

**Oil Price fluctuations and their Impact on the
Macroeconomic Variables of Kuwait:
A Case Study Using VAR Model for Kuwait**

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Abstract

Oil price fluctuations are a major source of disturbance for the economies of oil producing countries. In this study, a vector Autoregression Model, Vector Error Correction Model and Structure VAR Model were all estimated using seven key macroeconomic variables for state of Kuwait. A quarterly data were for the period 1984:1 – 1998:4 for those seven variables which were used to estimate the various models.

All three estimated models indicate a high degree of interrelation between major macroeconomic variables. The results also highlighted the causality running from the oil prices and oil revenues, and government development and current expenditure, towards other variables. The most striking result is that government fiscal stimuli is the main determinant of domestic prices, while monetary stimuli have the least results. The policy implication of this is that fiscal policy can be used more effectively to stabilize the domestic economy after an oil shock.

I. Introduction

The effects of the oil boom after 1973 on the economies of the GCC have been extremely mixed, though on balance many of the regional governments might look back on the period 1973-86 as a dubious blessing. Income on the oil account certainly rose rapidly, but so did price inflation, wage rates and reliance on foreign labor. Above all, the growth of the oil sector as a contributor to national income tended to reduce the role on non-oil sectors to insignificance in most states of the GCC. This has been termed in the literature by "the Dutch Disease". Dramatic rises in per capita income were the fruits of rising oil revenues alone, even in the case of the larger more diversified economies of the Gulf such as Iran, Al-Abbasi (1991).

There is a great deal of theoretical and empirical literature scrutinizing various aspects of the Dutch Disease economies such as Cordon and Neary (1982), Neary and van Wijnbergen (1986), Corden (1984), Fardmanesh (1991) Wijnbergen (1984) Bjerkholt and Offerdal (1985), Neary and van Wijnbergen (1986), Gelb and Associates (1988) and Taylor, Yurukoglu, and Chaudhury (1986) .

Also, several interesting empirical studies have been recently published on GCC Countries. Taher (1987) studied the impacts of changes in the world oil prices on the different sectors of the Saudi economy. A macroeconomic model of the economy was developed and estimated using econometric techniques for annual data from 1962-1983. Taher's model indicated that that even under the optimistic price scenario, government oil revenues will fall considerably short of the estimated 200 billion Saudi riyals suggested by the Fourth Development Plan, 1985-1990. Al-Mutawa (1992) Al-Mutawa (1991) analyzed the effects of oil shocks and macroeconomic policy changes for the United Arab Emirates. A theoretical model is developed within the framework

of the Dutch Disease literature. It contains four unique features that are applicable to the United Arab Emirates economy. These are: 1) the presence of a large foreign labor force; 2) OPEC's oil production quotas; 3) the division of oil profits, and 4) the important role of government expenditures.

An econometric model is then specified and the method of method of principal components" is applied owing to the undersized sample data and the impacts of oil price shocks on macroeconomic variables are then simulated. The simulation results show that an oil-quantity boom leads to a higher welfare gains than an oil-price boom. Moreover, an oil-price or quantity bust always leads to lower economic growth and have a negative welfare loss.

Al-Mutairi (1993) attempted to identify the sources of output fluctuations and the dynamic response of the economy to changes in key macroeconomic variables for Kuwait. In the study, several economic variables reflecting different economic stimuli are used. The variables consist of two macro-economic variables: GDP and index for price level two policy variables; M1 and government expenditure, and one external shock measured by innovations in the price of exported petroleum.

Al-Mutairi employed the Vector Autoregression technique (VAR) and his empirical results suggest that for short horizons of one and two years, shocks to oil price account for more than 50% of the variance of GDP forecast errors. However, at longer horizons of three years and more, these shocks are seen to be unimportant in inducing GDP fluctuations, accounting only for less than 10% of the variance. Shocks of real government expenditure are also found to have a significant role in causing GDP fluctuations. As for the non-oil GDP, oil price shocks are found to explain a relatively small fraction of its variations. On the other hand, money supply is shown to play a small role in inducing both GDP

and non-oil GDP variations which suggest a limited role that monetary policy in the economic activity in Kuwait.

Finally, Al-Mutawa and Cuddington (1994) extended the standard three-sector Dutch Disease model to capture the main characteristics of a prototypical small Gulf state i.e., U.A.E. In particular, foreign oil companies and foreign workers play large roles in the economy. Furthermore, OPEC production quota restrains oil exports (to some extent), and oil profits are the primary source of government revenue. Finally, the government has a policy of providing public services (housing, health care, education, etc) free of charge to both nationals and foreign workers. They concluded that small Gulf states may have the choice, within the context of OPEC negotiations, to press for either an increase in world prices (with OPEC quotas unchanged) or a relaxation of their quota (with prices unchanged). Their analysis shows that, in cases where the boom results in an improvement in the budget surplus (implying that national welfare must rise), an increase in the quota level is shown to be more preferable to an oil price increase.

The Kuwaiti economy, like the other GCC economies depends heavily on the oil sector. Oil contributes over two-thirds of GDP and over 90 per cent of exports. Although Kuwait tries hard to lesson its dependence on oil through the development of non-oil sector, its success, has so far been, at the best, very modest. It is expected that the country will continue to depend heavily on oil at least for the first half of the next millennium. The real problem is that oil prices and hence oil revenues are exogenously determined. As a member of OPEC, Kuwait has no control over the price of its crude oil and at least theoretically speaking can not exceed its assigned production quota.

The purposes of this study are to investigate the impacts of oil price fluctuations on key macroeconomic variables of the Kuwaiti

economy, determine the direction of causality and measure the magnitude of such impacts. This can be done through identification of how oil price fluctuations impact those key macroeconomic variables and the dynamic response of these economic variables, including policy variables such as government expenditure and demand for money.

A Vector Autoregression model (VAR), which is currently very popular, is employed for this study. The VAR technique is very appropriate because of its ability to characterize the dynamic structure of the model as well as its ability to avoid imposing excessive identifying restrictions associated with different economic theories. That is to say that VAR does not require any explicit economic theory to estimate the model. The use of VAR in macroeconomics has generated much empirical evidence, giving fundamental support to many economic theories (see Blanchard and Watson (1986) and Bernanke (1986) among others).

In the next section, the model is discussed in details along with the data utilized. The results and their interpretation are presented in section three followed by the conclusions and some policy implications.

II. The Model

a. VAR Methodology

The VAR system is based on empirical regularities embedded in the data. The VAR model may be viewed as a system of reduced form equations in which each of the endogenous variables is regressed on its own lagged values and the lagged values of all other variables in the system.

An n variable VAR system can be written as

$$A(l)Y_t = A + U_t \quad (1)$$

and
$$A(l) = I - A_1l - A_2l^2 - \dots - A_m l^m \quad (2)$$

Where Y_t is an $n \times 1$ vector of macroeconomic variables, A is an $n \times n$ vector of constraints, and U_t is an $n \times 1$ vector of random variables, each of which is serially uncorrelated with constant variance and zero mean. Equation (2) is an $n \times n$ matrix of normalized polynomials in the lag operator $l(l^{k_{Y_t}} = Y_{t-k})$ with the first entry of each polynomial on A 's being unity.

Since the error terms (U_t) in the above model are serially uncorrelated, an ordinary least squares (OLS) technique would be appropriate to estimate this model. However, before estimating the parameters of the model $A(l)$ meaningfully, one must limit the length of the lag in the polynomials. If l is the lag length, the number of coefficients to be estimated is $n(nl + c)$, where c is the number of constants.

In the VAR model above, the current innovations (U_t) are unanticipated but become parts of the information set in the next period. This implies that the anticipated impact of a variable is captured in the coefficients of lagged polynomials while the residuals capture unforeseen contemporaneous events. Hence, even though a direct interpretation of the estimated individual coefficients from the VAR system is very difficult, a joint F -test on these lagged polynomials is, nevertheless, useful in providing information regarding the impact of the anticipated portion of the right-hand side variables.

Therefore, an important feature of the VAR methodology is the use of the estimated residuals, called VAR innovation, in dynamic analysis. Unlike the traditional economic approach, these VAR innovations are treated as an intrinsic part of the system.

In order to analyze the impact of unanticipated policy shocks on the macro variables in a more convenient and comprehensive way, Sims (1990) proposed the use of impulse response functions (IRFs) and forecast error variance decompositions (FEVDs). IRFs and FEVDs are obtained from a moving average representation of the VAR model [equations (1) and (2)] as shown below:

$$Y_t = \text{Constant} + H_t(l)U \quad (3)$$

and $H(l) = I + H_1^l + H_2^l + \dots \quad (4)$

Where H is the coefficient matrix of the moving average representation which can be obtained by successive substitution in equations (1) and (2). The elements of the H matrix trace the response over time of a variable i due to a unit shock given to variable j . In fact, these impulse response functions will provide the means to analyze the dynamic behavior of the target variables due to unanticipated shocks in the policy variables. This is because the IRFs trace the reaction of all the variables in the VAR system to innovations in one of the variables and therefore can be used to analyze the effects of structural innovations.

Having derived the variance-covariance from the moving-average representation, the FEVDs can be constructed. FEVDs represent the decomposition of forecast error variances and therefore give estimates of the contributions of distinct innovations to the variances. Thus, they can be interpreted as showing the portion of variance in the prediction for each variable in the system that is attributable to its own innovations and to shocks to other variables in the system.

Furthermore, another significant feature of VAR pertains to the treatment of policy variables. Unlike traditional modeling in which

such variables are treated as exogenous, the VAR approach allows their determination by the specification of the reaction functions.

b. Vector Error Correction Methodology

c. Structure VAR Methodology

The major shortcoming of the VAR approach is its lack of theoretical subsistence (Cooly and LeRoy 1985 and Leamer 1985). In response to this criticism, Blanchard and Watson (1986) and Bernanke (1986) developed procedures, called the Structural Vector Autoregression (SVAR) approach, which combine the features of the traditional structural modeling with those of the VAR methodology. This is an improvement in that it takes advantage of economic theory in the estimation of the IRFs and FEVDs and permits the definition of an explicit economic structure, which can be incorporated into the interpretation of the estimated VAR model. Another advantage of using SVAR comes from the fact that standard VAR disturbances are generally characterized by contemporaneous correlations. In the presence of such correlations, the response of the system, indicated by

IRFs, to an innovation in one of the variables is in fact the response to innovations in all those variables that are contemporaneously correlated with it.

Similarly, the ability of FEVDs to quantify the relative contributions of specific sources of variation is confounded in the presence of this correlation. In standard VAR methodology this contemporaneous correlation is purged by the Cholesky orthogonalization procedure. However, the Cholesky procedure implicitly assumes recursivity in the VAR model as it is estimated. Although theoretical considerations may help in determining this ordering and ex-post sensitivity analysis may further help provide insights regarding appropriate ordering, it remains largely at the discretion of the modeler.

This remains the major criticism of the VAR approach; namely, that the innovations cannot be treated as exogenous policy variables (i.e., uncorrelated), unless a set of innovations is found which is contemporaneously uncorrelated and has a unique relation with the original set of contemporaneously correlated innovations. Thus, in a SVAR, a structural model is used to obtain contemporaneously uncorrelated innovations. This procedure is briefly explained below.

The SVAR methodology consists of specifying a dynamic structural model, based on economic theory, the coefficients of which are to be recovered from the underlying reduced form standard VAR model. The underlying VAR is first estimated. The corresponding variance-covariance matrix of the residuals along with the identifying restrictions imposed on the corresponding SVAR through the structural model are used to solve a non-linear system of equations and hence obtain the coefficients of the SVAR. This information is then used to orthogonalize the variance-covariance matrix of VAR, thus cleansing

the residuals of VAR in order to be used to estimate IRFs and FEVDs. The methodology has been explained in detailed in Appendix.

d. The Estimated Model and The Data

The first step in developing a VAR model is to make a choice of the macroeconomic variables that are essential for the analysis. The variables consists of one external shock measured by innovations in the price of Kuwaiti blend crude oil. Three key macroeconomic variables, oil revenues, consumer price index, (CPI) and the value of imports, three policy variables, Money Supply M2, government current expenditure and government development expenditure. The notations of these variables are as follow:

<i>OILP</i>	= Oil Price of Kuwaiti Blend Crude
<i>OILR</i>	= Oil Revenue
<i>EXDEV</i>	= Government Development Expenditure
<i>EXCON</i>	= Government Current Expenditure
<i>CPI</i>	= Consumer Price Index
<i>M2</i>	= Money Demand (<i>M2</i> Definition)
<i>IMPORTS</i>	= Value of Imports of Goods & Services

Quarterly date for the period 1984:1-1998:4 were utilized in this study. The data for the period of the Iraqi occupation and liberation of Kuwait were removed from the time series for obvious reasons. All data are from the Quarterly Monetary Statistics of the Central Bank of Kuwait and OPEC's Bulletin and are expressed in logarithmic form.

III. The Empirical Results

First, the VAR technique requires stationary data, thus each series should be examined for the probable order of difference stationarity. However, in transforming a variable, a usual question arises as to whether one should do an appropriate differencing to identify the stationarity structure of the process. In this context, Doan (1989) noted that differencing a variable is ‘important’ in the case of Box-Jenkins ARIMA Modeling. However, he also observed that it is not desirable to do so in VAR models. As a matter of fact, Fuller (1976) has 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’. Furthermore, Fuller (1976) has argued that differencing a variable ‘throws information away’ while producing no significant gain. Thus, following Doan and Fuller, the level rather than the difference was preferred.

Table 1 gives the non-stationary test for all the time-series, using the conventional Dicky-Fuller test and its augmented version (ADF). These tests include a constant but no time trend, as recommended by Dickey and Fuller (1986).

Table 1
t-Tests for Stationarity
1984:1-1998:4

Variable	DF		ADF		Phillips-Perron*	
	Level	1 st Diff	Level	1 st Diff	Level	1 st Diff
LO Price	-2.2	-5.73	-2.56	-6.04	-2.14	-5.56
LOR	-3.04	-8.36	-3.02	-5.97	-3.04	-7.71
LGXD	-4.59	-7.13	-2.26	-7.13	-4.82	-24.56
LGXC	-5.04	-12.98	-2.95	-5.94	-5.2	-15.02
LCPI	-0.29	-8.45	-0.26	-4.84	-0.32	-8.54
LM2	-0.36	-6.57	-0.42	-6.28	-0.34	-6.53
LIMP	-1.83	-10.57	-1.33	-7.16	-1.63	-12.17

* With 3 Lag.

The reported t-statistics in Table 1, when compared with the critical values obtained by Engle and Yoo (1987), indicate that almost all the series, except CPI, M2 and IMP, are stationary in the levels as shown by the DF, ADF and Phillips-Perron t-tests. These tests are reapplied after differencing all terms. The t-statistics on the lagged first-difference terms indicate that, for all series the null hypothesis is rejected, that is to say, all series are stationary.

Second, the estimation of a VAR model requires the explicit choice of lag length in the equations of the model. Following Judge et al (1988) and Mc Millin (1988), Akaike's AIC criterion is used to determine the lag length of the VAR model. The chosen lag length is one which minimizes the following:

$$AIC(n) = \ln \det \sum_n + (2d^2n)/T \quad (5)$$

Where d is the number of variables in the model, T the sample size and $\hat{\Sigma}^n$ an estimate of the residuals variance-covariance matrix Σ^u obtained with a VAR (n). The maximum lag length is set at five quarters, considering the sample size and number of variables in the model. A maximum lag of greater than five quarters would reduce the degrees of freedom for estimation unacceptably. The result of employing this technique is summarized in Table 2, which shows the corresponding AIC values. In Table 2, it can be seen that the AIC criterion is minimized for order 4. This suggests that, for this study, the VAR model should be of order 4.

Table 2
Results for Choosing the Lag Length of the VAR Model
Based on the AIC Criterion

VAR Order 'n'	AIC
0	- 13.17
1	-14.58
2	-15.25
3	-16.52
4	-20.86
5	-11.09

Estimating the Unrestricted VAR

The next step is to estimate the unrestricted VAR. The estimates along with their t-values are presented in Table 3. Although the estimates of individual coefficients in VAR do not have a straightforward interpretation, a glance at the table generally shows that most of the t-values are significant and all the nine equations have high R-squares. It also confirms the assertion that oil prices and hence oil revenues are relatively more exogenously determined than other variables included in the model. This is because the oil price and also the oil revenue equations hardly have any significant t-value with the exception of the CPI which is only marginally significant. Also, these two equations yield relatively low R-squares among the equations. Moreover, the overall pattern of t-values indicates that there is reasonable recursivity in the model in the sense that the order in which the equations are presented in Table 3. The t-values of the variables generally show an increasing pattern as we move from the oil price equation towards the value of import equation.

Variance Decomposition

Table 4 presents the variance decomposition for the 10-quarters ahead forecasts. Since unrestricted VAR assumes recursivity, variance decomposition depends on the ordering. This table corresponds to the following ordering of equations. LOILP, LOILR, LEXDEV, LEXCON, LCPI, LM2 and LIMPORTS. Generally speaking, this ordering reflects the fact that the oil price and oil revenues have an influence on all the other variables in the model but their own behavior is least determined by other variables included in the model. This is quite a plausible assumption because the oil prices and hence oil revenues which consist of oil revenues and the net factor income from abroad are largely determined by

world market conditions rather than conditions within the Kuwaiti economy.

Similarly this ordering assumes that the government expenditure is largely determined by the level of oil revenues which again is quite a plausible assumption. Considering the dominant role of the public sector in driving the economy of Kuwait, it is also sensible to assume that imports are largely dependent on the level of government expenditure. Furthermore, there is some empirical evidence in favor of this type of recursivity in the macroeconomic relationships between major economic variables in Kuwait Al-Mutairi 1992.

A glance at Table 4, which is based on this ordering, shows that initially oil prices and oil revenues are exogenous but as time goes by a small but increasing part of the variability in oil revenues is accounted for by the variance in the government expenditures. This is especially true for development expenditure and the value of import variables. This may be partially explained as a reflection of the relation between oil revenues and the level of value added of the oil sector which accounts for a large part of the GDP.

However, approximately 60 percent of the variance in oil prices and oil revenues remains unexplained by any of the variables included in the model. Moreover, other variables do not contribute significantly in explaining the behavior of the variance in the oil revenues except government development expenditure which accounted for 17 percent in the sixth quarter.

Looking at the variance decomposition in the government expenditure (development and current) it is observed that the oil revenues, followed by value of imports, account for a significant part of their variance. This is quite a plausible result and very apparent in the case of development expenditure. Over a longer period about one fifth of

the variance in government expenditures (development and current) is accounted for by the variations in the oil revenues.

The other variable which also picks up a significant part of the variation in government expenditure is the CPI. This is especially true in the case of current expenditure. The CPI accounts for one fifth of the current expenditure variations and about 15 percent of the development expenditure. This again is a reflection of the distinguishing characteristics of the Kuwaiti economy where a large part of the economic activity is in the public sector. Moreover, the monetary variable (M2) in the model is quite small, and almost negligible over a longer period, in explaining the behavior of the government expenditure.

In Kuwait, oil revenues themselves finance a major part of the imports. This fact is reflected in the variance decomposition of imports. It shows that 25-45% of the variance in the value of imports is accounted for by the variation in oil revenues. Other variables included in the model that exert significant influence on the behavior of imports are the two kinds of government expenditure, especially development expenditure.

Looking at the variance decomposition of the demand for money variable, it is apparent that the two types of government expenditure do not explain a large part of its variations. However, the variance in money demand is significantly explained by the variance in the CPI which accounts for approximately 30 percent, followed by oil prices and oil revenues which account for about 20 and 10 percent respectively. These results suggest a modest role of monetary policy in influencing economic activity.

Impulse Responses

Table 5 displays the Impulse Response Functions, which are essentially the dynamic multipliers. Since our primary interest is to see

the response of major macroeconomic variables to the shocks given to the oil revenues and then to the government expenditure, only ten time periods are presented here. Inspection of Table 5 reveals that an innovation in the oil prices and hence oil revenues has a similar effect on most of the macroeconomic variables in the model, including the two variables of government expenditures, imports, money supply and consumer prices. Generally, most of these variables show an increase in the first four quarters with the exception of government development expenditure and the CPI. However, in many cases, this increase has quickly shifted to decrease over the successive quarters with the exception of CPI where it in fact actually increased over the longer period.

Table 5 also displays the impulse response functions to innovations in the government current expenditure which show that imports rise substantially but after an initial decline in the second quarter then the impact tapers off over the longer time period. The CPI shows a much stronger response to the increase in government current expenditure after the first three quarters but then the impact slowed down in latter quarters. The money supply (M2) remains relatively insensitive to the government current expenditure and mostly has a negative sign.

Estimation of the Vector Error Correction Model

Since all the variables included in the model pertain to non-stationary time series data, Johenson's test was applied to check for co-integrating vectors. The test indicated that there are seven co-integrating vectors. Therefore a vector error correction model is warranted. A Vector error correction model is a VAR that builds-in co-integration. There is a sequence of nested models in this framework.

On the basis of Johenson's tests a Vector Error Correction Model (VECM) was estimated with seven co-integrating equations and with the same seven variables which were used in the unrestricted VAR. But since the results of estimating the VECM do not have a direct interpretation, they are not reported here.

Variance Decomposition

The variance decomposition results corresponding to the estimated VECM are presented in Table 6. They are based on the same ordering as was used in the unrestricted VAR.

Comparing these results with the unrestricted model shows that while the qualitative nature of macroeconomic linkages remains almost the same, the intensity of interaction between them is much higher when co-integration has been accounted for. For instance, looking at the variance decomposition of the oil revenues it shows that variables like government development and current expenditure have a larger share in explaining the variance in oil revenues compared with the unrestricted VAR. Similarly, the oil revenues have picked up a larger proportion of the variance in the two variables of government expenditure as well as value of import and in particular during the first 4-6 quarters.

Overall the VECM model is shows a significantly higher degree of statistical improvement. Theoretically it is a better model because, when there is co-integration an appropriate vector error correction model should be estimated. Empirically it shows better results because it yields much closer interaction between major macroeconomic variables than was being indicated by the unrestricted VAR model.

Impulse Response Functions

Table 7 displays the impulse response functions corresponding to the VECM model. Inspection of Table 7 indicates that an innovation in the oil prices and oil revenues have a similar effect on most of the variables included in the model. Most of them show an increase. This increase continues into the fifth quarter and then it diminishes.

All the variables settle at higher levels than their initial values. Comparing these IRFs with those corresponding to the unrestricted version reveals that it takes a little longer in the VECM version for the multipliers to reach to the level of the unrestricted version. While they generally reached their peak in the unrestricted version in about 6-7 quarters it took them 8-9 quarters to reach almost the same level in the VECM version.

Estimating the Structured VAR

Since the impulse response and variance decomposition results corresponding to the unrestricted VAR as well as those of the Vector Correction model crucially depend on the ordering in which the variables enter, they are sensitive to this ordering. As mentioned above one way to get around this problem is to resort to structural VAR. In this section the results of the structural VAR are reported. These results correspond to the just-identified model with the exact number of restrictions (see the Appendix for more details).

The variance-covariance matrix of the unrestricted VAR along with the zero restrictions imposed through the structural model were used to solve the non-linear system of equations in order to obtain the estimates of the structural VAR. The results of the structural estimates do not have a straightforward interpretation therefore they are not reported here.

However, variance decompositions obtained from this model and the impulse response function are reported and discussed.

Variance Decomposition

Table 8 reports the percent of forecast error variance decomposition of the major macroeconomic variables, based on the structural VAR. An inspection of the table reveals that while the macroeconomic linkages are qualitatively quite similar to those of the unrestricted VAR and VECM models, there are significant differences regarding the quantitative contributions of individual variables. For instance, in the unrestricted version as well as in the VECM version the unexplained variance in the oil prices and oil revenues is about 60 percent in the fourth quarter which in the SVAR for the corresponding period is only about 45 %. Meanwhile the role of both government and expenditure are definitely stronger, especially for the government development expenditure. In fact, variance decomposition of all the variables shows a significant contribution made by the two types of government expenditure which was not so in the unrestricted or VECM version.

Impulse Response Functions

Table 9 displays the impulse response functions corresponding to the just identified SVAR model. Comparing these results with those of the unrestricted VAR shows that while qualitatively the dynamic multipliers for the two versions are quite similar, quantitatively they are significantly different. For instance the response to a one standard deviation shock given to the oil prices and oil revenues invokes a three-fold increase in the current government expenditure in the SVAR version compared with the unrestricted version in the first five quarters.

Furthermore, the response of the CPI is also more positive to a shock given to both kinds of government expenditure, whereas the value of imports shows lower responsiveness in SVAR compared with the unrestricted VAR. Generally speaking the SVAR multiplier is a bit higher than the unrestricted VAR multipliers but very close to those produced by the VECM.

IV. Conclusions and Some Policy Implications

Recall that our primary goal is to examine how macroeconomic variables react to fluctuations in the world oil prices. Initially, a VAR model was specified and estimated. The VAR model has two key devices through which the dynamic structure of the model is characterized. These are the impulse response and the variance decomposition. The information content of these devices has been questioned because of the atheoretical approach developed by Sims (1980) to decompose VAR residuals into orthogonal shocks implying the difficulty in grating these shocks structure interpretations. This critique has led to the development of the structure VAR approach in which the orthogonalization is achieved by imposing a minimal set of restrictions derived from economic theory, Blanchard and Watson (1984).

Therefore, three different versions have been estimated in this study, namely, the unrestricted VAR, the Vector Error Correction Model and the Structure VAR. All three versions estimated indicated a high degree of interrelation between the major macroeconomic variables. For the most part, the results have highlighted the causality running from oil prices and oil revenues towards other variables. The three versions yield qualitatively very similar results. However, quantitatively the results are significantly different from each other. This is true for both the Impulse Response Function and Forecast Error Variance Decomposition.

However, theoretically speaking VECM and SVAR are relatively superior to the unrestricted VAR.

The results indicated that shocks to oil prices and hence to oil revenues are found to be very important in explaining most of the forecast errors variance of the government expenditure, current or development, however, government development expenditure has been more responsive to oil shocks than current expenditure. Furthermore, the results clearly show the importance of both types of government expenditure in explaining the forecast errors variance of the CPI. On the other hand, the value of imports is also explained well by oil shocks but more closely follows fluctuations in both kinds of government expenditures, especially those of development expenditure. Thus, fiscal policy as represented by government expenditure, current and development, appears to be effective. Shocks to government expenditures account for a relatively large proportion of the CPI and imports variance.

This conclusion is not surprising and is actually consistent with what is expected in a country in which the government is the sole owner of the main national income source, the oil and gas industry. Thus, government expenditure becomes the major determinant of the level of economic activity and the mechanism by which the government can effect the circular flow of income within the economy.

The most striking result of the model is the finding that oil shocks have produced a small and modest impact on the demand for money, suggesting a limited role of monetary policy in influencing economic activity. This is may be partially explained by the lack of well-developed financial markets in Kuwait. Moreover, this result is consistent with those reported by Al-Mutairi (1992), in that the main determinant of domestic prices is followed by value of imports, with the least effect coming from monetary stimuli.

The policy implication of this result is that fiscal policy can be used more effectively to stabilize the domestic economy after an oil shock. It also indicates that government expenditure should be used properly in order to control domestic prices (CPI) and balance of payment problems, i.e., the level of imports.

Finally, on the appropriateness of the methodology of VAR, the results show high sensitivity to the specification of the structure model underlying the SVAR. Therefore, the SVAR approach, which is gaining popularity among modelers, has serious problems when applied to a small open economy such as Kuwait, which is highly exposed to external shocks and therefore has problems in conforming to the standard macroeconomic theoretical build.

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APPENDIX

Structure Vector Autoregressive Model

Symbolically, let

$$AX_t = B \sum X_{t-i} + CY_t + DV_t \quad (1)$$

represent the dynamic structural model that is to be recovered from a reduced-form VAR. Here, X_t is a vector of n endogenous variables whose joint behavior is to be determined; Y_t is a vector of k exogenous variables, and V_t is a vector of n structural disturbances. It is assumed that V_t follows a multivariate normal distribution with $E(V_t) = 0$ and a diagonal covariance matrix ϕ . Thus the shocks are assumed to be both mutually uncorrelated contemporaneously and serially.

Assuming A to be non-singular, the reduced form associated with equation (1) is defined by:

$$X_t = \sum \phi_i X_{t-i} + GY_t + W_t \quad (2)$$

where W_t has a multivariate normal distribution with mean zero and variance-covariance matrix Y with non-zero covariances indicating contemporaneous correlation. Since VAR can be viewed as a system of reduced-form equations and the RHS variables for each equation are the same, OLS applied separately to each equation yields a consistent estimate of the model. VAR in equation (2) is assumed to satisfy stationarity conditions and hence a moving-average representation

(MA) exists. Therefore X_t can be expressed as a linear function of exogenous variables and current and lagged disturbances as follows:

$$X_t = \sum_{i=1}^{i=\infty} Q_{i-1} Y_{t-i-1} + \sum_{i=1}^{i=\infty} R_{i-1} W_{t-i-1} \quad (3)$$

where Q_i is an $n \times k$ matrix of coefficients of exogenous variables and R_i is an matrix of coefficients of i -period-ahead innovations. The elements of R_i quantify the net responses of the variables in the vector X_t . However, as mentioned earlier, construction of IRFs and FEVDs on the basis of W_t will not be valid because W_t are contemporaneously correlated. But equation (1) and (2) give a relation between W_t and V_t , where the elements of V_t are free of contemporaneous correlation. Using this relation, equation (3) can be written as:

$$X_t = \sum_{i=1}^{i=\infty} Q_{i-1} Y_{t-i-1} + \sum_{i=1}^{i=\infty} R_{i-1} A^{-1} D V_{t-i-1} \quad (4)$$

If we know A, D and the variance-covariance matrix ϕ , we can use equation (4), with non-contemporaneously correlated disturbances, to construct IRFs and FEVDs. The relation between W_t and V_t , namely $W = A^{-1} D V_t$ yields a relation between the variance-covariance matrix ϕ for VAR and the variance-covariance matrix ψ for SVAR given by:

$$\psi = A^{-1} D \phi D' (A')^{-1} \quad (5)$$

This is a system of non-linear equations to recover all the parameters in A, D and ϕ . Since ψ is an $n \times n$ matrix with only $n(n+1)/2$ distinct elements, at most that number of equations may be obtained from (5). But there are $3n^2$ parameters in A, D and ϕ . However, n elements of A and n elements of D can be normalized to unity. Also $n(n-1)$ off-diagonal elements of ϕ are zero because elements in V are uncorrelated. In order to recover the remaining $n(n+1)/2$ free parameters in A, D and ϕ , a total of $n(3n+1)/2$ additional restrictions are required. There are several ways of imposing these restrictions. Here comes the role of the specification of the structural models. While defining our SVAR models, we are confined to constraining only the contemporaneous structural parameters, invoking economic theory. The restrictions imposed on ϕ and D through the specifications of the SVAR will enable us to solve the non-linear system of equations in (5) to recover the parameters in A, D . Once the matrices A, D and ψ are recovered, ϕ and G in equation (2) can also be retrieved using the relations:

$$\phi_i = A^{-1}B_i \tag{6}$$

$$G = A^{-1}C \tag{7}$$