*J. King Saud Univ.*, Vol. 20, *Admin. Sci.* (1), pp. 1-16, Riyadh (2008/1429H.)

# A Dynamic VAR Modeling Analysis to Some Macroeconomic Variables in the Jordanian Economy

**Ahmad Ibrahim Malawi**
*Associate Professor, Department of Economics, Faculty of Business Administration, Mu'tah University, Mu'tah, Karak, Jordan*
*E-mail: aimalawi@yahoo.com*

(Received 16/4/1426H.; accepted for publication 16/5/1427H.)

**Abstract.** This study aims to analyze the dynamic causal chain among six Jordanian macroeconomic variables; price level, money supply, government expenditures, output, private consumption, and gross capital formation over the period (1967-2002). A reduced-form Vector Autoregression (VAR) model is used. Three major tools are employed; Granger-causality test, variance decompositions, and impulse response functions.

The results are found to be consistent with the economic theory and the results of previous work concerning some other developed and developing countries. The results show that the Jordanian government can utilize both the monetary policy proxied by money supply and the fiscal policy proxied by government expenditures, to control the Jordanian economy.

***Keywords:*** Dynamic, Interaction, VAR.

## 1. Introduction

The joint behavior of the major macroeconomic variables has had a long debate and discussion among economists. Stock and Watson [1] believe that macroeconomic time series appear to contain variable trends, and modeling these variables trends as random walks with drift seems to provide a good approximation to the long run behavior of many aggregate economic variables.

The behavior of the six variables (price level, money supply, government expenditures, output, private consumption, and gross (fixed) capital formation) in Jordan during the (1967-2002) period seems to support the belief of Stock and Watson [1]. Time plots for these variables are shown in Fig. 1.

The objective of this paper is to show the dynamic causal chain among the above six variables over time. Some other macroeconomic variables such as exchange rate and nominal interest rate are excluded from this study for the following reasons:

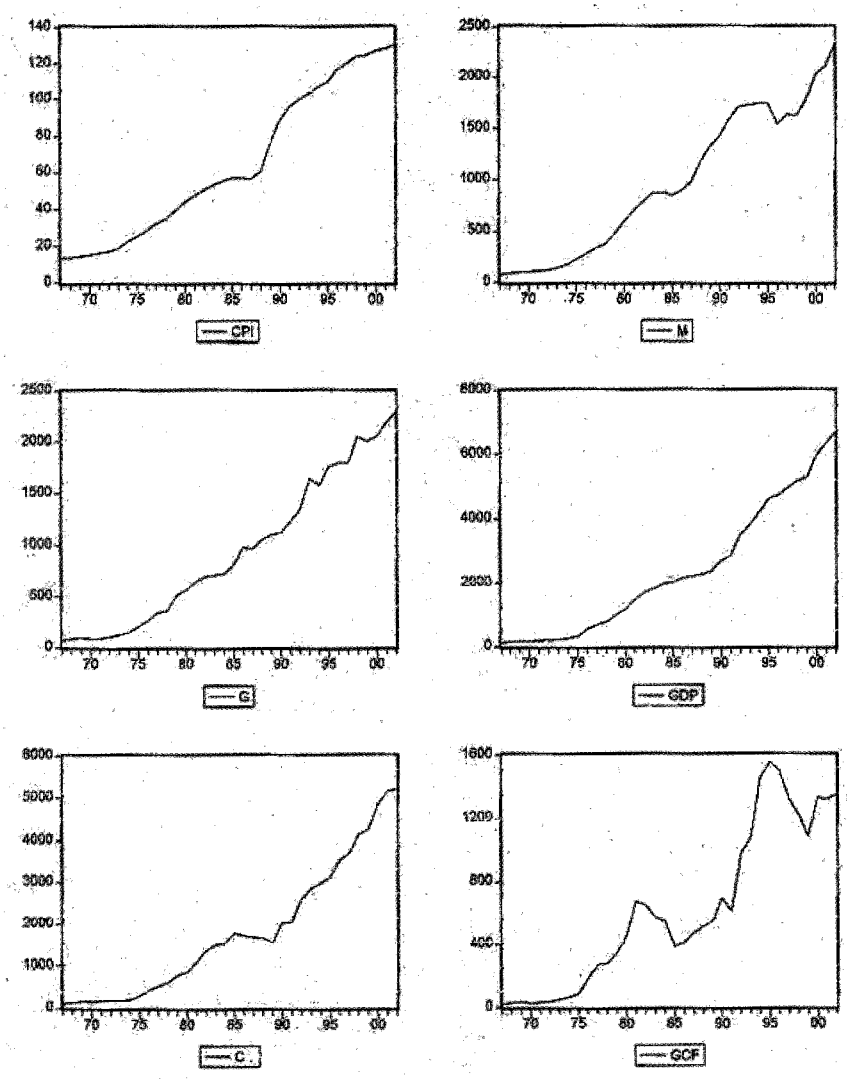


**Fig. 1. Time Pots for the Consumer Price Index (CPI), Money Supply (M), Government Expenditure (G), Gross Domestic Product (GDP), Private Consumption (C), and Gross Fixed Capita Formation (GCF).**

1) The Jordanian Dinar has been pegged to different foreign currencies during different subperiods of the study period. It started to be pegged to the Sterling Pound, then to the U.S. Dollar, to the SDR (Special Drawing Rights unit), and ended up to the U.S. Dollar again during the last few years [2].

2) The interest rate in Jordan is mostly determined by the Jordanian Monetary Authority represented by the Central Bank of Jordan, and so its changes don't reflect the market forces.

The data measured annually are from 1967 to 2002. The price level is proxied by the Consumer Price Index (CPI), which is commonly used. The money supply is measured by the narrow definition of money supply (M1). And, the test procedure in this study is based on a reduced-form relationship suggested by Sims [3]. The major tools that have been utilized are: Granger-causality test, variance decompositions, and impulse response functions.

## Economic Literature[1] and Previous Studies

Most of the empirical work concerning macroeconomic variables has focused on the policy variables, particularly the relative effectiveness of monetary and fiscal policies on influencing the economy.

Barro [4] has examined the effects of temporary changes of government purchases on interest rates, the quantity of money, the price level, and budget deficits for the British data from the early 1700s through World War I (WWI).

Tan and Baharumshah [5], in their study about the Malaysian economy, have analyzed the dynamic relationships among money (broad and narrow), interest rate, price level, and real output by employing a multivariate cointegration analysis, the Granger-causality test within the environment of vector error-correction modeling, the variance decompositions, and the impulse response functions.

Castro [6] found that fiscal shocks represented by government spending and taxes have small and significant effects on GDP, private consumption, interest rates, and prices for Spain.

Castro and Cos [7] found that, for Spain, government expenditures expansionary shocks have a positive impact on output in the short-run at the cost of higher inflation and public deficits and lower output in the medium and long-terms.

---

[1] Since the economic literature about this topic is very huge, the researcher has decided to limit this study to previous empirical work.

Malawi and Dayyat [8] have investigated the effect of monetary policy on economic activity in Jordan over the period (1970-2000) by using a time series analysis. It was found that money supply has a positive effect on GDP.

Malawi and Tarawneh [9] have explored the main factors that may explain the nature of the Jordanian inflation rate during the period (1967-2000). Their results have shown that money supply and government expenditures were responsible for most of the variations of the inflation rate, while the impact of national income and imports' price level were found to be limited in explaining the inflation rate.

## Econometric Methodology

In order to avoid imposing a priori restrictions of any specific economic theory, this empirical work is based upon a strategy suggested by Sims [3]. The procedure is to estimate relatively-unconstrained relationships among the variables in non-structural vector autoregression (VAR) models, which are based on Choleski decomposition.

VAR models have several advantages. Firstly, this kind of models shows the effect of one variable on another with lags, which is not always easy in the usual OLS method. Secondly, the usual econometric problems such as multicollinearity and autocorrelation are not considered to be serious problems in this method since the estimated parameters are not important. Thirdly, this method requires the minimum number of theoretical demands on the structure of the model. On the other hand, it is very difficult in VAR models to talk about elasticities. This means that these models are usually very helpful for forecasting [9, pp. 241- 242].

So, this study has utilized the estimation of a VAR model. Major tools like Granger-causality test, variance of decompositions, and impulse response functions are employed to explore the dynamic relationships among price level, money supply, government expenditures, output, private consumption, and capital (which is proxied by gross fixed capital formation) in a small open developing economy.

In this study, it is assumed that a six-dimensional multiple time series $Y_t = [CPI_t, M_t, G_t, GDP_t, C_t, GCF_t]'$ with six variables, and the relationship among these variables is:

$$Y_t = V + A_1 Y_{t-1} + A_2 Y_{t-2} + \ldots\ldots\ldots\ldots + A_n Y_{t-n} + u_t \qquad (1)$$

where $V = [v_1, v_2, v_3, v_4, v_5, v_6]'$ is a (6x1) vector of intercept terms, the $A_i$'s are (6x6) coefficient matrices, and $u_t$ is white noise with non-singular covariance matrix $\Omega$. The coefficients V, $A_i$'s, and $\Omega$ are assumed to be unknown. The time series data will be used to estimate these coefficients. Also, the variables are defined as follows:

$CPI_t$: is the consumer price index as a proxy variable for the price level.

$M_t$: is the nominal money supply with the narrow definition (M1).

$G_t$: is the nominal government expenditures.

$GDP_t$: is the nominal gross domestic product as a proxy variable for the output level.

$C_t$: is the nominal private consumption.

$GCF_t$: is the nominal gross (fixed) capital formation as a proxy variable for capital.

n: is the number of lags.

Since the consumer price index (CPI) is used to represent the price level, which its changes refelct the inflation rate, and this rate is considered to be an important macroeconomic variable in any economy, then the nominal values of the other five variables should be used instead of their real values. If the real values were used instead, then the nominal values would be divided by the CPI, and finally the CPI would be omitted from the model.

The model in Eq. (1) above is a reduced (or non-structural) form vector autoregression (VAR)[2] model. The difference between the non-structural and structural VAR models is that the non-structural form makes minimal theoretical demands on the structure of the model, where all we need is to specify only two factors: (i) the set of variables (endogenous and exogenous) that is believed to interact, and (ii) the maximum number of lags that are needed to capture most of the effects that the variables have on each other. On the other hand, the structural form implies that the specific relationships among the variables are based (either formally or informally) upon economic theory. But unfortunately, economic theory may not be sufficient to determine the right specification, i.e. the theory might be too complicated to allow one to derive precisely a specification from first principles [10, pp. 353-354]. So, the major advantage of the reduced form test is that the results are not conditional on the complete specification of the behavioral equations [11]. Also, Hafer and Sheehan [12] have stated in this context:

> "Because VAR analysis doesn't require the specification of an underlying theoretical model, it has been used to study the linkages among macroeconomic variables across national borders".

Regarding the value of n, i.e. the number of lags, the researcher utilized Akaike Information (Akaike) and Schwarz Criteria to choose the lag length. Unfortunately, the results have shown that the optimal lag lengths for these two criteria are 10 and 12

[2] VAR methodology superficially resembles simultaneous-equation modeling in that we consider several endogenous variables together. But, each endogenous variable is explained by its lagged, or past, values and the lagged values of all other endogenous variables in the model; usually, there are no exogenous variables in the model [25, pp. 735-736].

respectively, which might be considered very long for annual data. So, the value of n is chosen arbitrary to be three, which is supposed to be enough for capturing the dynamic interaction among variables with annual data. Leiderman [13] has chosen only two lags for annual data. Al-Tayeb and Malawi [2] have chosen five lags for annual data. Alaween [14] has chosen four lags for annual data. Dayyat [15] and Al-Majali [16] have chosen the lag-length to be six for annual Jordanian data. And finally, Malawi and Tarawneh [9] have chosen three lags for annual data in Jordan.

Yearly macroeconomic data were utilized to achieve the objectives of this study. The data were taken from the Monthly and Yearly Statistical Bulletins of the Central Bank of Jordan [17].

Since the price level is the average level of prices measured by a price index, and the best known price index is the consumer price index [18, p. 123], the Consumer Price Index (CPI) is employed in this study to be a proxy variable for the price level. The narrow definition of money supply (M1) is used as a proxy variable for the money supply and the gross (fixed) capital formation (GCF) is utilized to represent capital.

## Discussion of the Empirical Results

After running the computer program, written for the econometrics package RATS, on the variables of the VAR system in levels[3] of M, G, GDP, C, GCF, and the index of the price, CPI, and allowing for three lags, the following results are obtained for yearly observations from 1967 through 2002[4].

**Table 1. Granger-causality results for the VAR model (three- lags length)**

| Dependent variable | Independent variable | | | | | |
|---|---|---|---|---|---|---|
| | **CPI** | **M** | **G** | **GDP** | **C** | **GCF** |
| CPI | ..... | 6.19265*** | 2.39007* | 0.40019 | 2.47818* | 1.28065 |
| M | 1.23438 | ..... | 4.22929** | 3.40879** | 1.64893 | 1.90161 |
| G | 4.17752** | 3.68424** | ..... . | 5.62349*** | 0.60370 | 1.46119 |
| GDP | 16.75223*** | 4.28090** | 2.97404** | ..... . | 2.34971* | 0.58575 |
| C | 5.65739*** | 1.36755 | 4.40062*** | 7.24704*** | ..... . | 1.36102 |
| GCF | 7.81696*** | 5.02804*** | 7.44679*** | 5.90439*** | 15.78709*** | ..... |

Note: The asterisks indicate the following levels of significance:-
(*) significant at 10%
(**) significant at 5%
(***) significant at 1% or less.

[3] Even that some studies prefer to apply the VAR methodology on the variables after differencing them instead of their levels, Harvey [33] has noticed that the results from the transformed data may be unsatisfactory and the usual approach adopted by VAR lovers is therefore to work in levels even if some of these variables are non-stationary [25, p. 749].

[4] Estimation with two lags produced little difference in the empirical results, i.e. the results remain nearly identical. So, to conserve space, the results with two lags will not be presented here.

**1) Granger-causality test**

This test, which is based on F-statistics, has been carried out in this study to indicate whether the lags of a given variable in a particular equation help in forecasting the dependent variable of that equation one period ahead. The results are shown in Table 1. These results show the following:

a) Only three variables, C, G and M, Granger-cause the price index (CPI) at 10%, 10%, and less than 1% respectively. This result is quite consistent with the economic theory in the sense that a change in private consumption (C) or an expansionary fiscal policy (G) or an expansionary monetary policy (M) has a strong effect on the price level. No evidence is found to show that the other two variables, GCF and GDP, Granger-cause the price index.

b) Only G and GDP Granger-cause M at the 5% level of significance. This result is expected to be found in a developing country such as Jordan, where the Jordanian government finances its expenditures by deficit, i.e. through borrowing from the Central Bank of Jordan (i.e. deficit financing).

c) The variables M, GDP and CPI help to predict or Granger-causes G at 5%, less than 1% and 5% levels of significance respectively. The results for M indicate that the predictive power of money supply over G is consistent with the belief that money supply affects interest rates, which, in turn, affect interest payments on public domestic debt and thus affects G. Also, any change in GDP or CPI results in a change in G in Granger-sense.

d) Each of the variables C, G, M and CPI Granger-causes GDP at 10%, 5%, 5% and less than 1% respectively. These results are as expected since C and G are two components of GDP in the GDP identity. Also, the effect of any change in the price index (CPI) will directly change the nominal GDP.

e) G, GDP and CPI are found to be good predictors for the dependent variable C, or each of them Granger-causes C at a very high level of significance (1% or less). These findings are in line with the expectation that movements in G have an immediate effect on the private consumption; for example any increase in the current government expenditures may act as of raising the public employees wages reflected in an increase in CPI. Also, the same explanation can be said about GDP. Regarding CPI, higher inflation rates encourage people to raise their consumption, which is expected in the sense that inflation reduces the real interest rate and then savings, which implies that inflation raises the current consumption.

f) Each one of the variables in the model Granger-causes the gross capital formation (GCF) at a very high level of significance (1% or less). This can be explained based upon economic theory, where any increase in the price index (CPI), money supply (M), the government purchases (G), the level of income (GDP), or the level of private consumption (C) is expected to be a very strong incentive for increasing investment level, and in turn gross capital formation (GCF).

g) The results show that some statistical relationships are not significant, i.e. some economic variables may play no role in determining the other economic variables. The non-significance of some statistical relationships does not necessarily mean that the lags of one or more variables should be excluded from one or more

equations because the Granger-causality test is not a multivariate test. Therefore, even if the F-test says that one variable doesn't Granger-cause a second variable, the first variable may have some influence on the second variable through other equations in the VAR model [19, p. 72].

**Table 2. Variance decompositions (3-year horizon)**

| A. Percentage of Variance Due to Price Index (CPI): | | | | | |
|---|---|---|---|---|---|
| Horizon (years) | M | G | GDP | C | GCF |
| 1 | 0.04637 | 0.01356 | 0.00511 | 0.00474 | 0.00001 |
| 2 | 0.00259 | 0.01681 | 0.01690 | 0.00469 | 0.00352 |
| 3 | 0.00386 | 0.07543 | 0.04608 | 0.01888 | 0.00980 |
| B. Percentage of Variance Due to Money Supply (M): | | | | | |
| Horizon (years) | CPI | G | GDP | C | GCF |
| 1 | 7.45671 | 0.66163 | 0.83040 | 0.15826 | 1.13732 |
| 2 | 4.95335 | 1.01849 | 1.02076 | 0.16245 | 0.62914 |
| 3 | 2.52735 | 1.85707 | 0.86066 | 0.32746 | 0.53004 |
| C. Percentage of Variance Due to Government Purchases (G): | | | | | |
| Horizon (years) | CPI | M | GDP | C | GCF |
| 1 | 16.96814 | 5.14748 | 5.17390 | 1.73207 | 5.60460 |
| 2 | 19.58054 | 1.17883 | 7.89701 | 2.09836 | 6.23513 |
| 3 | 13.61946 | 4.98662 | 22.37980 | 5.38491 | 14.50445 |
| D. Percentage of Variance Due to Gross Domestic Product (GDP): | | | | | |
| Horizon (years) | CPI | M | G | C | GCF |
| 1 | 20.01188 | 20.24076 | 16.20970 | 4.37929 | 28.50842 |
| 2 | 37.03483 | 15.75728 | 18.48602 | 4.28892 | 15.82843 |
| 3 | 46.32110 | 13.64806 | 33.35192 | 5.47899 | 13.55533 |
| E. Percentage of Variance Due to Private Consumption (C): | | | | | |
| Horizon (years) | CPI | M | G | GDP | GCF |
| 1 | 55.26108 | 11.47495 | 16.14253 | 13.02724 | 3.52513 |
| 2 | 34.40512 | 45.44320 | 22.76889 | 16.46252 | 25.79892 |
| 3 | 28.87886 | 44.00279 | 18.48592 | 14.76434 | 22.78277 |
| F. Percentage of Variance Due to Gross (Fixed) Capital Formation (GCF): | | | | | |
| Horizon (years) | CPI | M | G | GDP | C |
| 1 | 0.04700 | 29.07189 | 18.41424 | 29.89684 | 1.24274 |
| 2 | 3.76635 | 33.00686 | 24.60588 | 29.95190 | 1.49380 |
| 3 | 8.46586 | 33.98028 | 19.72645 | 25.12402 | 1.35694 |

**2) The variance decompositions**

While the Granger-causality test is important, a more formal statistical assessment could be obtained by computing variance decompositions for the variables of this study at various horizons.

Table 2 gives these variance decompositions for the variables. Define the three-year-ahead forecast error in each variable as the difference between the actual value of that variable and its forecast from the model in Eq. (1). This forecast error could be explained by unanticipated disturbances of the other variables in the last three years. The following conclusions emerge from Table 2:

a) The figures in part A of Table 2 show that the money supply forecast error is affected more than the other four variables by the price index (CPI). This effect starts with 0.046% one year ahead and declines for a longer time period. On the other hand, the price index explains the least of the forecast error of the gross (fixed) capital formation (GCF), where it explains only 0.00001% for one year ahead. In all cases, the price index disturbance appears to have a very weak effect on the fluctuations of all the other variables at all horizons in the model. The contribution of price index disturbances at all horizons to fluctuations in all other variables varies from 0.00001% to less than 8%.

b) The figures in part B of Table 2 show that the effect of money supply (M) on the price index (CPI) is the greatest comparing to the effects on the other variables. The money supply explains 7.45% of the variations in the price index (CPI) for one year ahead, and this effect declines over time and ends up at 2.5% for three years ahead. These results support the Granger-causality test, where it is found that M Granger-causes CPI at less than 1% level of significance. In general, the results agree completely with the idea that inflation is a monetary phenomenon. Mansor [20], for example, has found that inflation in Malaysia is a monetary phenomenon and to a limited extent is imported. Also, the results of this study agree with what Friedman and Kuttner [21] have stated in this regard:

> "Economists have long understood that the quantity of money, or its growth ratecan play a useful role in the monetary policy process only to the extent that fluctuations in money over time regularly and reliably correspond to fluctuations in income, prices, or whatever other aspects of economic activity the central Bank seeks to influence"

On the other hand, the effect of (M) on the other variables seems to be minimal, where (M) explains only less than 2% of the variations in each of the other four variables for one, two and three years horizon.

c) The figures in part C of Table 2, show that the government purchases (G) have the greatest effect on the price index (CPI), where they explain between 13% and 20% of the variations in CPI during the given horizon. It seems from parts B and C of Table 2 that the percentage of variance of CPI that is due to G is greater than the

one that is due to M. Even though this result is very surprising, it is completely in line with the results of Sims [22] concerning the U.S. economy, where he has found that the inflation is a fiscal phenomenon. On the other hand, this result is not consistent with Dwyer's results [11] about the U.S. economy, where he has found that expected government deficits have no significance for future inflation.

d) The figures in part D of Table 2, show that the Gross Domestic Product (GDP) is very powerful in explaining most of the variations in four variables; CPI, M, G and GCF. However, it does not have enough strength to explain the variations in the private consumption (C). For instance, at a forecast horizon of three years, it is found that the contribution of GDP disturbances in explaining the variations in C ranges from 4% to less than 6%.

e) The figures in part E of Table 2 show that the price index (CPI) is the most influenced variable by the private consumption (C), where C explains around 55% of the variations in CPI for one year ahead, and this effect declines over time to reach 34% for two years and around 29% for three years ahead. This result is expected since C represents an important element of aggregate demand, and increases in aggregate demand push the price level up in the aggregate demand-aggregate supply model [23, p. 412].

f) The figures in part F show that the gross (fixed) capital formation (GCF) has more influence on M and GDP than on the other three variables; CPI, C and G. The relative contribution of GCF disturbances to M and GDP fluctuations at any horizon is higher than 25%. This contribution falls to less than 10% for CPI and C. The effect of GCF on GDP is natural since investment is considered as a part of the aggregate demand.

In this regard, it is worthy to mention that the above results are basically unchanged if data before 1973 (a wartime in the Middle East) are dropped or if M1 is replaced by M2 as a proxy variable for the money supply.

### 3) Impulse response analysis

Having shown the results of the variance decompositions of the variables in the model, the next step is to analyze the impulse responses. The impulse response function shows the response of one variable to an impulse in another variable in a system that involves a number of other variables as well. If there is a reaction of one variable to an impulse in another variable, we may call the latter causal for the former [24, p. 43]. In other words, the response function traces the response of an endogenous variable in the VAR system to unexpected shocks in the error terms of the variables in the system for several periods in the future [25, p. 749]. Thus, the impulse response function which is calculated by:

$$\frac{dY_{t+s}}{du_{jt}}$$ , $Y_t$ and $u_t$ as defined in Eq. (1),

measures the effect of an innovation in the jth variable on future values of each of the variables in the system [26, p. 327][5].

The impulse responses with upper and lower two standard deviation bands around the point estimates for the VAR model of this study are shown in Fig. 2.[6] The first row of the figure shows the dynamic responses of the variables in the model to unexpected positive shock to the price index (CPI). The second row of the figure shows the dynamic responses of the variables in the model to unexpected positive shock to money supply (M), and so on.

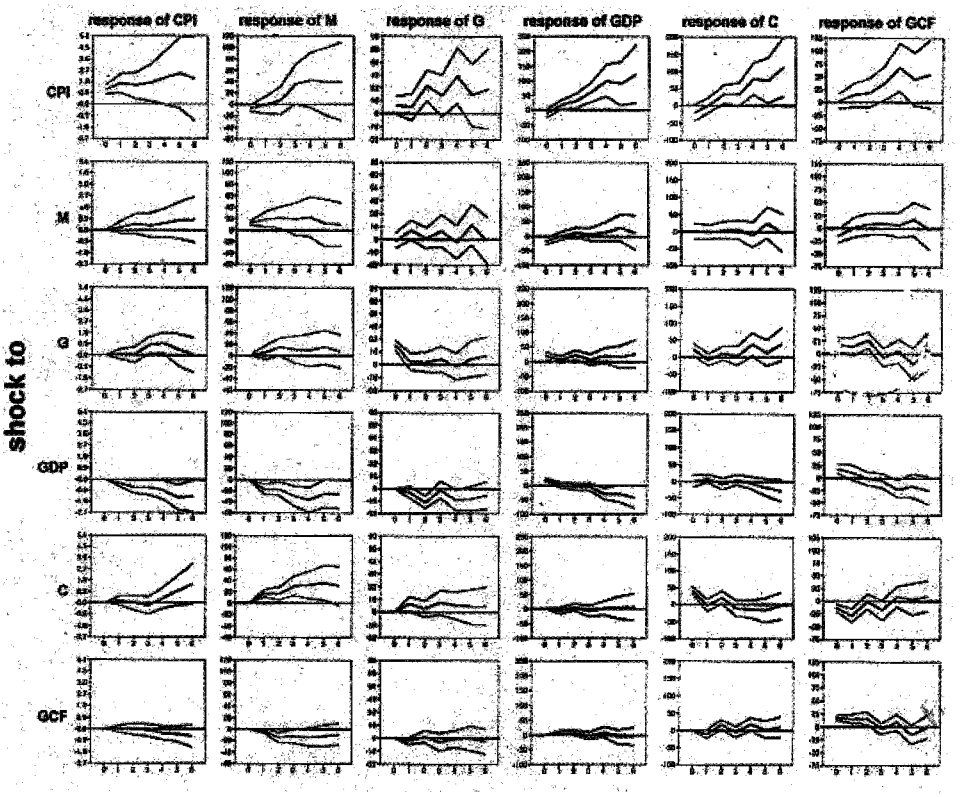


**Fig. 2. Impulse Responses.**

[5] Even that the utility of the impulse response function has been questioned by researchers, it is the centerpiece of the VAR analysis [34].

[6] The two extreme lines in each graph of Fig. 2 refer to two standard error bands, which are evaluated by using Monte Carlo procedure.

The analysis of the results of impulse responses can be summarized as follows:

a) Obviously, the first row of the figure shows that any unexpected positive shock to the price index (CPI) has an immediate and significant positive effect on all the other variables in the system and these positive effects last for a few years. The price index disturbances have a hump-shaped effect on GCF. This effect peaks after four years and starts to decline after that. The positive effect of a positive shock to CPI on G supports Barro's hypothesis [27, 28], where he has put forward a hypothesis stating that deficits are a result of inflation, rather than inflation being a result of deficits.

b) The second row in the figure shows that the effect of money supply (M) disturbances on CPI increases steadily over time, but it is marginally significant. On the other hand, the effect of a shock to M is very weak and insignificant on the other variables in the system. This is quite consistent with the earlier finding in part B of Table 2, where it has been found that M has the greatest effect on CPI comparing to the other variables of the VAR model, and also consistent with the Granger-causality test where it is found that M Granger-causes CPI at less than 1% level of significance.

c) The third row shows that any positive innovation to G has a positive effect on CPI. This effect is at a marginal significance level and starts after one to two years, peaking after four years and reaching a plateau after six years (i.e. CPI slowly returns to its original steady-state value). This effect is expected since any increase in G raises the total spending, which in turn raises the price index [29, 30]. The results here and in second above, i.e. the variance of decompositions, agree completely with Sims' results [22], where he has found that "the existence and uniqueness of the equilibrium price level cannot be determined from knowledge of monetary policy alone; fiscal policy plays an equally important role", and he has mentioned in this context:

> "In a fiat-money economy, inflation is a fiscal phenomenon, even more fundamentally than it is a monetary phenomenon"

Also, the results of this part are in line with the monetarists viewpoint. For example, Buchanan and Wagner [31] suggest that any increase in the government expenditures raises the price level. On the other hand, Dwyer [11] has found that expected government deficits in the U.S. have no significance for future inflation.

The same row shows also that the effect of G on the gross (fixed) capital formation (GCF) is immediate, positive and significant. Furthermore, it lasts for about two years. This effect is due to the fact that part of the government purchases is capital expenditures. Also, this effect becomes insignificant starting from the third year.

Also, the effect of any shock to G raises M immediately, and this effect vanishes after four to five years. This result is expected since the Jordanian government sometimes resorts to finance its expenditures by financing deficit through creating more

money supply. This effect is called "financing by deficits or deficit financing". This result is consistent with the suggestion advanced by Buchanan and Wagner [31], where they claim that if the government sells bonds to spend more, then the Federal Reserve (the American Central Bank) might purchase these bonds, which in turn raises the money supply through the open market operations.

The effect of shocks to G on the other two variables, Gross Domestic Product (GDP) and private consumption (C), are very weak. Blanchard and Quah [32] have found that all the aggregate demand disturbances have only transitory output effects.

d) The fourth row in Fig. 2 shows that any positive shock to GDP has only negative effects on CPI, M and G. This result may be due to the fact that both fiscal and monetary authorities resort to restrictive policies in the situation of economic expansion, which might reduce the price index. The dynamic response of GCF is quite different; a positive shock to GDP initially increases GCF slightly. Following this increase, the impact is reversed and becomes negative rather than positive after two to three years.

e) The fifth row shows that the responses of M and G are significantly positive and immediate to any positive shock to C. The peak response of M takes place after four to five years, and this effect declines to stabilize eventually.

f) Finally, the last row gives an indication that the response of M to a positive shock to GCF is negative, but the other four variables, CPI, G, GDP and C, don't respond to a shock to GCF. When these results are combined with the results of the Granger-causality test, it is clear from the last column of Table 1 that they support each other and GCF is not a good predictor for explaining the macroeconomic variables of this study about Jordan.

## Conclusions and Extensions

This study aims to analyze the dynamic causal chain among six Jordanian macroeconomic aggregate variables over the period (1967-2002). These variables are: price index, money supply, government purchases, GDP, private consumption, and gross (fixed) capital formation.

The test procedure in this study is based on reduced-form relationships suggested by Sims [3]. The major econometric tools that have been employed are: Granger-causality test, variance decompositions, and impulse response functions.

The results of this study, in general, agree with the economic theory from one side, and with most of the other studies about some developed and developing countries from the other side. A further consistent result is that it is found that the major two economic policies, the monetary policy proxied by money supply and the fiscal policy proxied by the government purchases, have the greatest effects on the other chosen macroeconomic variables. This means that the Jordanian government can utilize both of fiscal and

monetary policies to control the Jordanian economy, at least in the short run.

While I think this simple work is worthwhile, I also do believe that more future work is needed. I have in mind some specific extensions. Firstly, is to apply the model on a quarterly or monthly data. Secondly, is to examine the addition of new variables to the model such as foreign aid to the Jordanian government and international trade variables. Thirdly, is to apply the model on growth rates or first differences of the variables. And finally, is to apply the model on real values of the variables instead of their nominal values.

## References


[1] Stock, James H. and Watson, Mark W. "Variable Trends in Economic Time Series." Journal of *Economic Perspectives*, 2, No. 3 (1988), 147-174.

[2] Al-Tayeb, Saud and Malawi, Ahmad Ibrahim. "The Determinants of the Jordanian Real Exchange Rate against the U.S. Dollar: A Vector Autoregression (VAR) Model." *Al-Manarah*, Al-Bayt University, Jordan, VIII, No. 1 (2002), 71-88.

[3] Sims, Christopher. "Macroeconomics and Reality." *Econometrica*, 48 (1980), 1-48.

[4] Barro, Robert J. "Government Spending, Interest Rates, Prices, and Budget Deficits in the United Kingdom 1701-1918." *Journal of Monetary Economics*, 20 (1987), 221-247.

[5] Tan, Hui Boon and Baharumshah, Ahmad Zubaidi. "Dynamic Causal Chain of Money, Output, Interest Rate, and Prices in Malaysia: Evidence Based on Vector Error-correction Modeling Analysis." *International Economic Journal*, 13, No. 1 (1999), 103-120.

[6] Castro, Francisco de. "The Macroeconomic Effects of Fiscal Policy in Spain." Working Paper, Banco De Espana, (2003).

[7] Castro, Francisco de and Cos, Pablo Hernandez De. "The Economic Effects of Exogenous Fiscal Shocks in Spain: A SVAR Approach." Working Paper, Banco De Espana, (2006).

[8] Malawi, Ahmad Ibrahim and Dayyat, Rasha. "A Time Series Analysis of the Monetary Policy Effects on Economic Activity." *Dirasat, Administrative Sciences*, University of Jordan, Jordan, 31, No. 2 (2004), 394-405.

[9] Malawi, Ahmad Ibrahim and Tarawneh, Saeed. "The Effects of Money Growth and Government Expenditures on Inflation: Non-structural Vector Autoregression (VAR) Method." *Abhath Al-Yarmouk,* Humanities and Social Sciences, Yarmouk University, Jordan, 20, No. 3B (2004), 237-253.

[10] Pindyck, Robert S. and Daniel L. Rubinfeld. *Econometric Models and Economic Forecasts.* U.S.A.: McGraw-Hill, Inc., 1991.

[11] Dwyer, Gerald P. "Inflation and Government Deficits." *Economic Inquiry*, XX (July 1982).

[12] Hafer, R. W. and Sheehan, Richard G. "Policy Inference Using VAR Models." *Economic Inquiry*, XXIX (January 1991), 44-52.

[13] Leiderman, Leonardo. "On the Monetary Macro Dynamics of Colombia and Mexico." *Journal of Development Economics*, 14 (1984), 183-210.

[14] Alaween, Mohammad. "The Impact of Credit on Economic Fluctuations in Jordan During the Period (1973-1996)." *Unpublished Master Thesis, University of Jordan,* Jordan, (1998).

[15] Dayyat, Rasha "The Effect of Monetary Policy on the Economic Activity by Using Time Series Analysis." *Unpublished Master Thesis, Mu'tah University*, Jordan, (2003).

[16] Al-Majali, Ahmad. "The Impact of Credit on the Jordanian Economic Activity: VAR Model over the Period (1970-2000)." *Unpublished Master Thesis, Mu'tah University*, Jordan, (2003).

[17] Central Bank of Jordan, Monthly and Yearly Statistical Bulletins, Various Issues.

[18] Parkin, Michael. *Macroeconomics*. 5th ed., Addison-Wesley Publishing Company, Inc., 2000.

[19] Cuevas, Vector M. "Sources of Inflation and Output Fluctuations in the Mexican Economy." *Unpublished PhD Dissertation, University of Missouri, Columbia*, U.S.A., (May 1997).

[20] Mansor, I. "Inflationary Behavior in Malaysia: An Empirical Evaluation of Its Determinants." *Malaysian Journal of Economic Studies*, XXXII, No. 2 (1995), 29-40.

[21] Freidman, Benjamin M. and Kuttner, Kenneth N. "Money, Income, Prices, and Interest Rates." *The American Economic Review,* 82, No. 3 (June 1992), 472-492.
[22] Sims, A. Christopher. "A Simple Model for Study of the Determination of the Price Level and the Interaction of Monetary and Fiscal Policy." *Economic Theory*, 4 (1994), 381-399.
[23] Mankiw, N. Gregory. *Principles of Macroeconomics*. U.S.A.: Harcourt Brace College Publishers, 1997.
[24] Lutkepoh, Helmut. *Introduction to Multiple Time Series Analysis.* Berlin, Germany: Springer-Verlag, 1991.
[25] Gujarati, Damodar N. *Basic Econometrics*. 3rd ed., McGraw-Hill Inc., 1995.
[26] Hamilton, James D. *Time Series Analysis*. Princeton, New Jersey, U.S.A.: Princeton University Press, 1994.
[27] Barro, Robert J. "Comment from an Unreconstructed Ricardian." *Journal of Monetary Economics*, 4 (1978), 569-581.
[28] Barro, Robert J. "On the Determination of the Public Debt." *Journal of Political Economy*, 87 (October 1979), 240-271.
[29] Metzler, Lloyed A. "Wealth, Saving, and the Rate of Interest." *Journal of Political Economy*, 59 (April 1951), 93-116.
[30] Patinkin, Don. *Interest and Prices*. 2nd ed. New York: Harper and Row Publishers, 1965.
[31] Buchanan, James M. and Wagner, Richard E. *Democracy in Deficits: The Political Legacy of Lord Keynes*. New York: Academic Press, 1977.
[32] Blanchard, Oliver Jean and Quah, Danny. "The Dynamic Effects of Aggregate Demand and Supply Disturbances." *The American Economic Review*, 79, No. 4 (1989).
[33] Harvey, Andrew. *The Econometric Analysis of Time Series*. 2nd ed., Cambridge, Mass., U.S.A.: The MIT Press, 1990.
[34] Runkle, D. E. "Vector Autoregression and Reality." *Journal of Business and Economic Statistics*, 5 (1987), 437-454.

# تحليل ديناميكي للعلاقة بين بعض المتغيرات الاقتصادية الكلية في الأردن باستخدام نموذج الانحدار الذاتي المتجه

**أحمد إبراهيم ملاوي**

*قسم الاقتصاد، كلية إدارة الأعمال، جامعة مؤتة،*

*مؤتة، كراك، الأردن*

(قدم للنشر في ١٤٢٦/٤/١٦هـ، وقبل للنشر في ١٤٢٧/٥/١٦هـ)

**ملخص البحث**. تهدف هذه الدراسة بشكل أساسي إلى تحليل سلسلة العلاقة الديناميكية بين ستة متغيرات اقتصادية كلية في الاقتصاد الأردني وهي: مستوى الأسعار، وعرض النقد، والإنفاق الحكومي، ومستوى الإنتاج، والاستهلاك الخاص، وإجمالي التكوين الرأسمالي خلال الفترة (١٩٦٧-٢٠٠٢م).

ولتحقيق هذا الهدف، تم استخدام نموذج VAR بالشكل المختزل للمتغيرات الستة. وكانت أدوات التحليل الرئيسية التي تم استخدامها هي: اختبار جرينجر للسببية، وتحليل مكونات التباين، ودالة الاستجابة لردة الفعل.

وكانت نتائج الدراسة منسجمة تمامًا مع النظرية الاقتصادية من جهة ومع نتائج الدراسات السابقة المتعلقة بالدول النامية والدول المتقدمة من جهة أخرى، حيث أظهرت نتائج هذه الدراسة أنه بإمكان الحكومة الأردنية الاستفادة من كل من السياسة النقدية (ممثلة بعرض النقد) والسياسة المالية (ممثلة بالإنفاق الحكومي) للتحكم بالاقتصاد الأردني وتوجيهه بما يتلاءم والأهداف الاقتصادية للحكومة.