variable with the largest expectation or the most evidence for exogeneity among the variables of the VAR system. This ordering, indicates that oil revenues have an influence on total revenues and then later on all other variables in the model. While the oil revenues are deeply depended on oil prices, then its behavior is the least determined by other variables included in the model. Oil prices and consequently oil revenues are largely determined by the world market conditions rather than within the

[4] - Capital expenditures are used to expand the current capacity of the government, while current expenditures try to preserve the current capacities of government administration.

Iranian economy. Also, this ordering reflects that government expenditures are largely determined by government revenues, which is a plausible assumption with regard to characteristics of Iran as a developing oil export based economy.

Unlike, Eltony and Al-Awadi, I set the government current expenditures before government capital expenditures. Following Farzanegan's discussion (2011) I assume that capital expenditures are more flexible than current expenditures (So the exogeneity of current expenditures is more than the exogeneity of capital expenditures). Farzanegan argues that current expenditures are needed to manage and maintain new investments which are financed by capital expenditures. Thus, they are to some deal inflexible and sticky downward. In the case of increasing oil revenues, the current expenditures also go up because of the larger size of government. When oil prices go down, however, the government is not able reduce the size of its activities immediately, leading to a significant budget deficit. By contrast Farzanegan(2011), claims that capital expenditures are sensitive to fluctuation of oil revenues.

Similarly I assume that money supply is determined by government expenditures and according to previous studies for Iran, I suppose that money supply and government expenditures and revenues are determinant factors for the domestic price level (CPI).

4.2.1 The results of the VAR model for the second group of the variables

For the second group of the variables in this study, I use quarterly data for the period 1990:2-2009:1. All data are from the central bank of Iran (CBI). In contrast to my earlier estimation period this period is not included the war between Iran and Iraq.

Unit root tests

As illustrated in table 5, all variables are non-stationary in their level at five per cent and one per cent confidence levels. The results show that ADF and Phillips-Perron t-values for all of the variables in level are greater than critical values. According to the results of Phillips-Perron test all of the variables are integrated of order 1, i.e. I(1), but the results of the ADF test show that while LCPI and LM2 are integrated of order 2, i.e. I(2) other variables are integrated of order 1, i.e. I(1).

TABLE 5
ADF and Phillips-Perron unit root test

Variable	ADF			Phillips-Perron	
	Level	1st diff	2nd diff	Level	1st diff
LOILR	-1.53	-9.3***	-	-2.63	-24.26***
LTR	-1.76	-9.03***	-	-2.02	-21.02***
LCAPE	-0.58	-4.76***	-	-1.74	-32.66***
LCURE	-2.07	-10.48***	-	-1.21	-30.66***
LM2	-1.76	-1.12	-22.59***	-1.28	-17.69***
LCPI	-2.11	-2.03	-4.73***	-2.23	-5.78***
Critical Value 1%	-3.52	-3.52	-3.52	-3.53	-3.53
Critical Value 5%	-2.9	-2.9	-2.9	-2.9	-2.9

***: Null hypothesis rejection at 1%

Variance Decompositions (VD)

According to the discussion which I had for the first model I use the level of the variables for the VAR model rather than their first differences. According to Akaike Information Criterion (AIC), I choose 2 as the order of my VAR model.

The next step is to estimate the VAR. The estimates of individual coefficients in VAR do not have a straightforward interpretation so they are not reported here. Also I have examined the diagnostic statistics of the estimated VAR model. For stability of my model Figure 5 shows the AR graph which reports the inverse roots of the characteristic AR polynomial (see Lütkepohl, 1991). This figure shows that in the VAR model all roots have modulus less than one and lie inside the unit circle and the VAR model is stable.

FIGURE 5
Inverse roots of AR Characteristic Polynomial

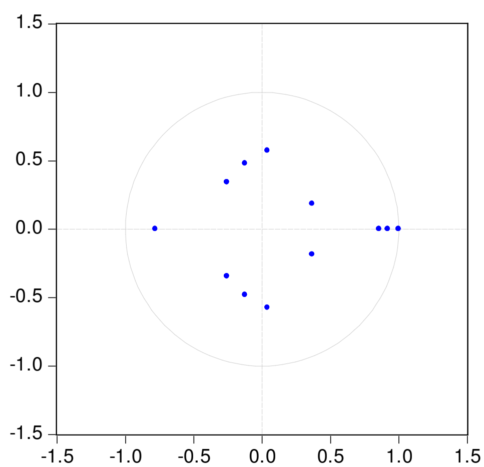


Table 6 presents the variance decomposition for the 10-quarters forecasts. Variance Decomposition separates the variation in an endogenous variable into the component shocks to the VAR. The table shows that almost for all of the variables the biggest portion of variations is typically explained by the variables' own trend in the first quarter. This implies that, at the beginning, the historical trend of each variable explains a large part of its own variations. The exception is for government total revenues (LTR), as about 77 per cent of its variations in the first quarter are explained by oil revenues. This can attribute to the highly dependency of government revenues on oil revenues. For the most part, after ten quarters, about 80 per cent of the variance in oil revenues is explained by the variable itself which is inductive of its exogenous nature.

The contribution of government current expenditure shocks to government total revenue shocks was about 2 per cent in the fourth quarter rising marginally to about 3 per cent in the tenth quarter. Also shocks to government capital expenditures contributed an average of 1.15 per cent to total government revenue shocks over from the 8th quarter to the 10th quarter. This implies that government revenues in Iran are highly depended on oil revenues and the variations in government expenditures (both capital and current) cannot contribute to the government revenues variations significantly, therefore the causality which is running from government expenditures to government revenues is expected to be very weak. Also the contributions of money supply and LCPI in explaining the shocks to the government revenues are negligible.

The big part of the variations in government capital expenditures is explained by itself in all quarters. However the shocks to government total revenues also affect the shocks to the government capital expenditures very significantly. As evidenced in table 6, shocks to government total revenues explained about 14 per cent of shocks to the government capital expenditure in the 1st quarter increasing to about 35 per cent in 10th quarter. This implies that a considerable causality can exist from government revenues to government capital expenditures. In addition to the results show, government current expenditures and money supply variations are relatively significant contributors to forecast errors in government capital expenditures.

Looking at the variance decomposition of government current expenditures, it is apparent that a noticeable part of its variance is explained by the variance in government total revenues (about 65 per cent in 10th quarter). This shows that there is a strong causality running from government total revenues to government current expenditures. Also the results indicate that oil revenues are important contributors to forecast errors in government current expenditures.

An interesting point is that oil revenue variations can explain a larger share of current expenditure movements compared to capital expenditure movements, indicating that the shocks to oil prices and consequently oil revenues mostly affect the government current expenditures rather than its capital expenditures. Also the contribution of government total revenue shocks in explaining the shocks to LCURE is more than its contribution in explaining the shocks to LCAPE. This result is to some extent in opposition to my earlier assumption and Farzanegan's discussion (2011) for considering the capital expenditures more flexible than the current expenditures. Maybe this is because we need to consider the effects of oil shocks asymmetrically. In other words: maybe we need to distinguish between positive and negative oil revenue changes. Because the government current expenditures are only sticky downward but in the case of increasing oil revenues, the current expenditures also go up because of the larger size of government. So in the case of increasing oil revenues the government current expenditures have possibility to be flexible even more than capital expenditures. An alternative explanation is that the government capital expenditures are often allocated to long run projects and government defines the financial resources of these projects beforehand. This can to some deal decrease the effects of the current situation and current oil revenue shocks on this kind of expenditures, while the current expenditures can be more affected by current changes in revenues.

Shocks to LCPI have insignificant contributions to both government current and capital expenditure variations in all periods. LCPI shocks contributed about 0.4 and 0.8 per cent respectively to government capital and current expenditure shocks in 10th quarter.

Moreover, forecast errors in money supply other than its own variations are mostly due to variations in government total revenues and government current expenditures. The implication of this result is that money supply is highly influenced by government revenues and government current expenditures in Iran.

For LCPI, the largest source of shocks in ending quarters was changes in government total revenues, which contributed about 38 per cent in the 8th quarter and about 46 per cent in the 10th quarter. The contribution of government current expenditure shocks to LCPI violability was about 13 per cent on average in the 8th and 10th quarters and this is considerable. Also shocks to money supply, explained about 25 per cent of shocks to the LCPI in the 4th quarter declining in effects to about 13 and 10 per cent in 8th and 10th quarters. The implication of this finding is that government total revenues, government current expenditures and money supply are important determinants for inflation in Iran. According to the table 6 in the short run (first quarter) after its own variations the money supply variations are the most important factors in determining the shocks to the price levels in Iran, while in the long run (after 10 quarters) government total revenues and government current expenditures are respectively the most important factors.

TABLE 6
Vector autoregression (VAR) estimates variance decomposition

	LOILR	LTR	LCURE	LCAPE	LM2	LCPI
Variance decomposition of LOILR						
1/QTR	100.00	0.00	0.00	0.00	0.00	0.00
4/QTR	87.19	6.12	1.4	1.76	0.57	2.93
8/QTR	81.48	11.4	1.7	1.73	0.71	2.95
10/QTR	80.02	12.88	1.74	1.72	0.7	2.91
Variance decomposition of LTR						
1/QTR	77.18	22.81	0.00	0.00	0.00	0.00
4/QTR	53.98	39.44	2.04	1.12	1.61	1.78
8/QTR	42.97	50.07	2.92	1.15	1.33	1.53
10/QTR	40.14	52.99	3	1.15	1.26	1.43
Variance decomposition of LCURE						
1/QTR	11.56	30.43	58	0.00	0.00	0.00
4/QTR	8.17	49.88	37.84	0.74	2.53	0.82
8/QTR	6.76	61.07	28.44	0.72	2.23	0.75
10/QTR	6.2	64.06	25.92	0.72	2.22	0.84
Variance decomposition of LCAPE						
1/QTR	0.09	13.37	15.93	70.59	0.00	0.00
4/QTR	1.42	25.31	23.05	45.05	5.05	0.08
8/QTR	1.61	33.05	21.1	38.96	4.97	0.28
10/QTR	1.61	34.83	20.56	37.66	4.86	0.45
Variance decomposition of LM2						
1/QTR	1.87	20.14	19.15	0.13	58.68	0.00
4/QTR	3.71	33.88	14.66	1.21	42.97	3.55
8/QTR	2.53	54.94	10.36	0.86	28.07	3.21
10/QTR	2.26	61.26	8.99	0.8	23.61	3.05
Variance decomposition of LCPI						
1/QTR	0.00	5.27	5.28	3.26	15.13	71.04
4/QTR	2.41	14.12	13.74	2.79	24.74	42.17
8/QTR	2.31	37.7	13.77	2.68	12.65	30.87
10/QTR	2.27	45.98	12.85	2.63	9.79	26.45

Impulse response functions

In Figure 6, the impulse response functions trace out the response of current and future values of the variables to a one standard deviation increase in the current value of oil revenues errors. Following Sims and Zha (1999), 68% confidence intervals for the IRFs are estimated in this study. To build these confidence bands, 1000 Monte Carlos simulations are employed.

Figure 6 shows that the innovations to oil revenues are found to have statistically significant and positive effects on oil revenues, total revenues and marginally government current expenditures only in the first quarter but in the long run these effects are insignificant. The responses of other variables to a shock in oil revenues are not statistically significant.

FIGURE 6
Response to Cholesky One S.D. Innovation in Oil Revenues

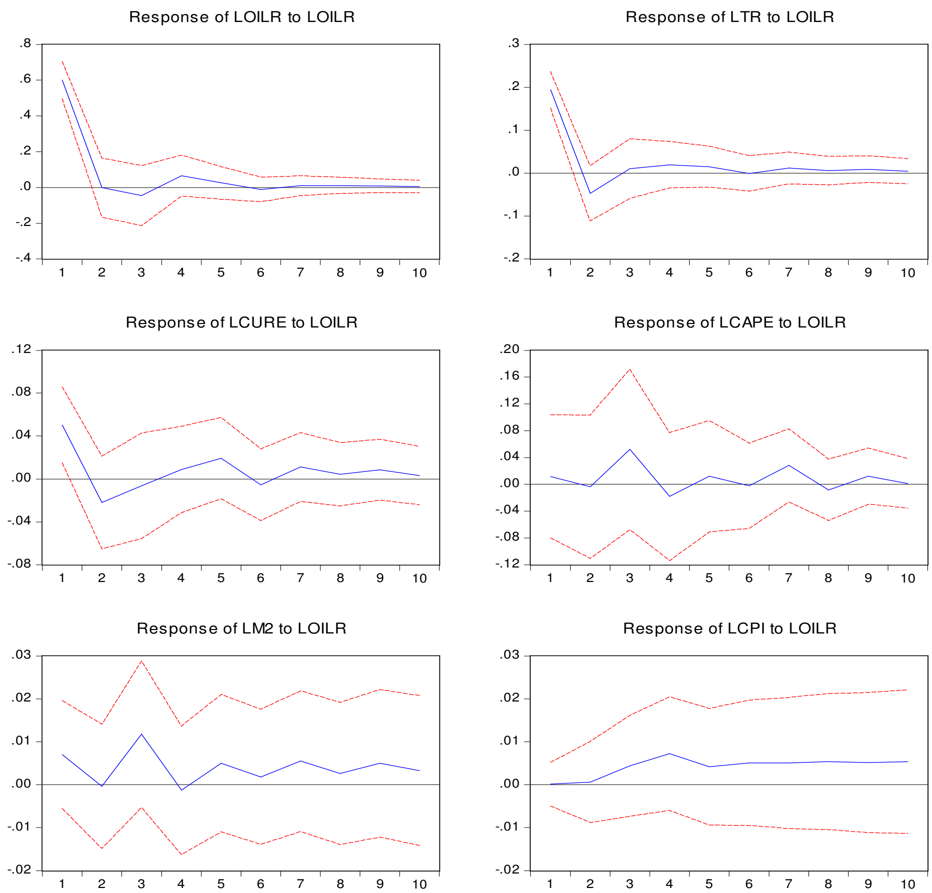


Figure 7 demonstrates that a one standard deviation increasing shock in government total revenues accompanied by positive and statistically significant responses in government total revenues, government expenditures (current and capital), money supply and LCPI. This implies that the causality runs from government total revenues to government expenditures (both current and capital). While the positive response of LCPI is slightly significant in the short run but after the third quarter it is becoming more significant.

Looking at the figures 6 and 7 reveals that it is not the oil revenue shocks themselves but the response of government total revenues to them that causes fluctuations in aggregate economic activity.

FIGURE 7
Response to Cholesky One S.D. Innovation in Government Total Revenues

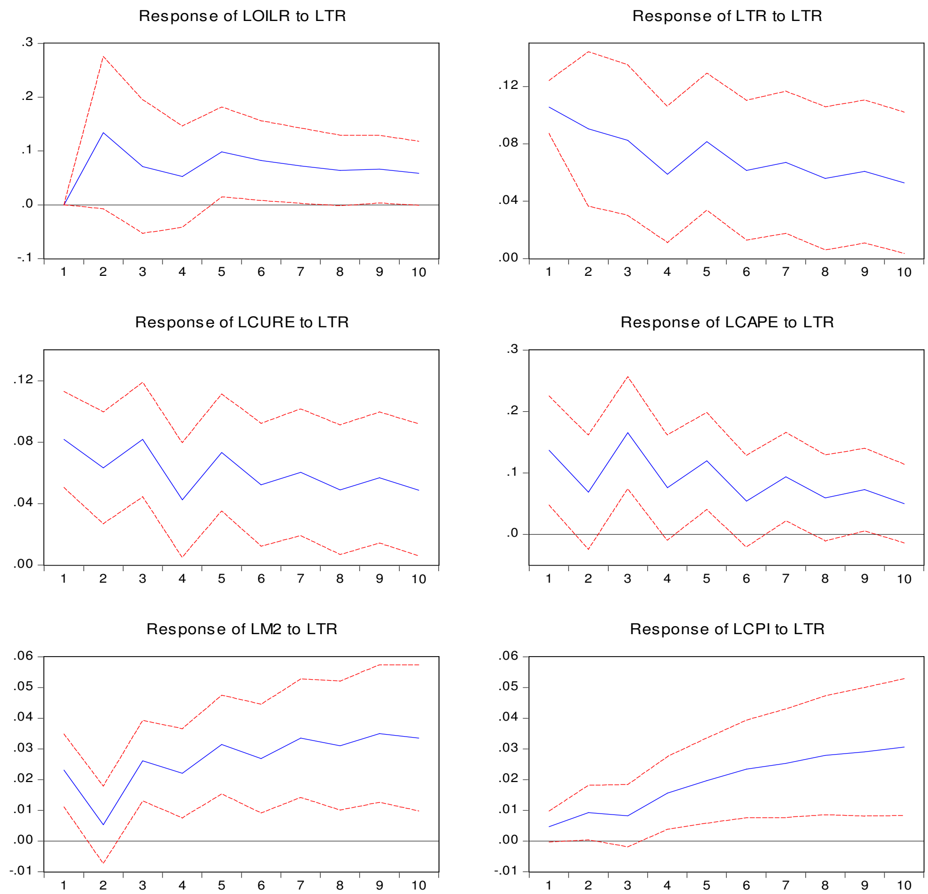
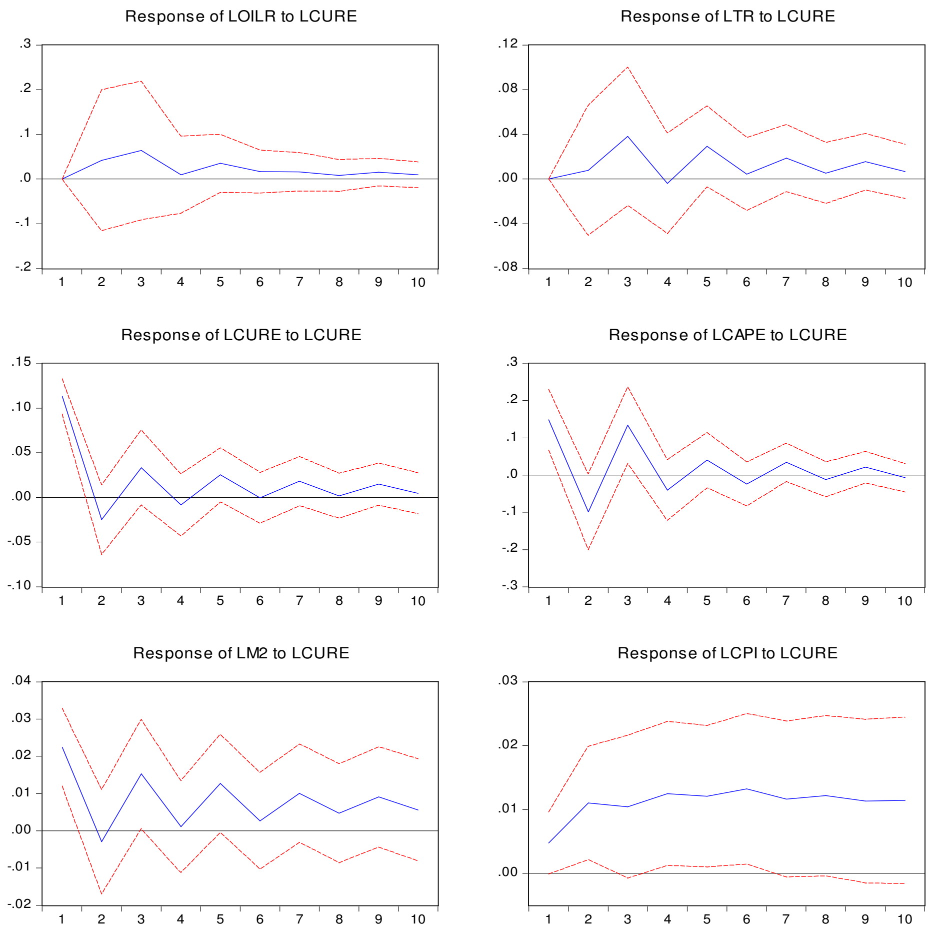


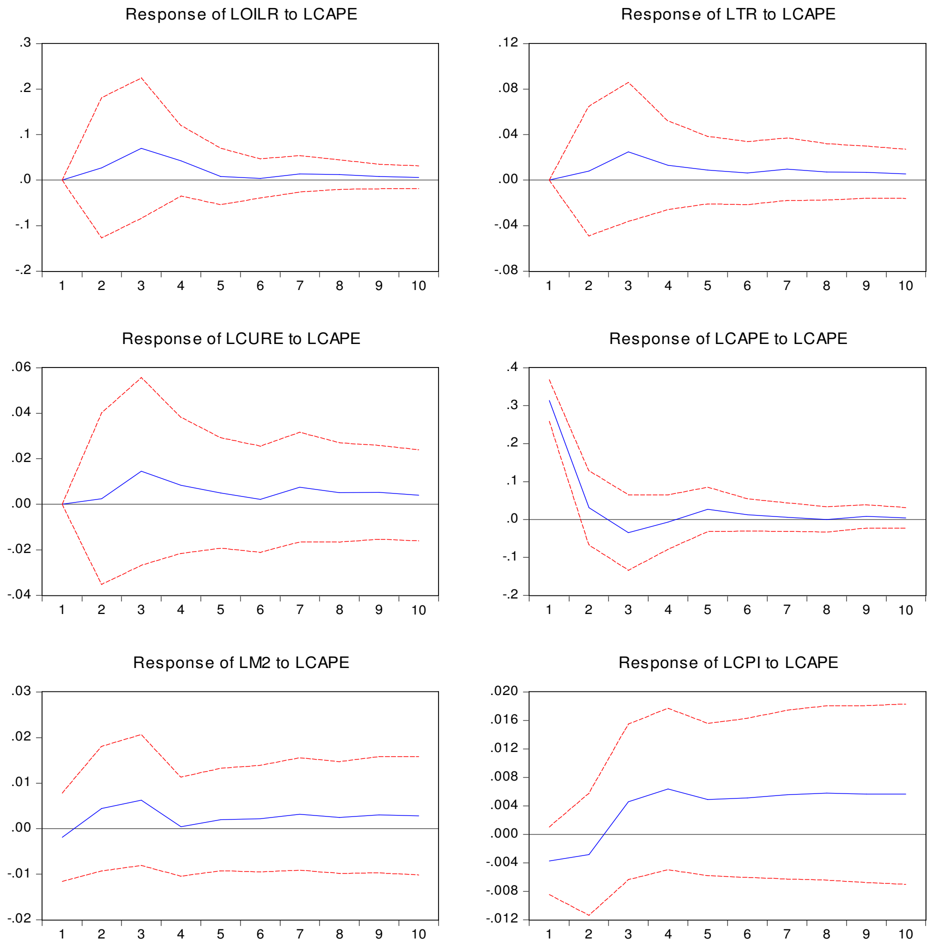
Figure 8 shows the innovations to government current expenditures have not significant effect on oil revenues and the government total revenues. This is plausible because the oil revenues are determined exogenously and government total revenues are heavily depended on oil revenues, thus government expenditures cannot affect them significantly. Also the results indicate that government capital and current expenditures and money supply respond to the innovations to government current expenditures positively but only significant at the first quarter and then, die out. The positive response of LCPI remains slightly significant for the first 7 quarters after initial shock and then disappears. This implies that government current expenditures are important in determining the domestic price levels.

FIGURE 8
Response to Cholesky One S.D. Innovation in Government Current Expenditures



The result of Figure 9 shows the innovations to government capital expenditures have positive and significant effect on its own variation but they have not significant effects on other variables of the study. According to this figure there is not causality from government capital expenditures to government total revenues. Moreover the government capital expenditures variations are not significant in explaining the money supply and domestic price changes.

FIGURE 9
Response to Cholesky One S.D. Innovation in Government Capital Expenditures



As the main purpose of this study the results of the impulse response functions imply that the innovations in government revenues significantly affect the government expenditures (both current and capital) in Iran, while the innovations in government expenditures cannot affect the government revenues significantly. Because the government revenues in Iran are deeply affected by oil revenues and government expenditures could not have a significant role in explaining the variations in government revenues. Therefore in the VAR model of this study the results of the impulse response functions confirm the results of the variance decomposition indicating that there can be unidirectional causality from government revenues to government expenditures (both capital and current) in Iranian economy.

4.2.2 The results of the VECM for the second group of the variables

The other area of debate is whether an unrestricted VAR should be used where the variables in the VAR are cointegrated. There is a body of literature that supports the use of a vector error correction model (VECM), or cointegrating VAR, in this situation. It is shown through Monte Carlo simulations that short run forecasting performance of unrestricted VAR models are better than VECM performance (Farzanegan and Markwardt, 2009). Vector error correction (VEC) model is a restricted version of the VAR model. If there is cointegration, imposing this restriction will yield more efficient estimates (Naka and Tufte, 1997). However as the robustness of my results for the second group of the variables in this study, I will try to use the VEC model and compare its results with the results of the unrestricted VAR model.

Since the VEC specification only applies to cointegrated series, I should first run the Johansen cointegration test to determine the number of cointegrating relations. If I rely on the results of the Phillips-Perron unit root test in table 1, I can say that all of the variables are non-stationary and integrated of order 1. A vector of variables integrated of order one can be cointegrated if there exists linear combination of the variables, which are stationary. Following the approach of Johansen and Juselius (1990) two likelihood ratio test statistics, the maximal eigenvalue and the trace statistic, were utilized to determine the number of cointegrating vectors. The results of the maximal eigenvalues and trace test statistics are presented in table 7.

The test statistics indicate that the hypothesis of no cointegration among the variables can be rejected for Iran. The results reveal that at least two cointegrating vectors exist among the variables of interest. Therefore, a vector error correction model is justified. On the basis of Johansen's test, a Vector error correction model (VECM) was estimated. Using the same variables which were used in the VAR model, two co-integrating equations were estimated. Again, since the results of estimating the VECM do not have a direct interpretation, they are not reported here.

TABLE 7
Tests for Cointegration

	Maximum eigenvalue statistic		Trace Statistic	
Rank	Max-Eigen Statistic	0.05 Critical Value	Trace Statistic	0.05 Critical Value
r=0	49.10*	40.07	122.19*	95.75
r≤1	34.10*	33.87	73.09*	69.81
r≤2	19.41	27.58	38.98	47.85
r≤3	10.62	21.13	19.56	29.79
r≤4	8.31	14.26	8.94	15.49

*: denotes rejection of the hypothesis at the 0.05 level

The variance decomposition results corresponding to the estimated VECM are presented in table 8. They are based on the same ordering as was used in the VAR. Comparing these results with the results of the VAR model shows that the role of shocks to the oil revenues in explaining the shocks to the other variables has become more significant in the long run. The shocks to oil revenues can explain about 89, 50, 8, 9, 12 and 9 per cent of shocks respectively to oil revenues, government total revenues, government current expenditures, government capital expenditures, money supply and LCPI in the 10th quarter for the VEC model, while in the case of VAR variance decomposition (as presented in table 6), these percentages were respectively about 80, 40, 6, 1.6, 2 and 2.

Moreover, comparing the VEC variance decomposition results with the VAR variance decomposition results show that in the case of VAR the contributions of shocks to government total revenues in explaining the shocks to LOILR, LTR, LCURE, LM2 and LCPI in 10th quarter are more significant. The exception is for LCAPE which in the case of VECM, the contribution of government total revenues variations in explaining its variations is more significant.

These results can imply that in the VEC model which the long-run behavior of endogenous variables is restricted to converge to their cointegration relationships, oil revenue shocks can affect the other macroeconomic variables more directly while in the VAR model this influencing has changed to be more through the total revenues channel. The estimates of variations for government expenditures and government revenues in the VEC model in compare to VAR indicate that oil revenues have a more leading role in explaining the fiscal policy stance.

Considering the shocks to the government revenues and expenditures as the main purpose of this study reveals that in the VEC model similar to VAR model the contributions of government capital and current expenditures in explaining the movements in government total revenues are slight, but the contribution of government revenue shocks in explaining the shocks to the government expenditures (both capital and current) is very considerable. Also this again indicates that the strong causality is running from government revenues to government expenditures (both current and capital) in Iranian economy while the evidence for the reverse causality is very weak.

Moreover, table 8 shows that for money supply in the short run, the largest sources of shocks after its own variations are government current expenditures and government total revenues, but in the long run in addition to them also the importance of government capital expenditures, oil revenues and LCPI in explaining the shocks to money supply are increasing (While in the case of VAR model the contribution of total revenues was strongly significant and the contribution of oil revenues was almost negligible).

In addition the results of the VEC model show that the sources of the variations in LCPI are distributed among all of the variables. In other words, in the long run in addition to its own variation, the variations in LCURE, LCAPE, LOILR, LM2 and LTR are significant contributors in explaining the shocks to LCPI. These are consistent with some studies about the determinants of Iranian inflation which indicate that inflation in Iran can be a monetary phenomenon and moreover government expenditures can increase the aggregate demand and consequently cause the inflation.

The contributions of oil revenues, government capital and current expenditures and LCPI movements to LCPI shocks in VEC model compare to the VAR model are more significant. Generally, the VEC model shows a relatively higher degree of statistical significance. Theoretically, this is because it yields a closer interaction between macroeconomic variables than what the VAR indicated.

TABLE 8
Vector error correction (VEC) estimates variance decomposition

	LOILR	LTR	LCURE	LCAPE	LM2	LCPI
Variance decomposition of LOILR						
1/QTR	100.00	0.00	0.00	0.00	0.00	0.00
4/QTR	90.74	2.53	1.87	3.5	0.31	1.03
8/QTR	88.8	2.57	2.39	4.53	0.46	1.22
10/QTR	88.45	2.77	2.64	4.4	0.41	1.29
Variance decomposition of LTR						
1/QTR	79.15	20.84	0.00	0.00	0.00	0.00
4/QTR	60. 81	31.38	2.7	1.92	2.62	0.52
8/QTR	51.92	37.34	5.2	2.01	2.87	0.64
10/QTR	49.46	39.1	6.04	1.83	2.86	0.68
Variance decomposition of LCURE						
1/QTR	12.84	33.2	53.95	0.00	0.00	0.00
4/QTR	11.33	47.51	29.8	1.91	5.58	3.85
8/QTR	8.45	56.67	25.01	2.4	4.89	2.55
10/QTR	7.71	60.07	23.29	2.26	4.46	2.18
Variance decomposition of LCAPE						
1/QTR	0.09	16.82	13.94	69.12	0.00	0.00
4/QTR	6.11	29.83	14.05	41.23	7.27	1.48
8/QTR	8.24	39.68	11.36	29.52	9.5	1.68
10/QTR	8.69	42.95	10.12	26.54	9.83	1.83
Variance decomposition of LM2						
1/QTR	1.09	12.49	16.52	0.81	69.06	0.00
4/QTR	8.86	17.67	15.75	11.12	42.88	3.69
8/QTR	11.47	21.24	14.71	12.98	34.16	5.41
10/QTR	11.87	21.71	14.18	13.06	33.32	5.84
Variance decomposition of LCPI						
1/QTR	0.05	1.9	6.95	7.21	11.62	72.24
4/QTR	3.55	4.35	23.51	6.02	15.75	46.79
8/QTR	7.49	6.22	25.79	12.15	8.95	39.37
10/QTR	8.27	6.49	26.12	13.2	7.84	38.04

5 The Iranian economy, sanctions and the political implications of this study

The most recent external challenges of the Iranian economy are U.S and U.N sanctions against the Iranian nuclear program[5]. The Iranian oil industry has been plagued by the sanctions during the last years. Structural upgrades and access to new technologies, such as natural gas injections and other enhanced oil recovery efforts, have been limited by a lack of investment partly due to U.S. sanctions (Ilias, 2010). More recently, the United States has focused on targeted financial measures to isolate Iran from the U.S. financial and commercial system[6]. Also the United States has enforced sanctions to reduce the development of Iran's oil industry and constrain Iran's financial sources. The purposes of the recent sanctions are to change the Iranian government policies regarding to its nuclear program (as the United States claims).

Some analysts believe that such sanctions will cause to Iran's growing international trade and financial isolation while some others assert that sanctions are not effective at promoting policy change in Iran and they will hurt the United States and other countries' economies which are sending these sanctions.

Economists have argued long and for many reasons that sanctions do not work (see van Bergeijk 2009, Chapter 6 and 7 for a review of the literature). First, it is hardly possible to make necessary political unity for forceful sanctions. Second, the lapse of time between the decision to use the economic sanctions and their actual bureaucratic implementation presents the target country the possibility to adjust and circumvent the sanctions. Third, the empirical evidence showed a rather low success rate[7].

Bergeijk (1989, 2009) shows that a sanction simply cannot be expected to succeed if, for example, economic linkages are too low so that no or hardly any damage can ever be done. He states that two basic premises belong to the core of economic science. First, boycotts and embargoes deprive the sanctioned economy from (some of) the gains from international trade and investment, and consequently sanctions reduce welfare. Second, the idea that (the mere threat of) this disutility influences the victim's behavior can also be traced to the tenets of economic catechism.

The findings of the impulse response function for the SVAR model in this study show that the government total expenditures to GDP ratio responds positively and statistically significantly to shocks in oil revenues. The policy

[5] - U.S and U.N declare that Iran's uranium enrichment activities are for the development of nuclear weapons. Iran asserts that the purpose of her uranium enrichment program is to produce fuel for nuclear power reactors and not for developing the nuclear weapons. (Katzman, 2012).

[6] - U.S. efforts to shout Iran out of the international banking system. These efforts have been implemented by the Treasury Department through preventing Iran from accessing the U.S. financial system (on November 6, 2008 the Treasury Department barred U.S. banks from handling any indirect transactions with Iranian banks) and also using punishments to pressure firms to cease doing business with Iran (Katzman, 2012).

[7] - Bergeijk, 2009.

implication of this result is straightforward. Sanctions that succeed in restricting the Iranian government's oil export capacities and consequently oil export revenues may affect the government total expenditures as an important engine for developing the Iranian economy.

The results of my VAR model offer additional insights as the focus is on the government total revenues channel. According to the results of the impulse response functions for the VAR model, although the oil revenue shocks have positive and significant effect just on the government current expenditures and only in the first quarter, the findings show that there is strongly unidirectional causality from government total revenues to government current expenditures (and also to government capital expenditures). Regarding to the sticky downward current expenditures in Iran from the policy point this result is important[8]; if the sanctions decrease the Iranian oil revenues, the government total revenues will decline and this will deteriorate the budget deficit of the government and impose inflationary pressures on the whole economy.

Decreasing in government revenues and consequently government expenditures will strongly influence the welfare and subsidization programs of the government. Subsidies on gasoline and other essential products are part of income redistribution programs in Iran which are highly depended on government revenues. My results for both VAR and VEC models show that government current expenditure variations which are caused by the shocks to oil revenues and also government total revenues are stronger than government capital expenditure variations. Regarding to the composition of government current expenditures, this result indicates that the Iranian people may sense the pressures of the sanctions very early and severe[9]. The decreases in government revenues will cause decreases in government payments to its employees (as a big portion of the Iranian households) and also financial resources for financing the issues related to health, education, pensions and social security. This can damage the Iranian people's standard of life.

Moreover as the results of the VAR and VEC models indicate, decreases in government revenues due to the sanctions may decrease the capital expenditures significantly which are mostly used for developing the infrastructure of the economy and expanding the current capacity of the government. This will reduce the government's investments in oil and non-oil sectors of the economy and as a result will damage the process of the economic growth and development of the country in the future years. This process may take time and therefore the sanctions may take some time to start biting (see also Bergeijk and Marrewijk, 1995).

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[8] - With respect to the importance of the items inside the government current expenditures, the government always tries to keep the current expenditures in their high level even in the case of a negative oil market to avoid the public discontent.

[9]- Current expenditures include the following items: expenditures on goods and services such as wage bills of government employees, employer contribution including social security and pensions, interest payment, subsidies and all other payments which relate to the management of government functions in military, health, education, cultural, and social activities. The government invests and creates new capacities in infrastructure services and public goods through the capital or development expenditures. (Farzanegan, 2011).

However, finally I should add that the effectiveness of sanctions remains depended on two main points[10]. First, to what extent other countries will support U.S and U.N on the sanctions against the Iranian oil exports and reduce the importing oil from Iran. Second, to what extent the Iranian government will be able to find new markets and new customers for its exporting oil.

During the past years Iran has tried to shift her trading relationship from western countries to the developing world mostly China, India, Jupon and South Korea to improve her bargaining power on her exporting oil and also to decrease the damage of the sanctions from the western countries. Against the recent sanctions Iran has tried to create some attractions for her exporting oil by presenting some special discounts and facilities for the customers. Iran also has started to privatize some of the state-run oil and gas companies. Privatization of these energy companies can make it easier for investors to circumvent U.S. sanctions, which complicate investors' ability to engage in business transactions with Iran directly.[11]

6 Summary and conclusions

In this study I re-examine an important topic— the nexus between government expenditure and government revenue—in the area of the public economies. Taking into account the heavily dependency of government expenditures on oil revenues in Iranian economy as a developing oil export based economy I try to take different approach to this issue by considering the effects of oil shocks on the dynamic relationship between government expenditures and government revenues. For this purpose I use two different groups of the variables.

For the first group of the variables (including oil price, oil revenues to GDP ratio, government total expenditures to GDP ratio and a dummy variable for capturing the effects of war between Iran and Iraq) I employ a SVAR model by imposing three long run restrictions to estimate the dynamic relationship among these variables using annual data for the period 1970-2008. The results of the variance decomposition analysis indicate that both oil price shocks and oil revenue shocks have considerable contributions in explaining the shocks to government total expenditures ratio to GDP however the ability of oil revenue's variations in explaining the shocks to the government total expenditures to GDP ratio is much better than the ability of oil price shocks. Moreover the results of the impulse response functions show that the shocks to oil revenues have statistically significant and positive effects on government total expenditures to GDP ratio, while the shocks to the government total expenditures don't have significant effect on the government oil revenues to

[10] - Effectiveness, however, is not a sufficient condition for success (Bergeijk, 2009). Considering the UN sanctions against the Iraqi occupation of Kuwait shows that although these sanctions were effective in delivering economic damage to Iraq but they were not successful in changing the Iraqi policy. And eventually they were followed by military intervention of 'Desert Storm'.

[11] - Ilias, 2010.

GDP ratio. This indicates that there is unidirectional causality from oil revenues to GDP ratio to government total expenditures to GDP ratio in Iranian economy.

For the second group of the variables (including oil revenues, government total revenues, government current and capital expenditures, money supply and CPI), I use unrestricted VAR and VEC models with respect to their special characteristics employing quarterly data for the period 1990:2-2009:1. The results of the VAR model show that the variations in government total revenues and government current expenditures are sensitive to the shocks to oil revenues. The findings for both VAR and VEC models are representing that there is unidirectional causality from government total revenues to government expenditures (both current and capital). Because of the special characteristic of VEC models in restricting the long-run behavior of the variables, my findings show that in the case of VEC, oil revenue shocks can affect the other macroeconomic variables more directly and strongly while in the VAR model this influencing has changed to be more via total revenues channel. An unexpected result is that the variations in government current expenditures caused by the shocks to oil revenues and total revenues are stronger than the variations in government capital expenditures caused by the mentioned resources. This indicates that oil revenue fluctuations may affect the standard of life of the Iranian people which are mostly the government employees. As another result of this study, both VAR and VEC models confirm the results of the previous studies indicating that money supply, government revenues and government expenditures can be important determinants in explaining the Iranian domestic prices.

These results suggest that fiscal policy appears to be effective in Iran as the oil shocks impact government expenditure and then government expenditure accounts for a relatively considerable part of the CPI and money supply variations.

From the political view the results of this study show that those sanctions aiming to restrict the Iranian government's oil export revenues, potentially can affect the government total expenditures as an important engine for developing the Iranian economy, but in reality this will remain depended on the ability of the Iranian economy in circumventing the sanctions.

Overall my results support the revenue-spending hypothesis for Iran. In this context Iran should enhance the effectiveness of fiscal policy by making budget expenditure less driven by revenue availability. This policy can help to avoid the costs and instability that variations in public spending generate mostly due to the fluctuations in oil revenues. The expenditures can be planed and isolated from volatile short-term revenue availability by using a medium-term expenditure framework. Moreover the Iranian government should reduce the dependence of its expenditures to oil revenues by financing these costs through nonoil sources such as taxes.

Another policy implication of the results reported in this study is that the Iranian government should vigorously pursue the independence of the Central Bank of Iran (CBI). With an independent CBI the oil stabilization fund can mitigate inflationary effects of the oil revenue shocks much better and protect the annual state budgets from external shocks. Moreover, Iran should use the oil revenues to develop the other sectors of her economy to reduce her deeply reliance on oil revenues in the future. The diversification of non-oil exports can reduce the adverse effects of oil price fluctuations (Faraji Dizaji, 2012).

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