Investigating the Sources of Macroeconomic Variability: The Case of Yemen

Mohammed A. Al-Wosabi

Department of Economics and Finance,

College of Business Administration, University of Bahrain.

1. INTRODUCTION

After the reunification of North and South Yemen in 1990, the Republic of Yemen has experienced dramatic internal and external difficulties which resulted in a poor economic performance. As a result of the first Gulf war, the country had to deal with the return of around 800,000 Yemenis working in the Gulf countries and a temporary suspension of most foreign aid as well as other security and political problems. Following the 1994 war, Yemeni government initiated a macroeconomic stabilization and structural reform program with the support of international organizations such as World Bank and IMF. The reform program focused on inflation control, price and trade liberalization, reduction in subsidies, unification of the exchange rate regime and financial sector reforms. The existence of a greater domestic market, resulting from the reunification and an increase in oil production as new oil wells coming fully on line in 1994, resulted in slight improvement in economic performance in this period. As oil production continued to expand with new fields coming fully on line, the current account strengthened, despite the weak performance of non-oil exports. In addition, two Paris Club agreements, in 1996 and 1997, result in halving the external debt of Yemen.

However, the drop in oil prices since 1997 reduced government oil-related receipts in and contributed to a weakening of domestic and external balances in 1998. At the same time, implementation of the structural reform agenda was delayed in 1998 by difficulties in mobilizing the necessary political consensus. Since 2000 GDP growth has steadily begun to slip as the government became distracted from maintaining the momentum of reforms. Macroeconomic performance weakened further in 2004. Oil production declined by 5.9 percent, reducing overall growth to 2.7 percent; and inflation increased to 14.5 percent by the end of the year because of expansionary macroeconomic policies. This low economic growth has been reflected in the rise of the unemployment rate to 16.8% in 2005 and actual unemployment rates are likely to be even higher.

The oil sector accounted for about 13 percent of real GDP in 2005. It also contributed about 67 percent of government budgetary revenue and 88 percent of exports during the same year. However, Yemen is likely to become a net fuel importer by 2011, and to fully exhaust its reserves of crude oil by 2018, unless some new oil field can be discovered. Other economic activities in Yemen consist of services (38 percent of GDP); agriculture (15 percent); manufacturing, utilities and construction (10 percent); and Government services (10 percent).

GDP growth in Yemen has been driven mainly by factor accumulation rather than productivity. The production structure in Yemen is dominated by sectors that are dependent on external factors such as oil industry or on natural factors such as agricultural sector, which has low level of productivity. Therefore, the economy is highly sensitive to any external or natural changes and has limited response to many development policies.

The objective of this paper is to investigate the sources of macroeconomic varia-

bility in Yemen economy using Vector Autoregressive (VAR) model. The main focus of this study is to analyze empirically the strength of the short-run and long-run impacts of anticipated and unanticipated macroeconomic policies and shocks on the macroeconomy of Yemen. The paper contributes to macroeconomic literature by providing macroeconomic policy implications for the policy maker in charge of monetary and fiscal policy in Yemen. To my knowledge, this study represents the first attempt to estimate a macroeconomic variability of the economy of the Republic of Yemen over the period 1990 to 2003 using VAR technique proposed by Sims and and Litterman(1).

The paper is structured into four sections. The next section outlines data description and model specification. Section three discusses the VAR model estimation and empirical results. Summary and Conclusion are provided in Section 4.

2. DATA DESCREPTION AND MODEL SPECIFICAION

2.1 Data Description

The data for the study is obtained from IMF International Financial Statistics (On-Line IFS). The data for Republic of Yemen is available only from 1990, the year of the reunification of North and South Yemen(2). Because of the limited annual data, quarterly data were used from 1990 to 2003.

The variables included in the model are gross domestic product (GDP) as a measure of economic activity and economic growth of the country, consumer price index (CPI) as an inflation variable, money supply (M2) as the monetary policy variable, government expenditures (GEX) as fiscal policy variable,. Since the value of oil export constitutes more than 88% of the total export in Yemen between 1990 and 2003, the value of exports (EXP) is used as a proxy for oil export. All variables in the model except CPI are in millions of the national currency of Yemen- the Yemeni Rial- and in real terms.

For the purpose of statistical analysis variables are expressed in natural logarithms.

The objective here is to study the inter-relationship between these key macroeconomic variables, in particular, the influence of policy variables, such as government expenditures, money supply, and oil exports on the target variables of GDP and CPI using Vector Autoregression (VAR) model.

(1) Christopher A. Sims: «Macroeconomics and Reality,» *Econometrica*, vol. 48, no. 1 (1980); «Policy Analysis with Econometric Models,» *Brookings Papers on Economic Activity* (BPEA), vol. 13, no. 1 (1982), and «Are Forecasting Models Usable for Policy Analysis?,» *Federal Reserve Bank of Minneapolis Quarterly Review* (Winter 1986), and R. Litterman, «Forecasting and Policy Analysis with Baysian Vector Autoregression Models,» *Federal Reserve Bank of Minneapolis Quarterly Review* (Fall 1984).

(2) Several attempts to unify and combine the data of the two formerly separated countries have been executed by the Central Statistical Organization of Yemen (CSO) with the help of international organizations but all of them were not successful because of the totally different methods and measurement standards adopted by each country before the reunification.

2.2 Model Specification

To analyze the sources of fluctuations in GDP growth using a standard structural macro model, two major problems might arise: first, the theory must be exact enough to identify the endogenous and exogenous variables and the functional form connecting them; and the second problem concerns the identification problem of recovering structural parameters from estimated reduced form. Vector autoregressive (VAR) models have been evolved to overcome these problems. Pioneered by Sims[3] and popularized by researchers such as Litterman[4] and Doan[5], VAR model does not require any explicit economic theory to estimate a model. It uses only the observed time-series properties of the data to forecast economic variables.

The VAR models have many applications[6]. They are used to determine how each endogenous variable responds over time to a shock in that variable and in every other endogenous variable. They are useful for the analysis of the effect of alternative monetary or fiscal policies[7]. They also provide a straightforward way of predicting the values of set of economic variables at any given point in time.

The estimated reduced form of VAR model can be written as the following:

(1) $$Y_t = A + B(L)Y_t + U_t$$

where

(2) $$B(L) = I - H_1L^1 - H_2L^2 - .....H_kL^n$$

Where, Y_t is a (n x 1) vector of system variables, A is a (n x 1) vector of constants, B(L) is a (n x n) matrix of polynomials in the lag operator L $L^m Y_t = Y_{t-1}$) with the first entry of each polynomial on B's being unity, and U_t is a (n x 1) vector of serially uncorrelated white noise error with constant variance and zero mean.

The standard Sims VAR is unrestricted reduced form approach and uses a common lag length for each variable in each equation[8].

Each equation in the system can be estimated using OLS. Moreover, OLS estimates are consistent and asymptotically efficient. Even though the error terms are correlated across equations, Seemingly Unrelated Regression (SUR) does not add to the efficiency of the estimation procedure since all regressions have identical right-hand-side variables. However, before estimating the model, the lag length must be chosen. If L is the lag length, number of coefficients to be estimated is k(kL + c), where c is the number of constants. The VAR model presented above indicates that the current inno-

(3) Sims, «Macroeconomics and Reality».

(4) Litterman, Ibid.

(5) Thomas Doan, Robert B. Litterman and Christopher A. Sims, «Forecasting and Conditional Projection Using Realistic Prior Distribution,» *Econometric Reviews*, vol. 3, no. 1 (1984)

(6) T. Cooley and S. LeRoy, «A Theoretical Macroeconomics: A Critique,» *Journal of Monetary Economics*, vol. 16, no. 3 (1985).

(7) Sims, «Policy Analysis with Econometric Models».

(8) Sims, «Macroeconomics and Reality».

vations (U_t) are unanticipated but becomes part of the information set in the next period. The implication is that the anticipated impact of a variable is captured in the coefficients of lagged polynomials while the residuals capture unforeseen contemporaneously events. The impact of the unanticipated policy shocks (i.e. the policy variables such as changes in money supply and government expenditures) on other economic variables of the model can be analyzed by employing the impulse response function (IRF) and variance decomposition (VDC) that are obtained from a moving average representation of the VAR model given in equations (3) and (4).

$$Y_t = \text{Constant} + H(L)U \tag{3}$$

and

$$H(L) = I + H_1L + H_2L + ... \tag{4}$$

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 a variable j.

The impulse response functions make it possible to analyze the dynamic behavior of the target variables due to unanticipated shocks in the policy variables. Variance decompositions show 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.

To implement the reduced form VAR model into a structural model whose dynamics are determined by economically interpretable shocks we used «EViews6 econometric software».

3. MODEL ESTIMATION AND EMPIRICAL RESULTS

VAR is a technique that facilitates to capture both the dynamic and interdependent relationships of variables. As a pre-requisite, certain properties of the variables in the model must be checked in order to determine the appropriate specification for VAR estimation. To select the appropriate VAR or vector error correction (VEC) model, the first step is to check whether the data is stationary or non-stationary. A series is said to be stationary if the mean and autocovariances of the data do not depend on time. Stationary time series data is necessary to have valid statistical tests.

3.1 Tests for Unit Root

To check whether the time series are stationary or non-stationary we test the data for the presence of unit root. The order of integration for each variable is determined using Augmented Dickey and Fuller (ADF) and Phillips and Perron (PP) unit root tests[9]. The results of these tests are reported in table (1).

(9) David A. Dickey and Wayne A. Fuller, «Distribution of the Estimators for Autoregressive Time Series with a Unit Root,» *Journal of the American Statistical Association*, vol. 74, no. 366 (1979), and Peter C. B. Phillips and Pierre Perron, «Testing for a Unit Root in Time Series Regression,» *Biometrika*, vol. 75, no. 2 (1988).

Table (1)
Unit Root Tests

Variable	ADF			PP		
	Constant	Constant & Trend	No Constant & No Trend	Constant	Constant & Trend	No Constant & No Trend
Log Level						
EXP	-2.250023	-1.668340	-0.409261	-1.698378	-1.173027	0.004757
M2	-0.555822	-1.084126	1.174561	-1.036415	-1.888780	0.537019
GEX	-1.602600	-2.807071	0.755278	-1.290042	-2.166484	1.194719
GDP	-1.734320	-1.436559	1.048876	-0.037994	-2.328255	3.981011
CPI	-0.036428	-2.689363	1.467539	0.440107	-2.004395	3.948158
Log First Difference						
EXP	-2.955503*	-3.268557***	-2.950238*	-3.013943**	-3.265816***	-3.001491*
M2	-2.201679	-2.356929	-1.882500***	-3.972672*	-4.050458**	-3.841300*
GEX	-3.718625*	-3.682663**	-3.600122*	-3.772516*	-3.737293**	-3.641856*
GDP	-1.957442	-2.152457	-0.546653	-3.669859*	-3.561416**	-2.205723**
CPI	-2.622960***	-2.628510	-1.247436	-2.658225***	-2.681178	-1.145327

Notes: * reject null hypothesis (unit root) at 1% level;
** reject null hypothesis (unit root) at 5% level;
*** reject null hypothesis (unit root) at 10% level, using MacKinnon Critical Values.

The results of the ADF and PP tests for all variables indicate that we can not reject the null hypothesis that the log level series have unit roots at the 10% or less significance. This suggests that all log level series are non-stationary. When first differenced in log, we find the evidence that variables are stationary. Since the results, overall, tend to suggest non-stationarity in log levels of the variables but stationarity in their log first differences, we proceed by contending that the variables are integrated of order I(1).

3.2 Cointegration Analysis

Since the five variables are noted to be I(1), there exists the possibility that they share a long-run equilibrium relationship, as was pointed out by Engle and Granger[10]. We test this long-run equilibrium using cointegration tests based on the methodology developed in Johansen[11]. In formulating the dynamic model for the test, the

(10) Robert F. Engle and Clive W. J. Granger, «Co-integration and Error Correction: Representation, Estimation, and Testing,» *Econometrica*, vol. 55, no. 2 (March 1987).

(11) Soren Johansen: «Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models,» *Econometrica*, vol. 59, no. 6 (November 1991), and *Liklihood-based Inference in Cointegrated Vector Autoregressive Models* (New York: Oxford University Press, 1995).

question of whether an intercept and trend should enter the short- and/or long-run model is raised[12]. We used all five deterministic trend models considered by Johansen with four lags[13].

The number of cointegrating relations from all five models, on the basis of trace statistics and the maximal eigenvalue statistics using critical values from Osterwald-Lenum[14] at 1 and 5 percent levels are summarized in table (2).

Table (2)

Tests of Selected Number of Cointegrating Relations by Model

Data Trend:		None	None	Linear	Linear	Quadratic
TEST TYPE	Critical Value%	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	1	3	4	4	5	4
	5	3	4	5	5	5
Maximum Eigenvalue	1	3	4	4	5	5
	5	3	4	5	5	5

Notes: The Selection of cointegrating relations is based on 0.01 and 0.05 level critical values from Osterwald-Lenum. see: M. Osterwald-Lenum, «A Note with Quintiles of the Asymptotic Distribution of the Maximum Likelihood Cointegration Rank Test Statistics,» *Oxford Bulletin of Economics and Statistics*, vol. 54 (1992).

As can be seen from table (2), both tests show evidence of minimum three and maximum five cointegrating relations. Generally, there are two different ways of specifying a VAR model when the time series under study are cointegrated - an unrestricted VAR in levels or a vector error correction (VEC) model. There is no theoretical clear cut evidence of which specification is more appropriate. While the VEC model conveniently combines the long-run behavior of the variables and their short-run relations and thus can better reflect the relationship among the variables, there is no guarantee that imposing restriction of cointegration can be a reliable basis for making structural inferences[15]. Moreover, current finding is still unclear on whether the VEC model outperforms the unrestricted VAR at all forecasting horizons. Naka and Tufte found that the two methods have comparable performance at short horizons[16]. The support

(12) Richard I. D. Harris, *Using Cointegration Analysis in Econometric Modelling* (London: Prentice Hall/Harvester Wheatsheaf, 1995), p. 95.

(13) Johansen, *Liklihood-based Inference in Cointegrated Vector Autoregressive Models*, pp. 80 and 84.

(14) M. Osterwald-Lenum, «A Note with Quintiles of the Asymptotic Distribution of the Maximum Likelihood Cointegration Rank Test Statistics,» *Oxford Bulletin of Economics and Statistics*, vol. 54 (1992).

(15) Jon Faust and Eric M. Leeper, «When Do Long-run Identifying Restrictions Give Reliable Results?,» *Journal of Business and Economic Statistics*, vol. 15, no. 3 (July 1997).

(16) Atsuyuki Naka and David Tufte, «Examining Impulse Response Functions in Cointegrated Systems,» *Applied Economics*, vol. 29, no. 12 (December 1997).

for the use of the unrestricted VAR can also be found in Clements and Hendry[17], Engle and Yoo[18] and Hoffman and Rasche[19].

After comparing the unrestricted VAR using the variables in levels and VEC first-difference series on the Yemen economy data, it has been found that there are no significant differences between both methods. Thus, this paper pursues the analysis using the unrestricted VAR model.

3.3 VAR Model Lag Length

In specifying a VAR model, number of lags to be included can not be determined arbitrarily. Various criteria are available to choose proper lag length for the VAR model. This paper used five criteria, as discussed in Lütkepohl in deciding the lag length for our model[20]. The results from all criteria are summarized in table (3). After trying different lag length, four of the five criteria indicated a maximum lag length equal to five.

Table (3)

Tests for Model Lag Length

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-2587.682	NA	6.26e+39	105.8237	106.0168	105.8970
1	-2096.255	862.5040	3.40e+31	86.78592	87.94418	87.22536
2	-2066.915	45.50692	2.94e+31	86.60878	88.73225	87.41442
3	-2051.888	20.23997	4.81e+31	87.01585	90.10454	88.18769
4	-2026.977	28.47042	5.73e+31	87.01946	91.07336	88.55750
5	-1851.420	164.8082*	1.67e+29*	80.87429	85.89341*	82.77854*
6	-1826.164	18.55572	2.80e+29	80.86383	86.84816	83.13427
7	-1798.355	14.75546	6.21e+29	80.74920*	87.69874	83.38585

Notes: * Indicates lag order selected by the criterion.

LR: Sequential modified LR test statistic (each test at 5% level).

FPE: Final prediction error.

AIC: Akaike information criterion.

SC: Schwarz information criterion.

HQ: Hannan-Quinn information criterion.

(17) Michael Peter Clements and David F. Hendry, «Forecasting in Cointegrated Systems,» *Journal of Applied Econometrics*, vol. 10, no. 2 (1995).

(18) Robert F. Engle and Byung Sam Yoo, «Forecasting and Testing in Co-integrated Systems,» *Journal of Econometrics*, vol. 35, no. 1 (1987).

(19) Dennis L. Hoffman and Robert H. Rasche, «Assessing Forecast Performance in a Cointegrated System,» *Journal of Applied Econometrics*, vol. 11, no. 5 (1996).

(20) Helmut Lütkepohl, *Introduction to Multiple Time Series Analysis* (Berlin; New York: Springer-Verlag, 1991), sec. 4.3.

One of the diagnostic views, inverse roots of the characteristic AR polynomial, indicated that the estimated model with a lag length of five is unstable (nonstationary) and some roots lie outside the unit circle. If the VAR is unstable, certain results (such as impulse response standard errors) are not valid(21). Using lag length of four results in a stable (stationary) model which lies inside the unit circle. Thus, lag length of four will be used in this paper.

3.4 VAR Granger Causality and Block Exogeneity

VAR model can be used to test Granger causality among the variables of the model. In addition, VAR model allow endogenous variables to be treated as exogenous. We used Chi-square (Wald) statistics for the joint significance of each of the other lagged endogenous variables in each equation of the model and also for joint significance of all other lagged endogenous variables in each equation of the model. The results are reported in table (4).

Table (4)

VAR Granger Causality/Block Exogeneity (Chi-Square-Wald Tests)

	Excluded Variables					Block Exogeniety
Dependent Variable	EXP (1)	M2 (2)	GEX (3)	GDP (4)	CPI (5)	All Variables (6)
EXP (Row 1)		3.900686	2.335226	12.06607**	6.607993	16.58816
M2 (Row 2)	7.343400		11.68895**	28.92935*	5.970664	39.34735*
GEX (Row 3)	4.692909	11.27069**		6.997252	6.228689	19.48582
GDP (Row 4)	3.541126	11.05748**	4.506390		4.962972	35.00561*
CPI (Row 5)	20.98257*	11.13324**	2.623666	3.519350		42.66486*

NOTES:

a.The value in each box represents chi-square (Wald) statistics for the joint significance of each other lagged endogenous variables in that equation. The statistics in the last column is the chi-square statistics for joint significance of all other lagged endogenous variables in the equation.

b.The critical values (for individual excluded variables) with 4 df at 1%, 5% & 10% are 13.27670, 9.48773, & 7.77944 respectively. The critical values (for all excluded variables) with 16 df at 1%, 5% and 10% are 31.99993, 26.29623, and 23.68479 respectively.

c.* : significant at 1 percent; ** : significant at 5 percent; *** : significant at 10 percent.

Chi-square test statistics in row 1 indicates that null hypothesis can not be rejected for individual lagged coefficients except for GDP, which has significant effect on export (EXP). The monetary policy variable (M2) is influenced by government expenditure

(21) Ibid.

(GEX) and by the aggregate income (GDP). All variables together have affected M2. The fiscal policy variable of government expenditure (GEX) was affected only by the monetary policy variable but all other variables in the model have no impact on GEX. This may indicate that GEX depends on other factors such as foreign aid. Monetary policy has an impact on GDP. All other variables together have an impact on GDP. The test indicates that the inflation variable (CPI) is influenced by all other variables together and by export and M2 individually. The test result indicates that CPI has no influence on any of the variables. This finding is surprising since the main concern of the Yemeni government from mid 1990s to 2003 was to combat the inflation.

There is an evidence of bi-directional causality between GDP and M2, and between GEX and M2. Both economic policies affect each other but monetary policy has a stronger impact on income. It can be seen from table (4) that the monetary policy variable is the most influential one among all variables included in this study. It has a strong impact on income, government expenditure and inflation. This is in line with reality since, with the help of the IMF, the economic reform conducted in the 1990s focused mainly on fixing the monetary aspect of the economy.

Table (4) shows an important result. The oil export proxy (EXP) and the fiscal policy variable (GEX) show no significant impact on GDP. These findings may suggest that oil export revenues and government spending are directed to a non-productive activity.

3.5 THE DYNAMIC BEHAVIOR OF VAR MODEL

Although the results of table (4) enabled us to analyze the impact of anticipated policies they do not give us a clear understanding of the dynamic behavior of the model. The dynamic behavior of VAR model can be analyzed using two approaches: impulse response function and variance decomposition. To identify orthogonalized innovations in each of the variables and the dynamic responses to such innovations, variance-covariance matrix of the VAR was factorized using Choleski decomposition method suggested by Doan[22]. This method imposes an ordering of the variables in the VAR and attributes all of the effect of any common component to the variable that comes first in the VAR system. The responses can change dramatically if ordering of the variables in the VAR system is changed. We tried several orderings keeping most endogenous variable last and most exogenous first. Although the results were marginally sensitive to the ordering, general findings were similar in each case. The results reported here are based on ordering of the variables as: EXP, M2, GEX, GDP, and CPI.

3.5.1 Impulse Response Function (IRF)

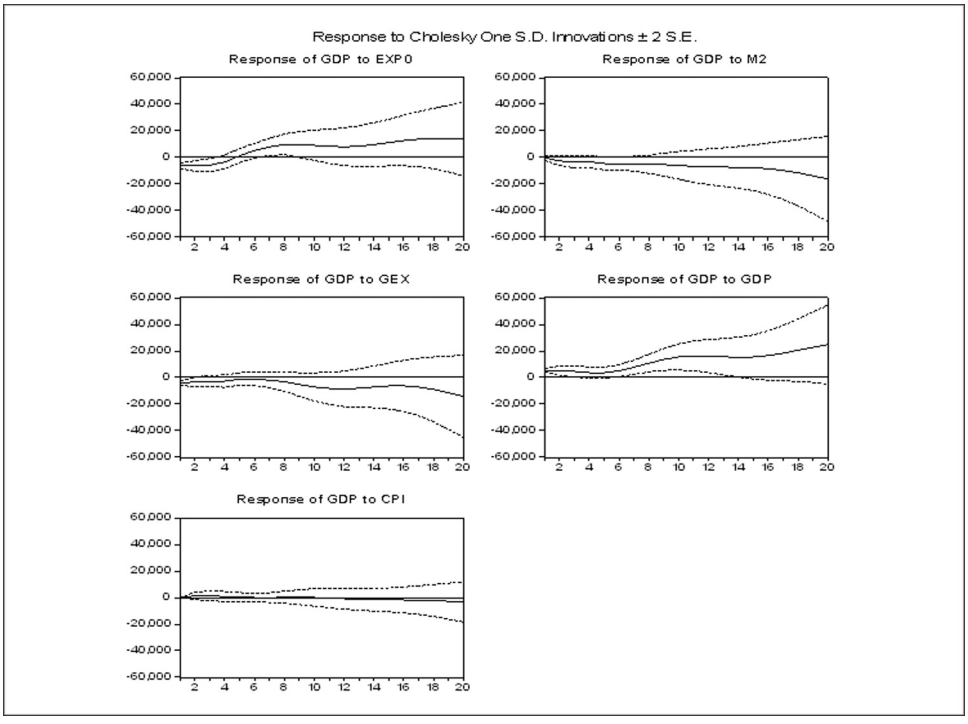
The impulse response functions provide information to analyze the dynamic behavior of a variable due to a random shock or innovation in other variables. The impulse response traces the effect on current and future values of the endogenous variables of one standard deviation shock to the variables. As Runkle pointed out, that

(22) Doan, Litterman and Sims, «Forecasting and Conditional Projection Using Realistic Prior Distribution».

impulse response functions or variance decompositions without confidence intervals (standard error bands) is similar to reporting regression coefficients without t-statistics[23]. Therefore, we obtained the error bands for impulse responses by using a Monte Carlo simulation procedure with 100 replications for all five variables. The impulse response of the two target variables (GDP and CPI) are reported here.

Figure (1) illustrates the dynamic response of GDP to a one standard deviation shock in oil export (EXP), monetary policy variable (M2), fiscal policy variable (GEX), and CPI. While EXP has a small negative impact on GDP in the short run it indicates a larger positive impact in the longer term. Both policy variables, M2 and GEX, have negative impacts on GDP. It may indicate that most of government expenditure is spent on nonproductive activity, mostly to buy tribal loyalty and to purchase different types of weapons. Monetary policy may not be well designed and could not achieve its planned targets. CPI has no impact on GDP in neither short run or long run. According to the figure (1), the increase in GDP depends partially on EXP. Other factors may include foreign assistance.

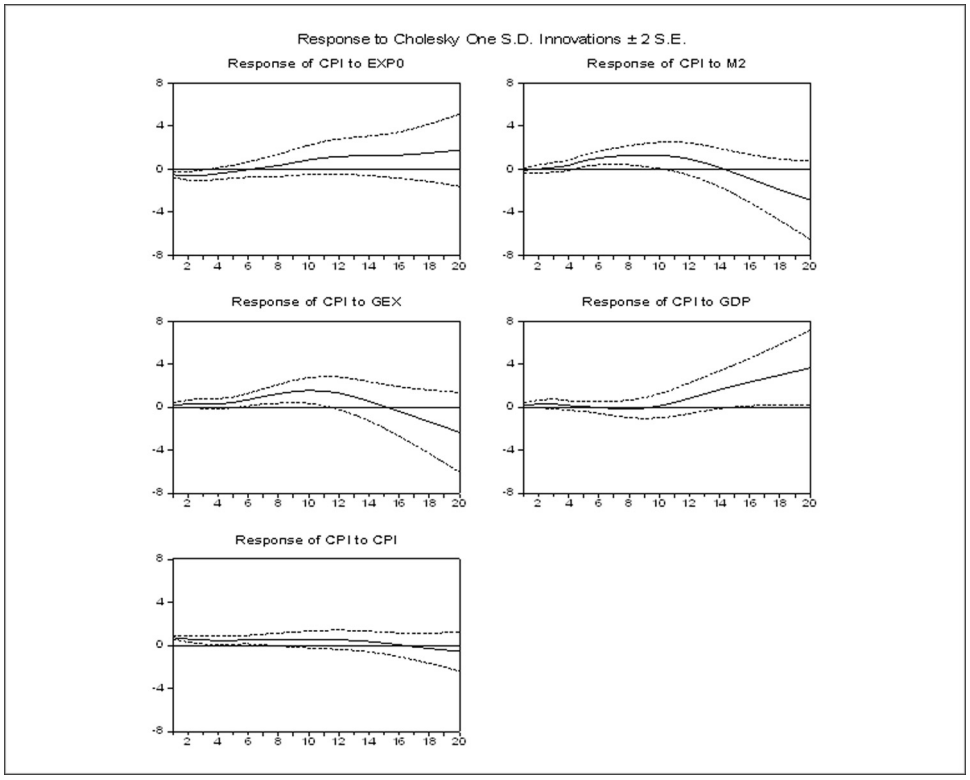
Figure (1)
Impulse Responses of Log (GDP)
to One Standard Deviation Shock of Log (EXP, M2, GEX, GDP, and CPI)



(23) David Runkle, «Vector Autoregressions and Reality,» *Journal of Business and Economic Statistics*, vol. 5, no. 4 (1987).

Figure (2) illustrates the dynamic response of CPI to a one standard deviation shock in itself and in all other variables. EXP has small negative impact on CPI in the short run but later change to a larger positive impact in the longer term. Both policy variables, M2 and GEX, have increasing positive impacts on CPI in the short run but their influence on CPI eventually tend to be negative in the long run. This effect increases as time passes. GDP has no impact on CPI in the short run but it shows a strong positive impact in the long run.

Figure (2)
Impulse Responses of Log (CPI)
to One Standard Deviation Shock of Log (EXP, M2, GEX, GDP, and CPI)



It is noticeable that both fiscal and monetary policies have negative effect on GDP and CPI mainly in the long-run. A shock in export has a consistently positive effect on GDP and CPI.

3.5.2 Variance Decompositions

The impulse response functions illustrate the qualitative response of every variable in the system to shocks to itself and to all other variables in the model. To indicate the relative importance of these shocks require variance decomposition. In this technique, each variable is explained as linear combinations of its own current innovations and lagged innovations of all variables in the system. Table (5) reports the variance decompositions of

the forecast errors for each variable in the model at horizons up to 20 quarters (5 years). The results of the variance decompositions seem to be consistent with impulse responses.

Variance decomposition for EXP: The source of variation in EXP is totally explained by a shock to itself. Shocks in all other variables have no impact at all in the first period. However, their impact start to increase as time passes. In the 20th period, shocks on GDP and policy variables have greater effect on EXP than its own shock. These results indicate that increase in production and the right monetary and fiscal policy give a big boost to export in the long run.

Variance decomposition for M2: Other than itself, a shock to EXP variable has a significant effect on M2 in the first quarter. Shocks on GEX and M2 are important in the long run as well. In the 20th quarter, a shock to GEX and GDP accounts for 36 and 22 percent variation.

Variance decomposition for GEX: Variation in GEX is explained mostly by shocks to GEX, M2 and EXP in the short run and long run.

Variance decomposition for GDP: A shock to GDP accounts only for almost 34 percent variation in the first quarter and gradually increases to 51 percent in the 20th quarter. On the other hand, a shock to EXP accounts for almost 46 percent which gradually decreases to almost 22 percent in the 20th quarter. A shock to GEX accounts for almost 19 percent which gradually decreases to almost 11 percent in the 20th quarter. This indicates that variation in GDP is explained not only by a shock to GDP but also to all other variables, mainly EXP and GEX.

Table (5)

Variance Decompositions Proportion of Variance Explained by Shocks

Variance Decomposition of EXP:						
Period	S.E.	EXP	M2	GEX	GDP	CPI
1	23420.24	100.0000	0.000000	0.000000	0.000000	0.000000
5	73016.28	76.58937	0.781386	1.791717	20.01267	0.824859
10	105507.6	49.34888	5.295751	5.757950	38.74355	0.853873
15	158073.4	28.08217	19.28267	13.39807	37.68974	1.547343
20	232436.9	14.29882	27.27515	25.05597	31.10869	2.261378
Variance Decomposition of M2:						
Period	S.E.	EXP	M2	GEX	GDP	CPI
1	13937.18	27.08755	72.91245	0.000000	0.000000	0.000000
5	49950.88	13.38571	35.73044	24.94622	23.60995	2.327682
10	67984.79	7.670816	30.23146	37.46449	21.97842	2.654807
15	69611.54	8.780808	30.15142	36.74485	21.60624	2.716691
20	71135.59	8.738398	30.53797	36.45982	21.58529	2.678525

to be Continued

Continued

Variance Decomposition of GEX:						
Period	S.E.	EXP	M2	GEX	GDP	CPI
1	3989.495	24.38072	29.24612	46.37316	0.000000	0.000000
5	12532.50	21.55390	26.32306	37.79512	8.102614	6.225305
10	13865.94	21.08284	22.92111	38.64511	11.65432	5.696612
15	14695.46	19.90869	23.53071	39.67246	11.73791	5.150227
20	15031.71	19.47185	24.45540	39.32127	11.65900	5.092483
Variance Decomposition of GDP:						
Period	S.E.	EXP	M2	GEX	GDP	CPI
1	9361.302	46.43758	0.066819	19.41043	34.08517	0.000000
5	18337.90	38.77323	15.55001	13.46147	30.77260	1.442698
10	39520.15	31.27005	12.32116	8.981566	47.10442	0.322800
15	61621.28	23.91008	12.13113	11.54399	52.09059	0.324213
20	90615.18	22.46128	14.97031	11.56262	50.49435	0.511439
Variance Decomposition of CPI:						
Period	S.E.	EXP	M2	GEX	GDP	CPI
1	0.932671	31.74863	1.599912	4.159722	3.554546	58.93719
5	2.073902	29.35116	17.80729	12.13669	5.453716	35.25114
10	4.707624	11.30127	37.39081	36.65374	1.388763	13.26542
15	6.861352	20.24889	23.45457	28.29146	19.77983	8.225246
20	11.71695	15.40465	23.02113	18.18412	40.12596	3.264130

Variance decomposition of CPI: 59 percent of variation in CPI is due to a shock in CPI itself and 31 percent is due to a shock in EXP in the first quarter. In the 10^{th} quarter the variation in CPI is mainly due to shocks in the two policy variables. However, in the 20^{th} period GDP is the main determinant in the variation in CPI.

4. CONCLUSION

This study applied VAR technique to study the macroeconomic variability in the Yemeni economy using data of five key macroeconomic variables, gross domestic product (GDP) as a measure of national income, consumer price index (CPI) as the inflation variable, monetary policy variable (M2), government expenditure as a proxy for fiscal policy variable (GEX), and total exports of goods and services as a proxy for oil export (EXP).

VAR Granger causality/block exogeneity findings using Chi-Square-Wald tests show uni-directional causality for many variables. GDP has significant effects on ex-

port (EXP) and the monetary policy variable (M2). M2 has an impact on GDP. While the inflation variable (CPI) has no impact on any other variable, it is influenced by all other variables together and by export and M2 individually. There is an evidence of bi-directional causality between GDP and M2, and between GEX and M2. Both economic policies affect each other but monetary policy has a stronger impact on income. The oil export proxy (EXP) and the fiscal policy variable (GEX) show no significant impact on GDP.

It is noticeable that while both fiscal and monetary policies have negative effect on GDP and CPI mainly in the long-run, a shock in export has a consistently positive effect on GDP and CPI.

With regard to variance decomposition, it has been shown in this paper that the sources of variation in almost all variables are influenced by shocks to other variables, particularly in the long run. The increase in production and the right monetary and fiscal policy give a big boost to export in the long run. While export is the only variable that has an impact on M2 variation in the short run, shocks on GEX and GDP explain big part of that variation in the long run. The source of variation in GDP is mainly explained by EXP in the short run and GEX in the long run as well. The variation in CPI is mainly due to shocks in the two policy variables and GDP.

The results suggest that monetary policy is more influential on Yemeni economic variables than fiscal policy, which did not show the expected impact on the economic variables. This is may be explained by the fact that fiscal policy is rudimentary and ad hoc in nature. A big portion of the Yemeni government spending is unproductive and directed towards buying loyalty in a highly unstable tribal system.

Yemen economy depends heavily on oil exports and foreign aid. As discussed in the introduction section, these two factors experienced ups and downs movement during the period of 1990-2003, which was reflected in the results discussed above. In addition, as in many LDCs, decision making process in Yemen may contradict in many instances the economic rationale.

Yemeni government should reconsider its objectives and redesign its economic policies to be more focused on increasing productivity and achieving higher economic development targets.