USEFULNESS OF MONETARY AGGREGATES VERSUS INTEREST RATES IN MONETARY POLICY FORMULATIONS IN TURKEY

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ÖZET

Türkiye, 1980 yılından başlayarak, yeni kalkınma stratejisi çerçevesinde ekonomi politikalarının etkin bir biçimde uygulanabilmesi için, gerekli kurumları ve piyasaları oluşturmaya başladı. Bu yeni kurum ve piyasalar ise, doğal olarak, ekonomi politikalarının araçlarını ve etki alanlarını değiştirmeye başladı. Özellikle para otoriteleri, açık bir piyasa ekonomisinde para politikaları uygulama olanağına kavuştular. Bu çalışma, 1990–2005 arası döneme ait verilerden hareketle, basit bir vektör otoregresyon (VAR) analizi çerçevesinde Türkiye'de çıktı ve enflasyonun değişkenliğinin açıklanmasında faiz oranları ve parasal büyüklüklerin göreli önemlerini araştırmaktadır. VAR analizi sonuçları faiz oranlarının parasal büyüklüklere göre çıktının değişkenliğini açıklamada daha önemli bir role sahip olduğunu göstermektedir. Enflasyonun değişkenliğini açıklamada ise en dar tanımlı para arzı olan "dolaşımdaki para" önemli bir açıklama gücüne sahiptir.

1. INTRODUCTION

The knowledge of the link between nominal and real variables is essential in understanding the effects of monetary policy on output and inflation. However, there is not a consensus among macroeconomists about the ways in which monetary policy exerts its effects on the economy. This disagreement about whether or not

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monetary policy affects the economic activity, through which channels it exerts its influence, and whether there is a feedback from real sector to monetary sector calls for more research in this field.

Turkey started to implement a far-reaching 'economic stabilization and structural adjustment program' on January 24, 1980. This structural adjustment program aimed not only at stabilizing the economy and solving economic problems in the short run but also changing the development strategy Turkey had followed in the preceding two decades. Together with the new development strategy, Turkey not only began to implement an export oriented industrialization policy but also started to transform its planned economic structure into a more market oriented one. In the second half of the 1980s, Turkey embarked on establishing the institutions the markets necessary for the implementation of an efficient monetary policy. These developments have naturally led to substantial changes in conducting monetary policy in terms of both the instruments and the implementation.

In this framework, this study seeks to investigate the link between interest rates and monetary aggregates on the one hand and the industrial production and inflation on the other, and evaluate the usefulness of interest rates and monetary aggregates as the tools of monetary policy in effecting industrial output and inflation. For this purpose, I estimate a small vector autoregression (VAR) model using data from 1990 to 2005 and test roles of interest rates and monetary aggregates in explaining the variances of industrial output and inflation through variance decompositions.

The rest of the paper is organized as follows. In Section 2, a short review of monetary transmission mechanisms is provided. In Section 3, the results of variance decompositions from a simple VAR are presented. In Section 4, the implications of the empirical findings for the effectiveness of interest rates and monetary aggregates in explaining the variances of industrial output and inflation, and therefore, their usefulness as the tools of monetary policy are discussed. Section 5 is the conclusion.

2. MONETARY TRANSMISSION MECHANISMS

The literature on the monetary transmission mechanisms is voluminous. However, the effects of money on economic activity are still one of the most controversial issues in macroeconomics today. Although there is a consensus among economists that in the long run there are no substantial effects on real output or its growth rate from a monetary expansion, the magnitude and the duration of short run effects are intensely debated.

There are three steps in studying the effects of monetary policy on economy: The first step involves measurement of monetary policy and determination of

available transmission channels. In the second step, it is necessary to determine the macro economic environment under which monetary policy is conducted. Finally, in the third step, the results obtained from the monetary policy conducted needs to be calculated and compared with the targets in order to assess the effectiveness of the policy.

Monetary transmission channels considered in the current literature can be classified as interest rate channel, exchange rate channel, other asset prices channel, and credit channel. This study examines the relevance of interest rate channel through which monetary policy exerts its effects on inflation and output, and importance of interest rates and monetary aggregates in the formulation of monetary policy in Turkey. Therefore, in this section I shall review only the literature on interest rate channel[1].

2.1. Interest Rate Channel of Monetary Transmission

Friedman and Schwartz (1993)'s conclusion that monetary changes are not reflections of changes in economic activity is the starting point in conventional analysis of monetary transmission. This conclusion states that monetary changes are not responses to changes in other variables, i.e., monetary changes are exogenous to the system. However, for the existence of a transmission from money to the real variables such as employment and output, there must exist a close and stable relationship between changes in money stock and real income. Lucas (1973) and Barro (1977) studied the conditions under which a link can exist between monetary variables and real variables. These studies investigated the relationship between unanticipated changes in monetary variables and real economic activity. However, neither of these studies examined the details of the monetary transmission mechanism.

The interest rate channel is the standard feature of Keynesian models. Keynes (1964:79) summarizes interest rate channel as follows; "changes in the quantity of money may result, through their effect on interest rate, in a change in the volume and distribution of income...". In fact, inclusion of interest rate in the money demand function is an essential part of monetary transmission mechanism in Keynesian analysis. Tobin (1947) discards the assumption of an interest rate inelastic money demand function because if money demand is interest rate inelastic and investment and consumption are not responsive to interest rates, then there is no room for monetary policy to affect output and employment through interest rates.

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[1] An in dept review of monetary transmission channels is provided in Ozturkler (2002).

Interest rate channel of monetary transmission works as follows: The monetary authority controls a short-term nominal interest rate. Changes in short-term nominal interest rate lead to changes in the long-term real interest rate as a result of slow adjustment of prices. The changes in the long-term real interest rates then affect the business fixed and inventory investment, residential housing investment, consumer durable expenditures, and therefore, real GDP. However, in the long run, real GDP returns back to its normal level as a result of the adjustment in prices.

According to Modigliani and Papademos (1980), a change in money supply first affects short run interest rates because short-term instruments are the closest substitutes for money. But this effect spreads to long run interest rates because demand for longer maturities, whose yields become more attractive relative to shorter maturities, rises. Interest rate channel defined in this way assumes implicitly a transmission process starting from money to interest rates, the process continuing from interest rate to the components of aggregate demand, and then to output and employment. This approach to the transmission mechanism takes monetary aggregates as policy instruments, and regards interest rates as intermediate targets.

Friedman (1968) argues that there are two limitations of the process described above. First, increase in income due to lower interest rates will both increase money demand and price level, which will eliminate the initial effect of expansionary monetary policy and interest rates will return to their initial levels. Second, as output and employment increase, it will eventually increase real wage, which will reduce employment and therefore output to their initial levels.

Cagan (1972:1), an important representative of monetarist approach, argues that "there are three different kinds of monetary effects on interest rates-a portfolio effect, a credit effect, and an inflation effect". The portfolio effect is due to the fact that money and other financial assets are substitutes for each other. To measure that effect empirically, one needs to relate the level of interest rate to the rate of change of the money stock. In case of credit effect, the idea is that creating money through an expansion of credit reduces the interest rates because money created by banks contributes to the supply of real loanable funds. The final effect is important because it is essential to distinguish between nominal and real interest rates. The portfolio effect works through affecting the behavior of the public regarding their portfolio decisions, while the credit effect works through affecting the behavior of the banks and its effects on financial markets.

In Lucas (1990), money is required not only for the transactions on goods and services but also for the asset transactions. In this kind of neoclassical setting, naturally, the quantity of money affects the prices of not only goods and services but also the assets. Therefore, in this case, the resulting effects of a monetary shock on

the interest rates will be different than the case in which money is required only for the transactions on goods and services. In Fuerst's (1992) model, on the other hand, the monetary nonneutralities revolve around movements in nominal interest rate, which in turn depends on the liquidity effect. The liquidity premiums arise when the values of cash in goods and financial markets are different from each other. In this neoclassical model with a variable labor and capital, increase in money supply increases current as well as future real activity, while having an ambiguous effect on the price level.

Christiano (1991) modifies Lucas (1990) and Fuerst (1992)' models by assuming that households cannot continuously revise their consumption and savings decisions, i.e., they cannot immediately adjust to a monetary shock and resulting changes in financial markets circumstances. Under this assumption, for the firms to absorb the larger share of a money injection, interest rate has to decline. The lower interest rate (assuming liquidity effect dominates anticipated inflation effect, i.e., real interest rate also declines) encourages firms to borrow and invest more, raising employment and output. However, the assumption that households do not revise their economic decisions continuously is valid only in countries where price levels have relatively been stable for some time and the monetary shocks do not take place frequently. For example, Sahinbeyoglu (2001) stresses that the wages and prices adjust very quickly in Turkey compared to other countries such as the United Kingdom. In addition to the frequency of price changes, the size of the changes also displays a very high level variance, requiring economic agents to revise their decision continuously. This is because of the fact that high levels of variances in price level have important implications for the decision makers' welfares.

Taylor (1995:14) claims that the links of the monetary transmission described above form a circle, "with the circle being closed by linking the movements in real GDP and inflation back to the short-term interest rate through a policy rule or reaction function". This description, however, implies implicitly that causal relation between money and output through the interest rates is a two-way relationship. However, Mishkin (1995:5) argues that Taylor's position that "there are strong interest rate effects on consumer and investment spending and, hence, a strong interest rate channel of monetary transmission" is controversial. In addition, Bernanke and Gertler (1995) observe that empirical studies had great difficulty in determining the effects of interest rates.

Monetarists, for example, Meltzer (1995), criticize the above interest rate channel argument for considering only one asset price. According to this viewpoint, the transmission of monetary policy involves relative asset prices. Many Keynesians, such as Franco Modigliani (1971), also admit the importance of other asset prices in monetary transmission mechanism.

The basic assumption of the interest rate channel of monetary transmission is the existence of a short-term interest rate that is directly under the control of the monetary authority. This assumption implies that there must not be a long lag between money supply and change in interest rates because the longer this lag is the more the effect of monetary policy on economic activity will be postponed. As described by Kamin, Turner and Van't dack (1998), a change in the interest rate controlled by the Central Bank affects all short-term interest rates, and in turn affects long-term interest rates, which are the most relevant to the investment decisions of firms as well as households.

A second implicit assumption of the interest rate channel is the existence of price rigidity in the short run. This is because of the fact that the interest rate mechanism affects aggregate demand by changing the marginal profitability of investment projects and opportunity cost of consumption. However, as it is argued by Sims (1998), changes in interest rates resulting from open market operations can itself be the source of the changes in prices. On the other hand, Friedman (1969) asserted that although changes in money supply lead to changes in prices over the longer periods, the link between changes in money supply and prices is weaker in shorter periods. Even in high inflation countries where prices and wages adjust relatively quickly, in short run prices and wages can be taken as relatively rigid.

The conventional view of the interest rate channel links changes in real interest rates to aggregate demand, and therefore, to output and employment. However, Litterman and Weiss (1984) assert that changes in nominal interest rates are also important due to their informational content about the changes in anticipated inflation. They, in fact, argue that real interest rates are exogenous in the sense that they are determined by their own past history without any influence coming from money.

In any case, it is mostly agreed that there is a link between monetary policy and real activity operating through interest rates, at least in the short run. However, Fuerst (1992) argues that whether monetary injections lower interest rates via a liquidity effect is an empirical question and cannot be answered a priori. For example, according to Sims (1998), during the postwar period in the United States, by looking at the interest rates and output one can conclude that interest rates preceded each recession. However, he also warns against the fact that simple bivariate relations between economic variables can be misleading. In an inflationary environment with high and rising budget deficit and rudimentary financial markets, such has been the case for the period considered in this study for Turkey, simple correlation between interest rates and output reveals even less information about the functioning of monetary policy through interest rates. In such a setting, for example,

a monetary injection will not necessarily reduce interest rates if it primarily finances the budget deficit.

2.2. Measures of Monetary Policy

Once the monetary policy strategy is chosen given the economic policy objectives of the country, central bankers face the problem of choosing the instrument of monetary policy. Blinder (1998:26) points out that "the choice of monetary instrument is often posed as a contest between the rate of interest and the money supply". In addition, even when one set of these policy instruments is preferred over the other, the question of which interest rate and which definition of money supply will be used needs to be answered.

Blinder and Goldfeld (1976: 780) declare that "indicators of fiscal and monetary policy typically are designed to show the effects of government or Federal Reserve actions on some endogenous variable of interest, typically (but not always) real or nominal gross national product (GNP)". Measuring monetary policy is important for theoretical as well as practical reasons. Zha (1997: 26) stresses that "identification of monetary policy is partly a conceptual (economic) issue and partly an empirical (technical) one".

It is important for empirical researchers to have a measure to determine the stance of monetary policy central banks pursue to evaluate the effect of this policy on various sectors of the economy. The evaluation of alternative theories of monetary policy also necessitates an accurate measure of monetary policy. On the other hand, measuring economic variables presents a perpetual challenge because the composition of the many variables changes over time. For example, Anderson and Kavajecz (1994: 2) forcefully warn about the fact that "a failure to appreciate the interdependence of time, data, definitions and procedures may adversely affect or vitiate research and policy conclusions. Furthermore, as Barran, Coudert, and Mojan (1995) claim, financial liberalization has significantly altered the nature of monetary aggregates over time. They also point out that in most of the OECD countries, the link between money as well as credit and economic activity weakened.

However, in addition to the controversy about how to measure a given economic variable, a researcher investigating the link between monetary policy and real economic activity faces the question of which variables the monetary authorities can control, at least to some extent, so that they can influence the behaviors of economic agents by using these variables. Furthermore, the choice of any set of monetary variables as policy instruments depends on the broader monetary strategy monetary authorities follow in conjunction with the economic policy objectives of the country. In addition, Hagen (1998: 2) emphasizes that "the choice of a monetary

strategy at a particular point in time depends on the particular decision making and strategic problems the central bank faces at that point both internally and vis-à-vis other actors in the economic policy game".

For the United States, it is commonly accepted that the interest rate that the Federal Reserve Bank can control closely is the Federal funds rate, the overnight interbank interest rate. For example, Hamilton (1996: 26) argues that "the federal funds market is a good place to start for an understanding of either finance or monetary policy". However, in Turkey, the interbank money market was established in 1986. Therefore, any empirical study that wishes to study the time period prior to 1986 and claims that the interest rate had been the instrument of the monetary policy needs to substitute another interest rate for interbank interest rate.

In choosing the instrument of the monetary policy, whether the central bank can control the instrument closely is not the single issue. The link between the instrument and the target variables poses another problem because the link between a specific instrument, say monetary base, and a target variable, say nominal GNP, may change over the time. For example, Roberds and Whiteman (1992) find that during the 1970s and 1980s in the United States M2 had a more stable relationship with the economy than M1. On the other hand, Lown, Peristani, and Robinson (1999) conclude that in the United States in the late 1980s and 1990s the relationship between M2 and inflation and economic growth deteriorated. Furthermore, while one definition of money supply can be a good predictor of the movements in real variables in one country, while another definition can be a good predictor in another country. For instance, Friedman (1988) states that the experience of the United States economy led to the abandonment of quantity variables. On the other hand, the Turkish Central Bank continues to utilize quantity variables as the instrument of monetary policy it implements.

Bernanke and Mihov (1995) distinguish between two groups of the measures of the stance of monetary policy, namely "narrative approach", which was developed by Romer and Romer (1989) and Boschen and Mills (1991), and "data based indexes approach". They criticize the narrative approach for being subjective and its inability to distinguish between endogenous and exogenous components of the policy change. In the line of second approach, Bernake and Blinder (1992) argued that the link between federal funds rate and real variables is stronger than the link between monetary aggregates such as M1 and M2 and the real variables. On the other hand, Christiano and Eichenbaum (1992) argue that the quantity of nonborrowed reserves is a better indicator of monetary policy because the Federal Reserve Bank can control it directly. Strongin (1995) utilizes the changes in the mix of borrowed and nonborrowed reserves, arguing that they are not Federal Reserve's accommodations to of demand innovations.

When setting up the guiding principles for central bank, Mishkin (2000) states the price stability goal as the first principle of monetary policy a central bank conducts, emphasizing that high levels of inflation are detrimental to economic growth. One important characteristic of the period under study in Turkey is that during this period governments intensified their efforts to reduce inflation. During this period, inflation targeting has been an integral part of monetary policy in Turkey.

3. EMPIRICAL RESULTS
3.1. The VAR Model and Variables
3.1.1. The Model

During last two decades, empirical evaluation of the effects of monetary policy actions on the economy has widely used VAR models. Sims (1972)[2] has pioneered the use of VARs to estimate the effect of monetary policy on the economy.   Keating (1990: 455) defines VAR as "a system of dynamic linear equations in which each variable is written as function of a serially uncorrelated error and an equal number of lags of all variables in the system." One of the fundamental characteristics of VAR analysis is to extract the bulk of the information from the data, rather than using too much *a priori* information. In making choices between alternative policy actions, economic policy makers at all levels often need predictions of economic variables. If time series observations are available for a variable and the data from the past contain information about the future development of a variable, it is then possible to use as a forecast some function of data collected in the past. However, in dealing with economic variables often the value of one variable is not only related to its predecessors in time, but in addition, it depends on past and current values of other variables. That is, we often want to know about the likely impact of an impulse in one variable on the other variables in the system. By not categorizing variables a priori as exogenous and endogenous, the VAR analysis allows for analyzing the dynamic forecasting structure of a system of variables.

The VAR analysis can be represented simply as follows[3]:

VAR can be represented in two forms: a) in the structural or primitive form, and b) in the standard form.

We can write a multivariate structural VAR, or the primitive VAR, of order p in matrix notation as follows:

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[2] For a summary of how the approach has developed from a bivariate (Sims (1972)) to trivariate (Sims (1980)) to larger and larger systems, see Leeper, Sims, and Zha (1996).
[3] See Enders (1995, Ch.5), and Hamilton (1994, Ch.11) for theoretical discussions.

$$(1) \quad BX_{t} = r_0 + r_1 X_{t-1} + r_2 X_{t-2} + \ldots + r_p X_{t-p} + u_t$$

In equation (1), X_t is an (nx1) vector containing each of n variables included in the system. In the studies of monetary transmission mechanisms, these variables include one or more indicators of monetary policy, other monetary variables, and real variables such as output and employment. r_0 is an (nx1) vector of intercept terms. r_i, i=1,...,p, are (nxn) matrices of coefficients. u_t is an (nx1) vector of error terms. It is important to note that u_t represents shocks to the variables in the system, and B represents the contemporaneous feedback between the elements of X_t.

In equation (1), X_t is assumed to be stationary, error terms in the vector u_t are white-noise disturbances with constant standard deviations, and $\{u_{st}\}$ and $\{u_{qt}\}$ are uncorrelated white noise disturbances for $s \neq q$.

We then can write above system as a VAR in the standard form by pre-multiplying both sides of the equation (1) by B^{-1}.

$$(2) \quad X_t = A_0 + A_1 X_{t-1} + A_2 X_{t-2} + \ldots + A_p X_{t-p} + e_t$$

where $A_0 = B^{-1} r_0$, $A_1 = B^{-1} r_1$, ..., $A_p = B^{-1} r_p$, and $e_t = B^{-1} u_t$.

In equation (2) A_0 is an (nx1) vector of intercept terms, A_i is an (nxn) matrices of coefficients, and e_t is an (nx1) vector of error terms. Equation (2) is the reduced form of equation (1). Note that the error terms in e_t are composites of the error terms in u_t. Since the elements of u_t are white noise disturbances, elements of e_t have zero means and constant variances, and are individually serially uncorrelated. However, the error terms in e_t are correlated across equations, with variance covariance matrix Σ. This is because of the fact that there are contemporaneous effects of variables on each other.

As mentioned above, the variables to be included in the VAR are selected according to the relevant economic model. The relationship among the variables and the size of the data determine the appropriate lag length, otherwise no explicit attempt is made to reduce the number of parameters.

In equation (2) the matrix A_0 contains n intercept terms and each matrix A_i contains n^2 coefficients; therefore, $n + pn^2$ terms need to be estimated. Note that the right hand side of (2) contains only predetermined variables and the error terms are assumed to be serially uncorrelated with constant variance. Therefore, each equation in the system can be estimated using OLS.

At this stage we might be facing identification problems because the number of parameters estimated using the standard form VAR would not always be sufficient to recover the parameters in structural VAR. In empirical studies many

restrictions on the elements of B in equation (1) have been proposed in order to achieve identification. For example, Sims (1980) offered a recursive system in order to identify the model. In this way, contemporaneous effects of some the variables on the other variables are eliminated. For example, in a bivariate model, a shock to one of the variables affects both variables' contemporaneous values, while shock to the other variable affect only its contemporaneous value. Such a decomposition of error terms corresponds to a Choleski decomposition.

We can also write a VAR in the form of a vector moving average (VMA). The VMA representation allows us to trace out the time path of the various shocks on variables contained in the VAR system, i.e., VMA allows us to get the impulse response functions. Using VMA representation, one can also obtain variance decompositions. The impulse response analysis and variance decomposition together are called innovation accounting.

We can write VMA representation of equation (2) as follows:

$$(3) \quad X_t = \mu + \sum_{j=0}^{\infty} \Phi_j \, e_{t-j}$$

Recall that $e_t = B^{-1} u_t$. If we substitute this relationship into equation (3) we obtain the following form:

$$(4) \quad X_t = \mu + \sum_{j=0}^{\infty} \Phi_j B^{-1} u_t$$

We then define $\Psi_j = \Phi_j B^{-1}$, which we can use to write equation (4) as follows:

$$(5) \quad X_t = \mu + \sum_{j=0}^{\infty} \Psi_j \, u_t$$

The coefficients of Ψ_j are called impulse response functions. The coefficients of Ψ_j can be used to generate the effects of the structural u_t shocks on the entire time paths of the variables in X_t. From the coefficients of Ψ_j one can also obtain the impact multipliers or cumulative effects of each shock on the other variables. However, we again face identification problem because it may not be possible to recover the coefficients of equation (1). Therefore, in order to identify impulse responses, one needs to impose additional restrictions. As mentioned above, one kind of restriction that can be used is Choleski decomposition.

It is crucial to note that equations for each of the variables in (1) are not structural equations and best thought as forecasting equations. Then the errors in (1) can be interpreted as forecasting errors. The n-period ahead forecast error could be written as follows:

$$(6) \quad X_{t+n} - E\, X_{t+n} = \sum_{j=0}^{\infty} \Psi_j\, u_{t+n-1}$$

Then using the equation (6) we can calculate the n-period ahead forecast error of each variable in X as a linear function of the variances of u shocks. The decomposition of the forecast error variances in such a manner is called forecast error variance decomposition.

As the ongoing discussion suggests, an effective application of VAR methodology requires solving the identification problem. In the studies of the effects of the monetary policy, the identification problem is equivalent to the identification of monetary policy shocks.

The "narrative approach" is developed by Romer and Romer (1989). Romer and Romer (1989) criticize VAR methodology and other empirical studies of real effects of monetary disturbances by not being able to identify the direction of causality. This approach studies the minutes of the Open Market Committee to identify dates of monetary disturbances.

A second approach for achieving the identification of structural parameters is based on the restrictions on the elements of B in equation (1). This approach, on the basis of recursiveness assumption, imposes restrictions on the contemporaneous relations among variables.

A third approach focuses on identifying monetary policy shocks using some structural restrictions within the VAR methodology. Examples of this approach are Bernanke (1986), Bernanke and Blinder (1992), Sims (1992), Christiano, Eichenbaum (1992), Strongin (1995), Bernanke and Mihov (1995), and Leeper, Sims, and Zha (1996). This approach studies how different identifying schemes affect the estimated responses of macroeconomic variables to monetary policy through the impulse response functions. For example, Bernanke and Blinder (1992) argued that the federal funds rate is a good measure of monetary policy stance. Anomalous results such as the "price puzzle" together with "liquidity puzzle" in cases when short-term interest rates and monetary aggregates are used as measuring the stance of monetary policy led to further research into different identification assumptions. These researches have broadened the tools used for identification from monetary aggregates to bank reserve markets, and to different policy regimes.

In this study, I shall use a small VAR model of the Turkish economy to analyze the relationship between interest rate, monetary aggregates, inflation, and output. The reasons for choosing a relatively small VAR model are a) the available data restrict the use of large models, and b) small models require less identification restrictions[4].

The specific VAR that I consider contains four variables: interbank interest rate, a measure of monetary aggregate, inflation rate, and output. As mentioned before, even though this VAR provides a very simple description of the economy, it contains at least the minimum set of the variables that are essential for any discussion of monetary policy. The variables are defined as follows[5,6]:

CR: Percentage point change in interbank interest rate from the previous month. Interbank interest rate is weighted averages of overnight interbank interest rates.

GLCIC: Monthly growth rate of currency in circulation in log form.

GLM1: Monthly growth rate of M1 in log form.

GLM2: Monthly growth rate of M2 in log form.

GLWPI: Inflation rate in terms of Wholesale Price Index at 1968=100 in log form.

GLIP: Monthly growth rate of industrial production. Industrial Production Index is at 1997=100 in log form.

The original data set runs from 1990:1 to 2004:12. Twelve lags are included in the VAR[7]. Two sets of models are considered. In the first set interest rate leads the measure of monetary aggregate, while in the second set the measure of monetary aggregate leads interest rate. In both sets of models inflation rate leads output. With a 12-month forecasting horizon used, the variance decompositions are provided graphically in an appendix at the end of the text.

3.2. Results of Variance Decompositions
3.2.1. Model 1
In this first model ordering of the variables is: CR GLCIC GLWPI GLIP.

The results of Model 1 can be summarized as follows: After 4th month interest rate explains about 5% of the variance of inflation rate. By the 6th month

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[4] For a comparison of small versus large VAR models see Faust (1998).
[5] The source of the data is the Central Bank of the Republic of Turkey, Statistical Data, www.tcmb.gov.tr.
[6] The variables are all stationary in the form they are defined.
[7] The number of lags is determined by Akaike information criterion.

currency in circulation starts to explain over 10% of the variance in inflation. By 11th month it explains over 16% the variance. However, by 12th month its explanatory power starts to decline. By the 2nd month interest rate explain over 10% of the variance in output. By the 4th month it explains approximately 20% of the variance. Explanatory power of the currency in circulation of the variance in output becomes significant only after 6th month. By the 8th month it becomes approximately 10%, but then starts to decline.

3.2.2. Model 2

In this model, ordering of the variables is: CR GLM1 GLWPI GLIP.

The results of the Model 2 can be summarized as follows: Until 10th month interest rate explains less than 2% of the variance in inflation. After then its explanatory power is only 2%. Explanatory power of M1 of the variance in inflation never reaches to 2%. On the other hand, by the 2nd month interest rate explains over 10% of the variance in output. Its explanatory power reaches over 15% by the 3rd month, and stays at that level for the rest of the year. M1 explains 5% of the variance in output only after 6th month, and its explanatory power stay less than 10% for the rest of the year.

3.2.3. Model 3

In this model, ordering of the variables is: CR GLM2 GLWPI GLIP.

The results of the Model 3 can be summarized as follows: Interest rate explains less than 2% of the variance in inflation until 10th month. By the 11th month it reaches to 2%, but in 12th month it declines. M2 explains less than 1 % of the variance in inflation for the entire forecasting horizon. Interest rate begins to explain over 10% of the variance in output by 3rd month, but its explanatory power stay less than 15% for the rest of the year. M2, on the other hand, explains less than 2% of the variance in output for the entire forecasting horizon.

3.2.4. Model 4

In this model, ordering of the variables is: GLCIC CR GLWPI GLIP.

The results of the Model 4 can be summarized s follows: The explanatory power of currency in circulation of the variance in inflation reaches to 4% only after 6th month, it reaches over 9% by 11th month, but then it stars to decline. The explanatory power of interest rate of the variance in inflation is less than 3% for the entire forecasting horizon. Currency in circulation explains over 3% of the variance in output only after 6th month. By 10th month its explanatory power reaches over 5%, but then starts to decline. Interest rate explains 10% of the variance in output by 2nd

month. It continues to explain over 10% of the variance for the rest of the forecasting horizon.

3.2.5. Model 5

In this model, ordering of the variables is: GLM1 CR GLWPI GLIP.

The results of the Model 5 can be summarized s follows: M1 explains less than 2% of the variance in inflation for the entire forecasting horizon. Interest rate explains slightly over 2% of the variance in inflation only after 10th month. M1 starts to explain 5% of the variance in output by the 4th month. Its explanatory power reaches over 8% by 11th month, but then declines. Interest rate explains over 15% of the variance in output starting with 3rd month/ But its explanatory power stays less than 20% for the rest of the period.

3.2.6. Model 6

In this model, ordering of the variables is: GLM2 CR GLWPI GLIP.

The results of the Model 6 can be summarized s follows: M2 explains less than 1% of the variance in inflation for the entire forecasting horizon. Interest rate explains less than 2% of the variance in inflation for first 10 months. Only after 11th month its explanatory power reaches to 2%. M2 explains less than 2% of the variance in output. Interest rate explains 10% of the variance in output/ But its explanatory power never reaches to 15%.

4. ON THE POTENCIES OF INTEREST RATES AND MONETARY AGGREGATES:
A DISCUSSION

In the first three models considered interest rate variable leads monetary aggregate variable. In the first model currency in circulation explains the variance in inflation approximately three times better than interest rate. However, explanatory power of interest rate of the variance in output is double that of currency in circulation. In addition, for the effect of currency in circulation on output to take place takes much longer when compared with interest rate. When M1 and M2 are included in the model in place of currency in circulation, explanatory power of the monetary aggregate of the variance in inflation becomes insignificant. Furthermore, their inclusion reduces the explanatory power of interest arte of the variance in inflation. M1 has similar explanatory power as currency in circulation in explaining output. M2 basically has no explanatory power in the variances of both inflation and output. Moreover, inclusion of M1 and M2 significantly reduces the effect of interest rate on inflation.

In the second set of the models monetary aggregate variable leads interest rate variable. The explanatory powers of both currency in circulation and interest rate of the variances of inflation and output are significantly lower when currency in circulation leads interest rate when compared with the reverse ordering. However, again currency in circulation dominates interest rate in explaining the variance in inflation, while interest rate dominates currency in circulation in explaining the variance in output. When leading interest rate, explanatory power of M1 of the variance in inflation is drastically lower than that of currency in circulation. Furthermore, neither interest rate nor M1 has a significant explanatory power in explaining inflation. Interest rate dominates the M1 as the monetary aggregate variable in explaining the variance in output. M2 has no noteworthy explanatory power in explaining the variances in inflation and output.

5. CONCLUSION

In the 1980s, Turkey began establishing the institutions and markets essential for an efficient implementation of economic policies consistent with the new development strategy. These new institutions and markets have changed the scope of economic policy in terms of both the tools and the targets. Specifically, monetary authorities began experimenting with new policy instruments in an open and market based economy.

Since 1990, Turkish Central Bank has carried out its monetary policies on the basis of announced monetary programs. However, economic crisis frequently have forced monetary authorities to abandon these monetary programs before the end of announced implementation periods, and employ discretionary polices designed to solve short-term economic problems. Since the latest economic crisis in 2001, Turkey has been implementing a new economic restructuring program. The major intend of the program is to have low and stable inflation level. Therefore, it is important for the monetary authorities to have an accurate knowledge of the link between potential policy variables and target variables.

This study investigates the potencies of interest rate and monetary aggregates in explaining the variances in inflation and output. Empirical investigation on the basis of a simple VAR analysis indicates that interest rate has a more significant explanatory power than any of the monetary aggregates considered in explaining the variances in output. Only the narrowest definition of monetary aggregate, namely the currency in circulation, has a significant explanatory power in explaining the variances in inflation. When M1 and M2 are used in the VAR, we do not observe any significant effect on inflation and output. Specifically, when the interest rate leads currency in circulation in the ordering in the VAR, explanatory powers of interest rate and currency in circulation in explaining the variances in output and inflation reach to the highest level.

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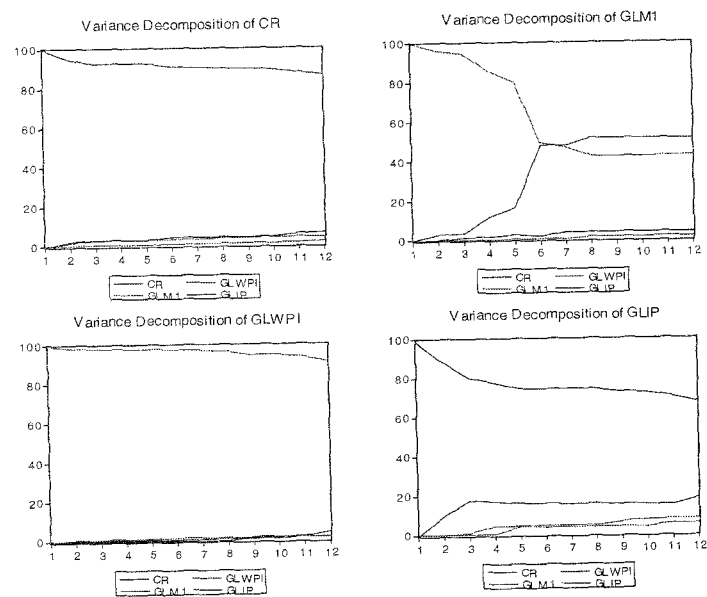
APENDIX: VARIANCE DECOMPOSIONS

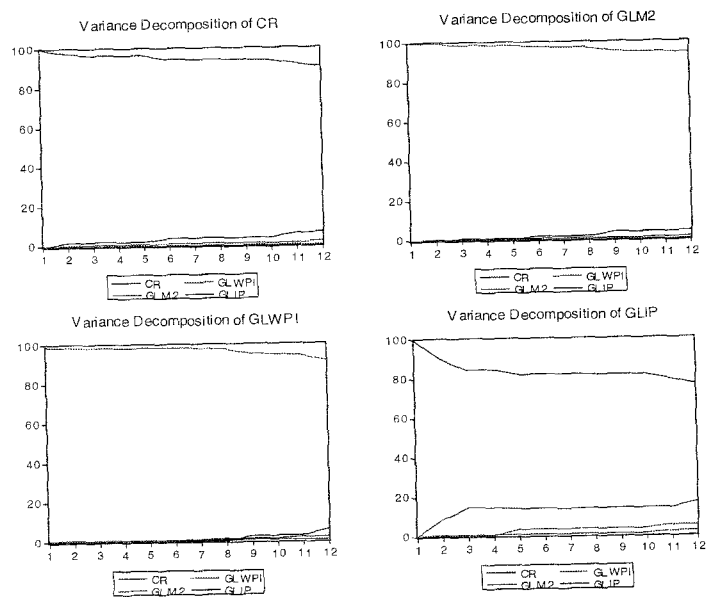Figure-1: Variance Decompositions from Model 1.
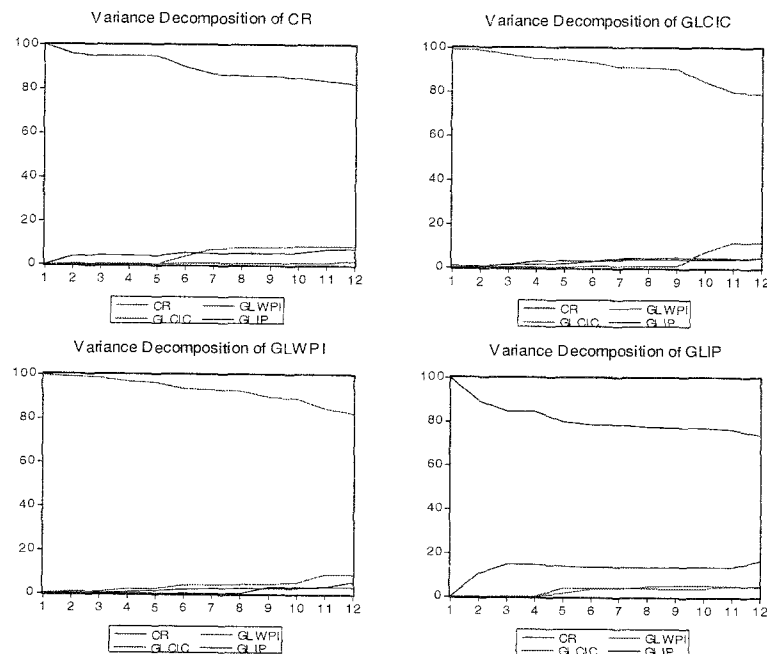
Source: Author's calculations

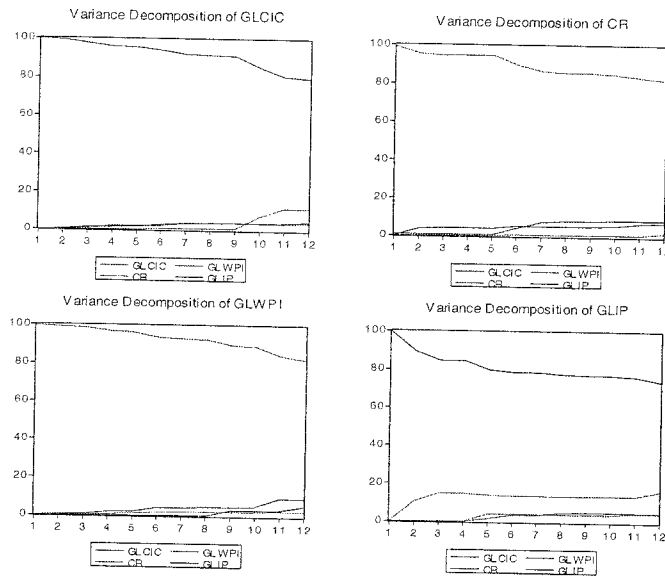Figure-2: Variance Decompositions from Model 2.

Source: Author's calculations
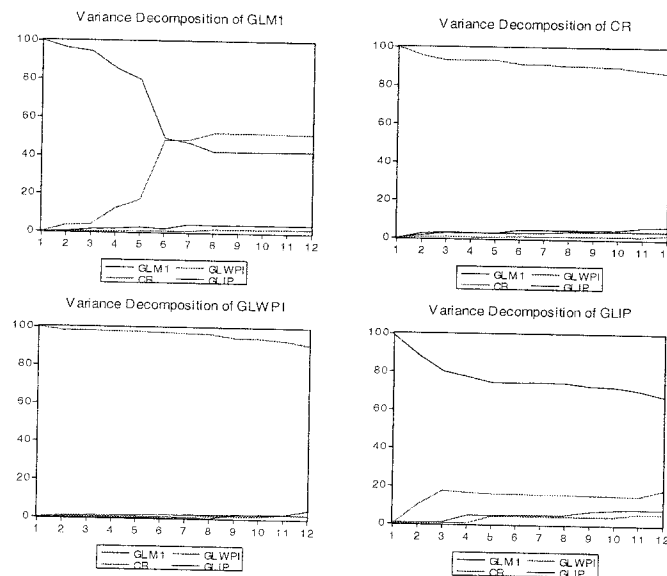
Figure-3: Variance Decompositions from Model 3

Source: Author's calculations
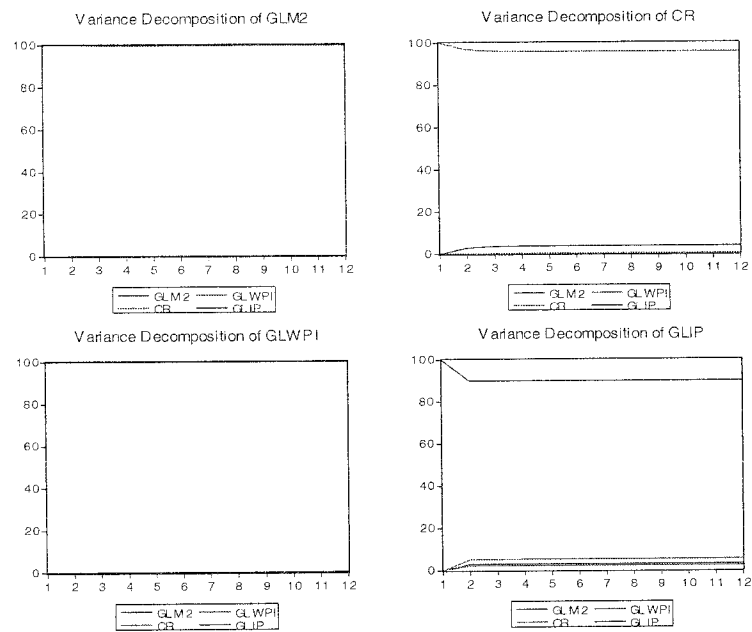
Figure-4: Variance Decompositions from Model 4

Variance Decomposition of GLCIC

Variance Decomposition of CR

Variance Decomposition of GLWPI

Variance Decomposition of GLIP

Source: Author's calculations

Figure-5: Variance Decompositions from Model 5

Variance Decomposition of GLM1

Variance Decomposition of CR

Variance Decomposition of GLWPI

Variance Decomposition of GLIP

Source: Author's calculations

Figure-6: Variance Decompositions from Model 6

Source: Author's calculations