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# DETERMINANTS OF TURKISH INFLATION

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## *Abstract*

*The main purpose in this paper is to investigate the determinants of inflationary process in Turkish economy. For this purpose, based on some potential causes of inflation, an empirical model is constructed upon emphasizing the roles of various factors on inflationary process. The results obtained support the view of cost-push inflation led by exchange rate depreciations, wage indexation mechanism, real interest structure and public sector pricing behaviour which is considered some part of wholesale prices, rather than the demand-pull monetary factors. Some other factors such as the course of real effective exchange rate have been found indicating a relieving effect on the cost pressure settled in domestic economy as well. Supporting these arguments, we find that the smaller the growth performance of the economy given the cost-pressure through exchange-rate pass-through effects, wage indexation mechanism and the real interest structure be imposed, the larger would be the inflation structure. These all might also be given as evidence to that the cost-push rather than demand-pull factors would affect the course of Turkish business cycles.*

**Key Words:** *Inflation, Turkish Economy, Cost-Push Pressure*

## I. INTRODUCTION

One of the main characteristics of Turkish economy for the post-1980 period is the chronic-high inflationary framework which dominates how all the other economic aggregates behave. Contrary to similar developing economies, no success had been achieved against this phenomenon and an unstable macroeconomic growth performance is also accompanied by this process. So a vast literature took place investigating the potential causes of inflation in Turkish economy. A multi-country comparison of inflation performances would be useful to notice the privileged position of Turkey in this subject within developing countries,

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\* This paper is a revised version of the paper named AN EMPIRICAL ANALYSIS OF TURKISH INFLATION (1988 2004): SOME NON-MONETARIST ESTIMATIONS by Cem SAATÇIOĞLU of the Istanbul University, forthcoming in Journal of Erciyes University Faculty of Economics and Administrative Sciences, 25, July-December, 2005, which mainly applies to cointegration analysis of contemporaneous econometrics in estimating the course of domestic inflation process, whereas a different estimation procedure is implemented in this paper even though attaining similar *ex-post* results.

\*\* H. Levent KORAP, would like to thank members of Marmara University Institute of Social Sciences Department of Economics Policy under the personality of department chairman dear F. Nuray ALTUĞ for their invaluable tolerance during the Philosophy Doctorate courses.

TABLE 1: ANNUAL PER CENT CHANGE in CONSUMER PRICES of SOME  
DEVELOPING COUNTRIES

	1987-96	97	98	99	2000	2001	2002	2003	2004
	<i>10 year average</i>								
<i>Turkey</i>	70.9	85.0	83.6	63.5	54.3	53.9	44.8	25.3	10.6
<i>South Africa</i>	12.1	8.6	6.9	5.2	5.4	5.7	9.2	5.8	1.4
<i>Hungary</i>	21.8	18.3	14.3	10.0	9.8	9.2	5.3	4.7	6.8
<i>Chile</i>	15.3	6.1	5.1	3.3	3.8	3.6	2.5	2.8	1.1
<i>Mexico</i>	36.7	20.6	15.9	16.6	9.5	6.4	5.0	4.5	4.7
<i>Bulgaria</i>	63.2	1061.2	18.8	2.6	10.4	7.5	5.8	2.3	6.1
<i>Poland</i>	78.2	14.9	11.8	7.3	10.1	5.5	1.9	0.8	3.5
<i>Romania</i>	76.8	154.8	59.1	45.8	45.7	34.5	22.5	15.3	11.9
<i>Russia</i>	-----	14.8	27.7	85.7	20.8	21.5	15.8	13.7	10.9
<i>Brazil</i>	656.6	6.9	3.2	4.9	7.1	6.8	8.4	14.8	6.6
<i>Argentina</i>	193.3	0.5	0.9	-1.2	-0.9	-1.1	25.9	13.4	4.4
<i>Peru</i>	287.4	8.5	7.3	3.5	3.8	2.0	0.2	2.3	3.7

Source: IMF World Economic Outlook (April-2005) Table 11 of Statistical Appendix, 216-219, also cited in Domaç (2004)

In our paper, we investigate the potential causes of Turkish inflation experience in an empirical way. Through a categorization of the potential causes of inflation, the various approaches investigating this phenomenon are tried to be related to the Turkish case and compared with literature so as to find out the different aspects of Turkish inflation. The next section focuses on literature review and model specification. Section three gives a model attempt considering the categorization in the former section. And the section four concludes.

## II. LITERATURE REVIEW and MODEL SPECIFICATION

For a developing country perspective, the main causes of inflation can be considered in a four branch categorization. The first one, named public finance and pricing behavior, emphasizes the expenditure requirement of public sector over its income generation capacity and the finance of this process by applying to central bank resources, that is, monetization. Pioneered by Phelps (1973: 67-82), in this approach public sector borrowing requirement (PSBR) can be financed either by seigniorage revenues led by an increase in monetary base or by using domestic and foreign borrowing possibilities. If the monetary authority aims to realize an accommodative monetary policy framework for the purpose of financing public deficits, the growth of monetary base over the demand for these balances by economic agents can cause the public finance requirement to be considered as the main determinant of inflationary process, and in such an environment inflation would be a fiscal phenomenon reflecting the expenditure pressure on public sector rather than a monetary case. If the

domestic borrowing possibilities are applied to as another alternative way, an *ex-ante* increase in monetary base would not be occurred, but as Sargent and Wallace (1981: 1-17) point out as the *so-called* unpleasant monetarist arithmetic, the larger the cost of borrowing thus the interest structure of the economy as a result of an accumulated debt stock, the harder would be the finance of this debt stock and the more condensed expectations of economic agents for the possibility of monetization by monetary authority in future periods would be occurred. If this process ends with the case of monetization, the *ex-post* increase in monetary base and thus in inflation would be greater than the former case. Uygur (2001: 7-23) also gives a highly illuminating outline of this approach even without taking into consideration the possibility of monetization in a financial pressure environment supported by restrictive monetary policies for the case of post-1994 Turkish economy.

Over the Turkish economy Gazioğlu (1986: 117-134), Anand and Wijnbergen (1988), Rodrik (1990), Ertel and İnel (1993: 299-312), Metin-Özcan (1995) and Metin-Özcan (1998: 412-422) emphasize the importance of monetization for inflationary environment, while Özatay (1992: 33-69) and Uygur (1992) give special attention to public sector pricing behavior. O.C. Akçay, Alper and Özmucur (1997) and O.C. Akçay, Alper and Özmucur (2001: 77-96) find evidence supporting Sargent and Wallace (1981: 1-17). Koru and Özmen (2003: 591-596) estimate the seigniorage revenues as a result of an accommodative monetary policy rather than being causes of inflation. Özmen (1998: 345-352) also finds a relationship from inflation towards the monetary growth rather than the opposite direction. Özatay (1996: 21-38) and Özatay (1999: 327-352) point out that, in an unsustainable fiscal environment, how the monetization of fiscal deficits coincided with interventions of controlling the domestic interest rates by monetary authority takes the economy into the 1994 economic crisis. However, Uygur (2001: 7-23) strongly criticizes this approach emphasizing the policy mistakes of policy makers as the leading factor behind the 1994 Turkish crisis. Celasun, Gelos and Pratti (2003) find the budgeted deficits as the main determinant of the construction process of inflation expectations. Bahmani-Oskooee and Domaç (2003) estimate that an increase in the dollarization process settled in the economy initially leads to a decline in the monetary base as the public switches from domestic to foreign money holdings. However, the monetary base increases later on to generate the required inflation tax for a given budget deficit. Besides, the decline in inflation tax which occurs as the public switches from domestic to foreign money holdings is in part compensated by increases in administered prices.

The second potential cause for inflation can be considered as the demand determined factors. In this respect, as a sub-division the demand-pull factors can also be perceived from a Monetarist or Keynesian economics side. Considering the classical dichotomy assumption between goods and assets markets, Monetarists are of the opinion that the quantity of money and the general price level have a proportionate relationship between each other and the direction of this relationship flows from changes in monetary balances to changes in price level, that is, inflation. Under the dichotomy assumption, the

stable income-velocity determined by market-based institutional factors gives the quantity of money an exogenous characteristics which is also under the control of monetary authority. Besides, the general price level has an endogenous characteristics determined by the changes in quantity of money. The increase in monetary aggregates does not have any effect upon real aggregates, while reflects to price level directly indicating the demand pressure in the economy. For this approach, the growth of nominal monetary aggregates over the demand for real money balances would be considered as the main causes of changes in price level (Begg, Fischer, and Dornbusch, 1994: 487). Friedman (1956: 3-21) constitutes a micro-scaled and portfolio-based well-known New Quantity Theory, while Friedman (1968: 1-17) indicates the transmission mechanism of a change in monetary aggregates into price level changes in an adaptive expectations based long-run Phillips curve analysis.

On the other side, Keynesians develop an inflationary-gap model in order to explain the inflation phenomenon (Paya, 1998: 375). Up to the point that full-employment income level is attained, a demand pressure caused by a monetary expansion partially reflects to changes in price level, but also positively influences the production possibilities of the economy. After this level once attained, monetary expansion completely reflects to price changes. In this theory, the diminishing returns encountered with a constant capital stock in the short run and increasing bargaining powers of working classes could also cause inflationary pressures from a cost-push side before full-employment (Kalin, 1989: 123).

When we consider the literature review concerning the prominent roles of monetary or demand-pull factors on Turkish inflation, Fry (1980: 635-645), Fry (1986: 117-134) and Togan (1987: 1585-1601) point out the sensitivity of Turkish inflation both to the monetary aggregates and also interest-structure of the economy. Lim and Papi (1997), Fisunoğlu and Çabuk (1998: 297-309), Günçavdı, Levent and Ülengin (2000: 149-171) and Günçavdı and Ülengin (2001) find the money supply increases as one of the main determinants of inflationary process. Diboğlu and Kibritçioğlu (2001) also indicate the role of price increases resulted from increases in autonomous aggregate demand-pull expenditures, and like Günçavdı and Ülengin (2001), propose the policies based on monetary control and restricting aggregate demand.

The third potential reason for inflationary process in a developing country would be considered as the cost-push factors. In this respect, the foreign exchange shocks or indexation of wages to past inflation and mark-up commodity pricing behavior targeting a constant rate of return for the enterprisers identified with Post-Keynesian school of thought or growing inflationary framework in the world economy imported into domestic economy, all reflecting to the domestic price level changes are important determinants of inflation. The real exchange rate targeting rule following the devaluations of domestic exchange rate would also strongly reflect to changes in price level. Montiel (1989: 527-549) and Dornbusch and Fischer (1993: 1-44) give the various transmission mechanisms leading to the cost-push factors mentioned above which reflect to the inflationary process. Besides,

Arestis (1992), Lavoie (1992) and Davidson (1994) approach the inflation phenomenon from a Post-Keynesian point of view emphasizing the price formation under an oligopolistic market structure and considering the class conflicts between different social groups.

From this perspective, Öniş and Özmucur (1990: 133-154) find a strong impact of devaluations on domestic inflation. On the other side, Rittenberg (1993: 245-259) finds the direction of causation between exchange rate and price level from price level changes towards exchange rate changes giving evidence to the validity of purchasing power parity for Turkish economy. However, Erol and Wijnbergen (1997: 1717-1730) find that the real exchange rate targeting policy would have only moderate inflationary impacts on the economy. Erol (1997: 363-382), Agènor and Hoffmaister (1997), Kesriyeli and Koçaker (1999), Leigh and Rossi (2002), Ongan (2003: 87-100) and also Metin-Özcan, Berument and Neyaptı (2004: 63-86) give evidence indicating the role of exchange rate devaluations on inflation. B. Akçay (1997: 49-64) finds the wage increases as an important determinant of inflationary process. Besides, Metin-Özcan, Voyvoda and Yeldan (2000) and Yeldan (2002) emphasize the determinant role of competition and income inequality between socio-economic groups, and by considering a mark-up based pricing behavior, estimate the downward-rigid pricing tendency of manufacture industry as an important determinant of Turkish inflation.

As a last reason of inflation, we can take account of expectation-based price stickiness. But this factor would be a secondary reason securing the perpetuity of past inflation to future periods rather than any main reason expressed above. Various indexation mechanisms on nominal monetary aggregates aiming at compensating the real costs of inflation and accommodative monetary policies realized in this manner, as expressed by Calvo and Végh (1999), would give rise to estimate the past inflation experiences as the main causes of inflation. Özatay (1992: 33-69), Uygur (1992: 1-31), Agénor and Hoffmaister (1997), Alper and Üçer (1998: 7-38), Akyürek (1999: 31-53), Cizre-Sakallıoğlu and Yeldan (1999), Erlat (2001), CBRT (2002) and Metin-Özcan, Berument and Neyaptı (2004: 63-86) point out the importance of inflationary stickiness and expectations phenomenon on Turkish inflation. Akat (2000) also strongly opposes to any accommodative monetary and exchange rate policy in this manner and suggests using a nominal anchor to reduce the impact of any factor causing inflationary stickiness.

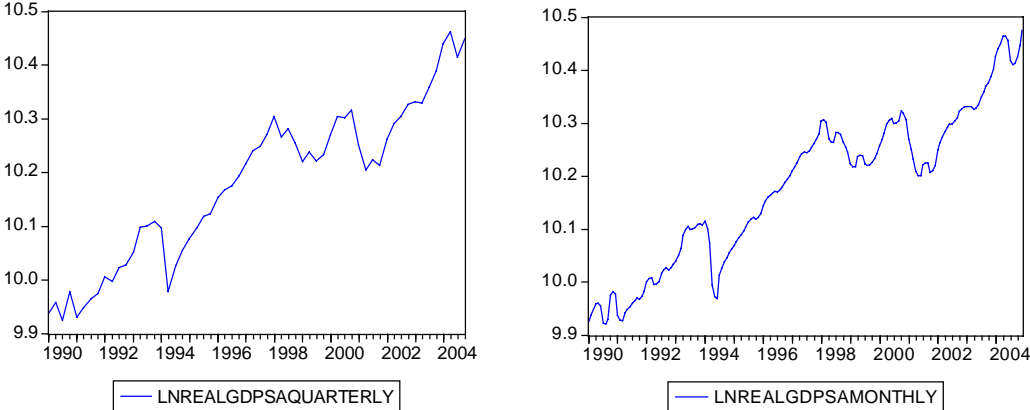
Through the categorization presented above, we now construct an inflation model comprising all the possible factors from different aspects for Turkish economy. Below is given such a model construction for estimation purposes,

$$ENFLASYON2 = f(GETDOLAR2, GETWAGE2, GETMB, GETPKAMU2, GETRGDP2, GETREERPPI2, GETBDDEF2, IREAL2, INER) \quad (1)$$

In this functional form, ENFLASYON2 indicates the monthly domestic inflation rate based on consumer price index (CPI) with the base year 1987: 100 which is calculated as  $(CPI - CPI(-1)) /$

CPI(-1). GETDOLAR2 is the monthly percent change of the depreciation of Turkish lira against the USD. GETWAGE2 is the monthly percent change of the payments to production workers in the manufacturing industry as a sum of main payments including salary, wages and overtime. GETMB is the monthly percent change of the Central Bank money under the liabilities of the CBRT, which is the sum of reserve money aggregate, that is, the sum of currency issued, required reserves, free deposits of banking sector, extrabudgetary fund accounts, and deposits of non-banking sector, and net liabilities from open market operations plus domestic currency deposits of the public sector. GETPKAMU2 is the monthly percent change in public sector prices which can be used to finance the expenditure requirement of public sector as a policy instrument using the government sector producer price index. GETRGDP2 is the monthly percent change of the seasonally adjusted real gross domestic product which is interpolated from the quarterly time series following QMS (2004: 108-111) by applying to low frequency to high frequency quadratic match average conversion option which fits a local quadratic polynomial for each observation of the low frequency series, then uses this polynomial to fill in all observations of the high frequency series associated with the period. The quadratic polynomial is formed by taking sets of three adjacent points from the source series and fitting a quadratic so that either the average or the sum of the high frequency points match to the low frequency data actually observed. For most points, one point before and one point after the period currently being interpolated are used to provide the three points. For end points, the two periods are both taken from the one side where data is available. For comparison purposes, we below give the course of seasonally adjusted real gross domestic product data (LNREALGDPSAQUARTERLY) taken from electronic data delivery system of the CBRT and the course of real income series (LNREALGDPSAMONTHLY) used in this paper in natural logarithms,

*FIGURE 1: COMPARISON OF QUARTERLY AND INTERPOLATED MONTHLY REAL GDP SERIES IN NATURAL LOGARITHMS*



GETREERPPI2 is the monthly percent change in the real effective exchange rate index based on producer price index published by the CBRT using the IMF weights for 17 countries, namely Germany, USA, Italy, France, United Kingdom, Japan, Netherlands, Belgium, Switzerland, Austria,



Spain, Canada, Korea, Sweden, Iran, Brazil and Greece. An increase in real effective exchange rate index would denote a real appreciation of domestic currency, whereas a decrease would denote a real depreciation. So we aim at considering the effect of relative price changes in an international context on domestic inflation through the effect occurred upon the price of domestic currency against foreign currencies. GETBDDEF2 is the monthly percent change in the consolidated budget deficit. Finally, IREAL2 represents the *ex-post* real interest rate adjusted for real output growth and inflation which is calculated by following the estimation procedure in Akçay, Alper and Özmucur (2001: 77-96). For this purpose, we used interbank money market rates (GECELİK) in monthly frequency as a representative short-term interest rate, monthly percent change in industrial production index (GETDY) for real output growth rate and monthly domestic inflation described above as in Equation 2 below,

$$IREAL2 = [GECELİK - ENFLASYON2 - GETDY - (ENFLASYON2 * GETDY)] / [(1 + GETDY) * (1 + ENFLASYON2)] \quad (2)$$

Also the aggregate INER above represents the price stickiness phenomenon which explains the changes in price level over itself. Two impulse dummies that take account of the outliers in the data, which take on values of unity from January 1994 till December 1994 and from January 2001 till December 2001 concerning the financial crises occurred in 1994 and 2001, are considered as exogenous variable in addition to eleven seasonal dummies.

All the data we use are in their linear forms following the modern literature on this issue and are taken from the electronic data delivery system of the Central Bank of Republic of Turkey (CBRT) except the interbank money market rates used in constructing the real interest rates which are obtained from IMF-IFS CD-ROM database.<sup>2</sup> The monthly frequency data are used and the time period for estimation purposes covers the time span of 1990.01-2004.12.<sup>3</sup>

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<sup>2</sup> However, Hoffman and Rasche (1996: 105-110) criticize using such form of variables expressed in ratios in the level form. Considering the natural log of M1 velocity and the natural log of commercial paper rate, they criticize Friedman and Kuttner (1992: 472-492) using semi-log functional form of interest rates which are used in difference form, and a spread variable between commercial paper and treasury bill rate in level form, and allege that this form are not robust to the estimated results in Friedman and Kuttner (1992: 472-492), and are completely reversed when the early 1980s are excluded from the sample for the case of U.S. economy for that the large elasticity of velocity in a high interest rate regime implied by the semi-log functional form does not capture the interest rate trend that dictates the aggregate of agent's long run preferences for liquidity. According to Hoffman and Rasche (1996: 105-110), Friedman and Kuttner's result does not reflect a change in aggregate structure in the 1980s, but the inadequacy of the semi-log functional form to deal with the range of interest rates that were observed in the early 1980s.

<sup>3</sup> We can obtain the wage data used in this study as of the beginning of the year 1990, and due to this fact, however the data considering earlier periods are available for other variables, we restrict ourselves by the time period of 1990.01-2004.12.

As a next step for our econometric analysis, we investigate the time series properties of the variables used. Granger and Newbold (1974: 111-120) indicate the occurrence of the spurious regression problem in the case of using non-stationary time series causing unreliable correlations within the regression analysis. At first, by using the augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979: 427-431) and Phillips-Perron (PP) (Phillips and Perron, 1988: 335-346) unit root tests, we check for the stationarity condition of our variables assuming constant and trend terms in the regressions. Thus for the ADF and PP tests, we compare the ADF and PP statistics obtained with the MacKinnon (1996: 601-618) critical values also possible in Eviews 5.0, and for the case of stationarity we expect that these statistics are larger than the MacKinnon critical values in absolute value and that they have a minus sign.<sup>4</sup> The results are shown in Table 4 below,<sup>5</sup>

TABLE 2: UNIT ROOT TESTS (assuming constant&trend)

Variable	ADF test	PP test
	(in levels)	
ENFLASYON2	-8.372428(0)*	-8.738562(19)*
GETDOLAR2	-8.872456(0)*	-8.708182(5)*
GETWAGE2	-21.12965(0)*	-19.26967(5)*
GETMB	-12.50284(0)*	-12.47709(4)*
GETPKAMU2	-11.01920(0)*	-11.01839(1)*
GETRGDP2	-3.682523(6)**	-6.311845(18)*
GETREERPP12	-8.957731(2)*	-8.866970(15)*
GETBDDEF2	-13.40625(0)*	-13.40671(2)*
IREAL2	-5.189229(1)*	-9.346540(4)*
Test Critical Values	ADF and PP	
%1 level	-4.010440	
%5 level	-3.435269	

When we examine the results of the unit root tests, we see that the null hypothesis that there is a unit root is strongly rejected for all the variables using constant&trend terms in the test equation in the level form and considering %5 and %1 level critical values. From now on, thus, we will carry on our empirical research by using the stationary form data.

<sup>4</sup> The asymptotic distribution of the PP modified t-ratio is the same as that of the ADF statistic.

<sup>5</sup> For the MacKinnon critical values, we consider %1 and %5 level critical values for the null hypothesis of a unit root. The numbers in parantheses are the lags used for the ADF stationary test and augmented up to a maximum of 12 lags due to using monthly observations, and we add a number of lags sufficient to remove serial correlation in the residuals, while the Newey-West bandwidths are used for the PP test. The choice of the optimum lag for the ADF test was decided on the basis of minimizing the Schwarz Information Criterion (SC). The test statistics and the critical values are from the ADF or UNITROOT procedures in Eviews 5.0. ‘\*’ and ‘\*\*’ indicate the rejection of a unit root for the %1 and %5 levels respectively. We should specify that all the computer outputs in this paper are available upon request.

We now try to apply to some contemporaneous vector autoregression estimation techniques (VARs) such as impulse response analysis. Let us follow Johnston and Dinardo (1997: 287-301), Greene (2000: 740-747) and QMS (2004: 708-716), and assume first an AR(p) process,

$$y_t = m + \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \dots + \alpha_p y_{t-p} + \varepsilon_t \quad (3)$$

We now consider a column vector of k different variables,

$$y_t = [y_{1t} y_{2t} \dots y_{kt}]' \quad (4)$$

and model this in terms of the past values of the vector as a VAR. The VAR(p) process would thus be,

$$y_t = m + A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + \varepsilon_t \quad (5)$$

The  $A_i$  are  $k \times k$  matrices of coefficients,  $m$  is a  $k \times 1$  vector of constants and  $\varepsilon_t$  is a vector of white noise process, with the properties,

$$\begin{aligned} & (\Omega, \quad s=t) \\ E(\varepsilon_t) = 0 \text{ for all } t \quad E(\varepsilon_t, \varepsilon_s') = & \quad (6) \\ & (0, \quad s \neq t) \end{aligned}$$

where the  $\Omega$  covariance matrix is assumed to be positive definite.<sup>6</sup> Thus  $\varepsilon$ 's are serially uncorrelated but may be contemporaneously correlated. Let us now explain some of the basic features of VARs by considering the simple case where  $k=2$  and  $p=1$ . This would give,

$$\begin{aligned} [y_{1t}] & \quad [m_1] \quad [a_{11} \ a_{12}] [y_{1,t-1}] \quad [\varepsilon_{1t}] \\ y_t = & \quad = \quad + \quad + \quad = m + A y_{t-1} + \varepsilon_t \quad (7) \\ [y_{2t}] & \quad [m_2] \quad [a_{21} \ a_{22}] [y_{2,t-1}] \quad [\varepsilon_{2t}] \end{aligned}$$

Thus, as in all VARs, each variable is expressed as a linear combination of the lagged values of itself and lagged values of all other variables in the system. In such a system of VARs, the behavior of the  $y$ 's will depend on the properties of the  $A$  matrix. For simplicity, we ignore the deterministic time trends and other exogeneous variables in our demonstration.

We now try to examine the construction of short run dynamic interactions among the variables used and consider again a two variable VAR system such as equation (7) but explicitly in this case,

$$y_{1t} = m_1 + a_{11} y_{1,t-1} + a_{12} y_{2,t-1} + \varepsilon_{1t} \quad (8)$$

$$y_{2t} = m_2 + a_{21} y_{1,t-1} + a_{22} y_{2,t-1} + \varepsilon_{2t} \quad (9)$$

A perturbation in  $\varepsilon_{1t}$  has an immediate and one-for-one effect on  $y_{1t}$ , but no effect on  $y_{2t}$ . In period  $t+1$ , that perturbation in  $y_{1t}$  affects  $y_{1,t+1}$  through the first equation and also affects  $y_{2,t+1}$  through the second

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<sup>6</sup> When  $A$  is  $n \times n$  and symmetric which is the matrix whose transpose  $A'$  equals to  $A$ ,  $A$  is positive definite if  $\delta' A \delta > 0$  for all  $n \times 1$  vectors  $\delta \neq 0$ .

equation. These effects work through to period  $t+2$ , and so on. Thus a perturbation in one innovation in the VAR sets up a chain reaction over time in all variables in the VAR. Impulse response functions calculate these chain reactions. The path whereby the variables return to the equilibrium is called the impulse response of the VAR (Greene, 2000: 745), if so, also supporting their stationary characteristics.

A shock to the  $i$ -th variable not only directly affects the  $i$ -th variable but is also transmitted to all of the other endogenous variables through the dynamic lag structure of the VAR. An impulse response function traces the effect of a one time shock to one of the innovations on current and future values of the endogenous variables. If the innovations  $\epsilon_t$  are contemporaneously uncorrelated, interpretation of the impulse response is straightforward. The  $i$ -th innovation  $\epsilon_{i,t}$  is simply a shock to the  $i$ -th endogenous variable  $y_{i,t}$ . Innovations, however, are usually correlated, and may be viewed as having a common component which cannot be associated with a specific variable. In order to interpret the impulses, it is common to apply a transformation to the innovations so that they become uncorrelated. In our paper, we apply to the generalized impulses as described by Pesaran and Shin (1998: 17-29) which construct an orthogonal set of innovations that does not depend on the VAR ordering. The generalized impulse responses from an innovation to the  $j$ -th variable are derived by applying a variable specific Cholesky factor computed with the  $j$ -th variable at the top of the Cholesky ordering (QMS, 2004: 715).

We now try to construct an unrestricted VAR model empirically using monthly observations as explained above in order to examine the possible interactions between the variables considered so as to affect the domestic inflation structure. We thus first determine the lag length of our unrestricted VAR model for which the maximum lag number selected is 12 due to using monthly frequency data considering five lag order selection criterions, that is, sequential modified LR test statistic (LR), final prediction error criterion (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC) and Hannan-Quinn information criterion (HQ). As the lag order selected in Table 3 below, LR test statistics and FPE statistics suggest 7, AIC statistics suggest 12, SC statistics suggest 1 and HQ statistics suggest 2 lag orders,

TABLE 3: VAR LAG ORDER SELECTION CRITERIA

*VAR Lag Order Selection Criteria*

*Endogenous variables: ENFLASYON2 GETDOLAR2 GETWAGE2 GETMB GETPKAMU2 GETRGDP2 GETREERPP12 GETBDDEF2 IREAL2*

*Exogenous variables: C D10 D11 D12 D2 D3 D4 D5 D6 D7 D8 D9 DUMMY2 DUMMY3*

*Sample: 1990:01 2004:12*

*Included observations: 167*

<i>Lag</i>	<i>LogL</i>	<i>LR</i>	<i>FPE</i>	<i>AIC</i>	<i>SC</i>	<i>HQ</i>
0	1642.698	NA	1.05E-19	-18.16405	-15.81155	-17.20922
1	1884.220	416.5166	1.55E-20	-20.08647	-16.22165*	-18.51782
2	2045.378	260.5539	6.11E-21	-21.04644	-15.66930	-18.86398*

3	2160.706	174.0289	4.25E-21	-21.45756	-14.56810	-18.66128
4	2262.897	143.1890	3.57E-21	-21.71134	-13.30956	-18.30124
5	2354.314	118.2407	3.54E-21	-21.83610	-11.92200	-17.81218
6	2449.638	113.0188	3.51E-21	-22.00764	-10.58122	-17.36991
7	2554.481	113.0043*	3.31E-21*	-22.29319	-9.354446	-17.04164
8	2653.560	96.11219	3.61E-21	-22.50970	-8.058636	-16.64433
9	2745.883	79.60856	4.73E-21	-22.64531	-6.681930	-16.16613
10	2862.978	88.34662	5.24E-21	-23.07758	-5.601877	-15.98458
11	2998.436	87.60163	5.56E-21	-23.72977	-4.741749	-16.02295
12	3156.953	85.42823	5.72E-21	-24.65812*	-4.157774	-16.33748

\* 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

We first choose the lag order selected by minimized AIC statistics for our dynamic VAR specification, that is 12, in order to check our econometric model for the pairwise Granger causality and dynamic impulse response relationships, and then try to implement the same estimation procedure by considering the lag length suggested by sequential modified LR statistics, that is 7, employing Sims' (1980: 1-48) small sample modification, which compare the modified LR statistics to the 5% critical values starting from the maximum lag, and decreasing the lag one at a time until first getting a rejection (QMS, 2004: 709).

For the pairwise Granger causality tests in which each equation are represented by columns and probs. are in parantheses, we test whether an endogeneous variable can be treated as exogeneous under the null hypothesis. For each equation in the VAR, we consider  $\chi^2$  (Wald) statistics for the joint significance of each of the other lagged endogeneous variables in that equation. The statistic in the last row (All) is the  $\chi^2$  statistic for the joint significance of all other lagged endogeneous variables in the equation. If we respresent ENFLASYON2 with ( $\pi$ ), GETDOLAR2 with (e), GETWAGE2 with (w), GETMB with (m), GETPKAMU2 with ( $\pi_{pub}$ ), GETRGDP2 with (y), GETREERPPI2 with (reer), GETBDDEF2 with (h) and IREAL2 with (r) for simplicity, we examine the pairwise Granger causality / block exogeneity wald test results using lag length 12 of AIC statistics below in Table 4,

TABLE 4: VAR PAIRWISE GRANGER CAUSALITY / BLOCK EXOGENEITY WALD TEST  
(lag length = 12 and probs. in parantheses)

	$\pi$	e	w	m	$\pi_{pub}$	y	reer	h	i'
$\pi$		28.69 (0.00)	14.32 (0.28)	12.49 (0.41)	30.61 (0.00)	14.63 (0.26)	22.24 (0.03)	9.556 (0.65)	8.840 (0.72)
e	9.843 (0.63)		29.98 (0.00)	11.75 (0.47)	6.299 (0.90)	19.87 (0.07)	12.43 (0.41)	9.662 (0.65)	21.48 (0.04)
w	33.35	21.47		17.90	24.99	9.163	13.47	18.01	7.264

	(0.00)	(0.04)		(0.12)	(0.01)	(0.69)	(0.34)	(0.12)	(0.84)
<i>m</i>	15.84	15.18	11.63		18.85	10.31	16.24	22.05	18.37
	(0.20)	(0.23)	(0.48)		(0.09)	(0.59)	(0.18)	(0.04)	(0.10)
<i>π<sub>pub</sub></i>	10.01	19.40	14.75	16.54		26.61	15.09	12.23	20.61
	(0.61)	(0.08)	(0.26)	(0.17)		(0.01)	(0.24)	(0.43)	(0.06)
<i>y</i>	19.76	14.42	14.18	10.07	15.70		15.60	9.451	15.51
	(0.07)	(0.27)	(0.29)	(0.61)	(0.21)		(0.21)	(0.66)	(0.21)
<i>reer</i>	14.73	8.164	34.46	9.365	18.99	17.53		8.849	28.23
	(0.26)	(0.77)	(0.00)	(0.67)	(0.09)	(0.13)		(0.72)	(0.01)
<i>h</i>	14.71	14.62	11.09	19.70	17.70	9.316	15.19		14.76
	(0.26)	(0.26)	(0.52)	(0.07)	(0.13)	(0.68)	(0.23)		(0.26)
<i>i<sup>r</sup></i>	48.11	38.85	19.57	67.20	65.41	17.79	29.66	64.43	
	(0.00)	(0.00)	(0.08)	(0.00)	(0.00)	(0.12)	(0.00)	(0.00)	
<i>All</i>	238.19	272.69	187.46	403.80	284.88	149.13	220.21	384.20	179.9
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

We estimate above that the main determinants of domestic inflation are the growth rates of wages and the real interest structure of the economy in addition to the real domestic income generation process. Depreciation of domestic currency is mainly affected by domestic inflation structure recalling some form of purchasing power parity. Also wage structure dominated in the economy and the growth rate of public prices and the real interest structure are Granger cause to the depreciation rate of domestic currency. Growth rate of wage structure have a mutually causal relationship with exchange rate depreciations, and is affected by real interest structure. Real effective exchange rate also affects the course of the growth rate of wages. Thus, the factors alleviating or aggravating the cost structure of the economy affect the changes in wages. The growth rate of central bank money is mainly responsive to the real interest structure. Some evidence to monetization of consolidated budget deficits have been revealed through pairwise Granger causality analysis, even only considers %10 significance level. But this result should be appreciated in a cautious way, because the way of causality has not yet become clear. The growth rate of public prices has an endogeneous characteristics to our simultaneous system structure, especially to overall domestic inflation, growth rate of wages and real interest rates in such a way that opposes to taking account of public prices as a policy variable imposing it an exogeneous characteristics. The main determinant of the domestic real income growth process is found as the course of public prices and the depreciation rate of domestic currency against USD. As can be expected, real effective exchange rate mainly responds to the real interest structure of the economy possibly through short term capital flows sensitive to the interest differentials across the countries. The consolidated budget deficits have been affected by both the growth rate of central bank money and the real domestic interest structure. In line of these findings, the main factor that seems to affecting our

simultaneous system structure is the real interest rate dominated in the economy, which is also mainly affected by the course of real effective exchange rate.

As can be seen in Figure 2 and Table 5 below, we report the inverse roots of the characteristic AR polynomial such that the estimated VAR would be stable (stationary) if all the roots have modulus less than 1 and lie inside the unit circle. If the VAR is not stable, certain results such as impulse response standard errors are not valid (QMS, 2004: 708). The estimated results point out that the VAR stability condition check suggests that the model does not satisfy the stability condition due to the fact that at least one root lie outside the unit circle impeding us implementing impulse response analysis of the contemporaneous VAR methodology. We should specify that no serial correlation problem of the 12<sup>th</sup> degree of the monthly data has been found in our unrestricted VAR model considering %5 significance level with an LM statistic LM(81)=79.80877 (0.5166) of which probs. is given in paranthesis under the null of no serial correlation,

FIGURE 2: INVERSE ROOTS OF AR CHARACTERISTIC POLYNOMIAL

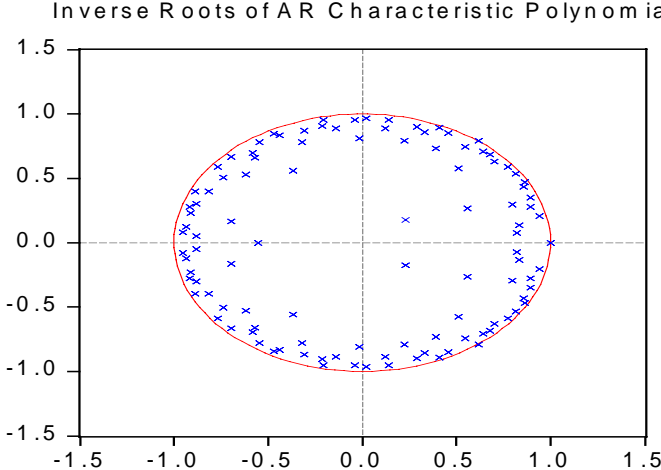


TABLE 5: ROOTS OF CHARACTERISTIC POLYNOMIAL

<i>Root</i>	<i>Modulus</i>
1.002068	1.002068
0.615730 - 0.789890i	1.001524
0.615730 + 0.789890i	1.001524
0.406520 - 0.895965i	0.983876

We now implement the same estimation procedure by considering the lag length 7 of the sequential modified likelihood ratio statistics at %5 level in order to control whether our estimation results are sensitive to the lag length used,

TABLE 6: VAR PAIRWISE GRANGER CAUSALITY / BLOCK EXOGENEITY WALD TEST

(lag length = 7 and probs. in parantheses)

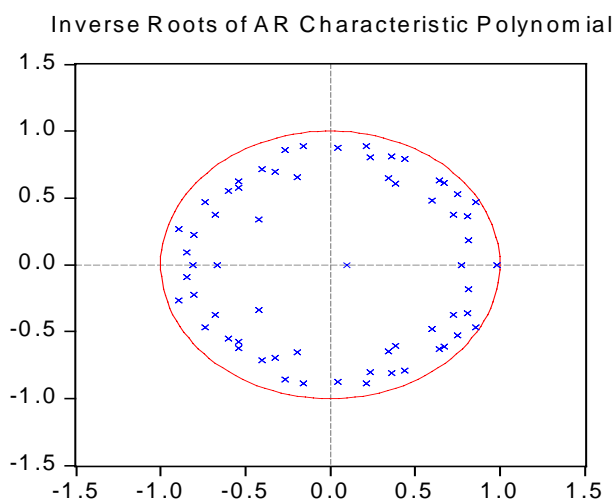
	$\pi$	$e$	$w$	$m$	$\pi_{pub}$	$y$	$reer$	$h$	$i^r$
$\pi$		6.455 (0.49)	17.13 (0.02)	6.817 (0.45)	8.331 (0.30)	7.716 (0.36)	19.69 (0.01)	3.929 (0.79)	7.579 (0.37)
$e$	11.05 (0.14)		36.71 (0.00)	11.89 (0.10)	9.184 (0.24)	4.402 (0.73)	3.341 (0.85)	9.983 (0.19)	9.354 (0.23)
$w$	13.81 (0.05)	15.76 (0.03)		12.14 (0.10)	22.01 (0.00)	4.558 (0.71)	14.48 (0.04)	12.64 (0.08)	5.585 (0.59)
$m$	5.388 (0.61)	10.18 (0.18)	6.393 (0.49)		8.205 (0.31)	7.871 (0.34)	9.271 (0.23)	26.86 (0.00)	14.76 (0.04)
$\pi_{pub}$	5.437 (0.61)	9.224 (0.24)	10.93 (0.14)	10.01 (0.19)		12.32 (0.09)	8.181 (0.32)	8.397 (0.30)	14.43 (0.04)
$y$	6.440 (0.49)	10.94 (0.14)	6.142 (0.52)	12.21 (0.09)	8.284 (0.31)		12.82 (0.08)	11.56 (0.12)	11.85 (0.11)
$reer$	9.141 (0.24)	10.08 (0.18)	25.92 (0.00)	9.500 (0.22)	14.62 (0.04)	15.47 (0.03)		8.404 (0.30)	9.50 (0.22)
$h$	5.840 (0.56)	9.568 (0.21)	6.380 (0.50)	22.83 (0.00)	8.445 (0.30)	7.088 (0.42)	7.287 (0.40)		11.83 (0.11)
$i^r$	34.87 (0.00)	33.03 (0.00)	11.04 (0.14)	99.68 (0.00)	54.85 (0.00)	23.16 (0.00)	25.12 (0.00)	102.86 (0.00)	
All	127.97 (0.00)	197.89 (0.00)	137.88 (0.00)	405.30 (0.00)	181.36 (0.00)	118.06 (0.00)	168.54 (0.00)	397.88 (0.00)	95.64 (0.00)

Pairwise Granger causality and block exogeneity test results using lag length 7 of the sequential modified likelihood ratio statistics reveal that our estimation results in Table 6 above do not sensitive to the different lag specification. The main factor affecting the domestic inflation process is again found to be the wage structure dominated in the economy and the real interest rate variable. Depreciation of domestic currency is mainly affected by the growth rates of wages and the real interest rate, but now domestic inflation is not Granger cause to the exchange rate. Wages are responsive to the domestic inflation and exchange rate depreciations as well as to the real effective exchange rate. Thus, we can here suppose an indexation mechanism of wages to the other cost push factors. Growth rate of consolidated budget deficits and the growth rate of central bank money have a mutually endogeneous relationship again. Real effective exchange rate and real interest structure dominate the course of real income growth process. All these estimation results support the findings obtained so far. Figure 3 and Table 7 below reveal that VAR model using lag length 7 of sequential modified LR statistics satisfies the stability condition that enables us to implement impulse response analysis for the dynamic



interactions leading us to the specification of domestic inflation. We also find no serial correlation problem of the 12<sup>th</sup> degree of the monthly data used in our unrestricted VAR model considering %5 significance level with an LM statistic  $LM(81)=97.75476$  (0.0991) of which probs. is given in paranthesis under the null of no serial correlation,

*FIGURE 3: INVERSE ROOTS OF AR CHARACTERISTIC POLYNOMIAL*



*TABLE 7: ROOTS OF CHARACTERISTIC POLYNOMIAL*

<i>Root</i>	<i>Modulus</i>
$0.984519$	$0.984519$
$0.857235 - 0.466647i$	$0.976018$
$0.857235 + 0.466647i$	$0.976018$

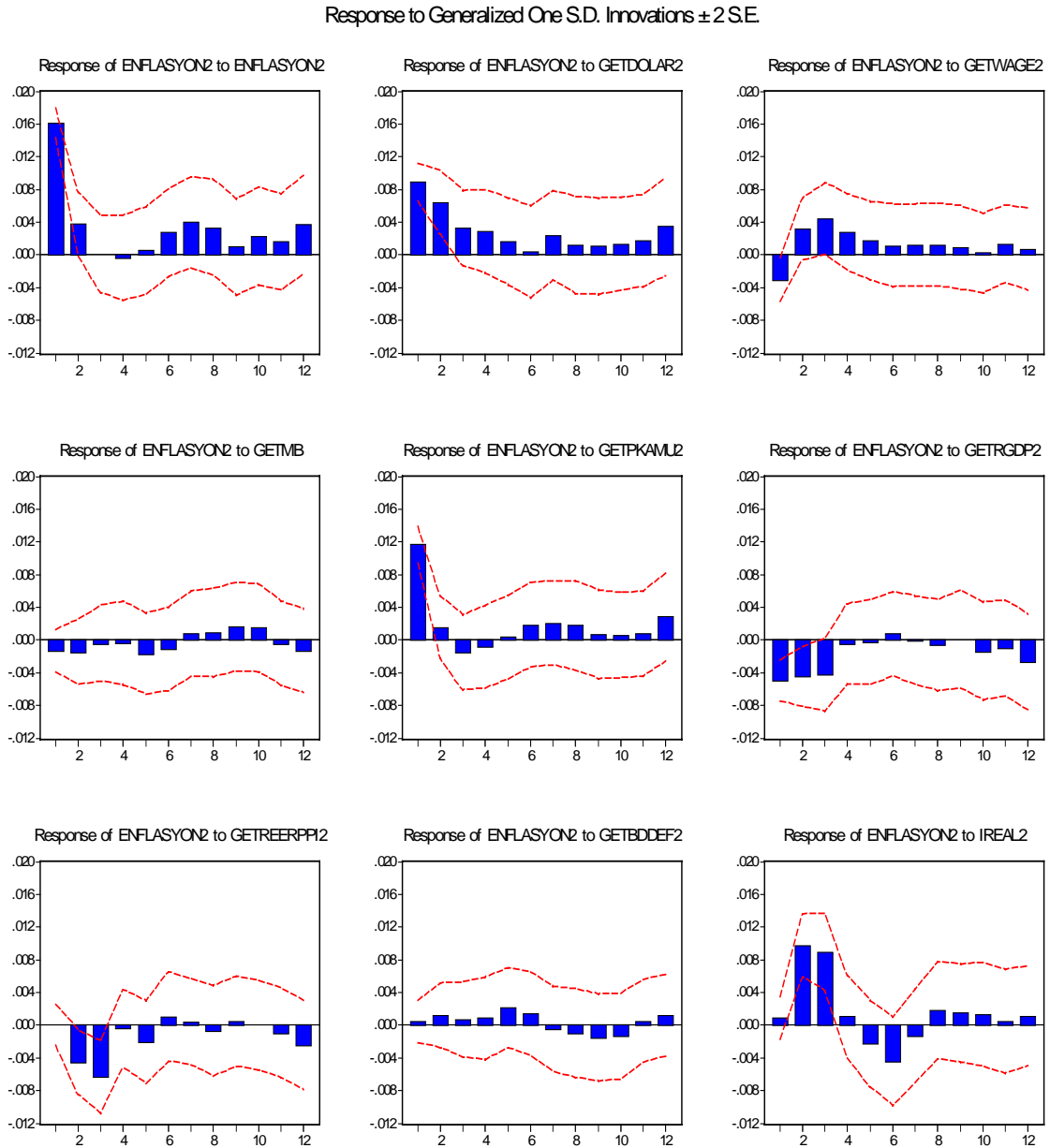
We now focus on the generalized impulse responses of domestic inflation and consider 1000 Monte Carlo repetitions of plus / minus two standard deviations. Below is given the dynamic impulse response estimation results. In Figure 4 below, we find that the main factors that positively affect the domestic inflation process are the pass-through exchange rate effects, shocks to the public prices, shocks to the wage indexation mechanism, shocks to the real interest structure, and shocks to the inflation over itself reflecting price stickiness phenomenon. Interestingly, no effect of monetary variable has been revealed over domestic inflation. On the other side, shocks to the real effective exchange rate and shocks to the real income generation process have a negative relationship with domestic inflation structure. If briefly required to touch upon these factors, a statistically significant positive effect of domestic inflation over itself has been carried on two periods, and a one standard deviation shock of inflation leads to a %1.6 increase in domestic inflation. Similarly, a positive one standard deviation shock to the depreciation rate of domestic currency against USD increases domestic inflation about %0.8 considering a two months horizon. Shocks to the wage structure of the economy have an initially negative effect on domestic inflation, but following second and third periods point out

a positive and significant effect on domestic inflation. After a third period horizon, a positive one standard deviation shock to the wage structure dominated in the economy would increase inflation %0.44. One of the main determinants of domestic inflation process in our dynamic impulse response analysis is found as administered public prices represented by the monthly percent change in public sector whole sale price index. A one standard deviation shock to the administered prices under the control of public sector increases domestic inflation about %1.2 throughout a one month horizon just after does the shock on public prices occur. Also shocks to the real interest structure be imposed upon domestic economy have a highly strong interaction with inflation such that a one standard deviation shock to the former increases inflation about %1 after a three months horizon.

Besides, we find in our paper that a negative interaction occurs between domestic real income growth process and domestic inflation rather than a positive interaction supporting an inflationary growth hypothesis. Having a statistically significant effect carrying on three months horizon, a positive one standard deviation shock to the real income growth would decrease domestic inflation about %0.4. Thus, due to the symmetric nature of impulse responses the lower the real growth rate of domestic economy, the higher would be the domestic inflation structure. This case may be interpreted such that the smaller the growth performance of the economy given the cost-pressure settled through exchange-rate pass-through effects, wage indexation mechanism in the economy and the real interest structure be imposed, the larger would be the inflation structure. These all might also be given as evidence to that the cost-push rather than demand-pull factors would affect the course of Turkish business cycles. Supporting such an argument, we find below that there exists a negative dynamic interaction between real effective exchange rate and domestic inflation. A positive shock to the real effective exchange rate, for which an increase in real effective exchange rate would denote a real appreciation of the domestic currency whereas a decrease would denote a real depreciation, decreases domestic inflation about %0.6 after a three months horizon. That is, depreciation of the price of domestic currency against foreign currencies in the real exchange basket used would be below the depreciation of goods and services against domestic inflationary framework given the production possibilities or real domestic income generation process, giving rise to a relieving effect on the cost pressure settled in domestic economy.

In line of these estimation results, we also find that the demand-pull factors such as growth rate of outside money, i.e. central bank money under the control of monetary authority, and growth rate of consolidated budget deficits which reflect expenditure pressure on public sector seem not to affect the domestic inflationary process in a statistically significant way.

FIGURE 4: GENERALIZED IMPULSE RESPONSES OF DOMESTIC INFLATION  
(using lag length 7)



Also in Table 8 below, we verify the estimation results obtained so far by considering correlation matrix of the variables all used in stationary form,

TABLE 8: CORRELATION MATRIX OF THE VARIABLES USED IN THIS PAPER

	$\pi$	$e$	$w$	$m$	$\pi_{pub}$	$y$	$reer$	$h$	$i^r$
$\pi$	1.00								
$e$	0.60	1.00							
$w$	0.02	-0.02	1.00						
$m$	-0.17	-0.27	0.04	1.00					

$\pi_{pub}$	0.69	0.75	-0.04	-0.27	1.00				
$y$	-0.25	-0.47	0.03	0.13	-0.38	1.00			
$reer$	-0.10	-0.70	0.02	0.14	-0.33	0.41	1.00		
$h$	0.18	0.26	-0.03	-0.99	0.27	-0.13	-0.16	1.00	
$i^r$	0.27	0.42	-0.08	-0.01	0.26	-0.43	-0.30	-0.01	1.00

In Table 8, we see strong positive correlations between domestic inflation and growth rate of exchange rate depreciations and real interest rate, but negative correlations between domestic inflation, real income growth process and real effective exchange rate in the first column of the correlation matrix supporting our estimation results above. We find negative strong correlations between the growth rate of exchange rate, real income growth process and real effective exchange rate in the second column of the correlation matrix. Thus the higher the cost pressure occurred by exchange rate pass-through effects, the lower would be the real income growth process and the larger would be the depreciation of real effective exchange rate. Besides, there exists a positive correlation between cost push factors, i.e., the growth rate of exchange rate depreciation, growth rate of public prices and real interest structure. Interestingly, a one-to-one negative correlation does exist between growth rate of consolidated budget deficits and that of central bank money. Thus, we can conclude that there exists an opposite relationship between these variables possibly revealing monetary targeting attempts of monetary authority given the expenditure pressure on consolidated budget. We should also conclude that Granger causality estimated above between these variables does not occur in favor of monetization but of monetary targeting attempts. As can be expected, there is a strong positive correlation between real effective exchange rate and real domestic income growth process.

### III. CONCLUDING REMARKS

In this paper, we try to investigate the potential causes of chronic-high inflationary environment in Turkish economy for the period 1989-2004 using monthly observations. Under a general categorization of the potential causes of inflation, and using modern econometric estimation techniques which enable us to examine the short run dynamic interaction process of inflation phenomenon with its potential causes, we estimate that cost-push or supply side factors such as exchange rate, wage indexation mechanism and real interest structure in the economy seem to be the main causes of inflationary process in Turkish economy, while demand-pull monetary factors have not been found indicating consequential effects on inflation. Also the price inertia phenomenon taken place through the expectations of past inflation experiences enables this process to settle and perpetuate in the economy, while the course of real effective exchange rate indicates a relieving effect on domestic inflation structure.<sup>7</sup>

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<sup>7</sup> A more detailed investigation of the literature survey upon Turkish inflation, which in general supports our main empirical findings in this paper, can be found in Saatçioğlu and Korap (2004).

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