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# MONETARY CONDITIONS INDEX:
# A MONETARY POLICY INDICATOR FOR TURKEY

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## I. INTRODUCTION

In conducting monetary policy, central banks have a set of variables which play different roles. At one end, central banks have a *final target* (e.g. inflation or output). At the other end, they have *instrument(s)* (e.g. discount rate) through which they implement monetary policy. However, there are indirect connections and long lags between instruments and the final target. Because of this, most central banks have other variables between instruments and final target, namely the *intermediary target* (e.g. monetary aggregates, exchange rate). For a policy to be useful, an intermediary target must respond to changes in an instrument. In this case, the central bank may operate directly upon an *operational target* (e.g. short term interest rate) when it changes its instrument. Freedman (1994) makes two distinctions between the operational target and the intermediary target. The first distinction arises from how quickly and directly a change in an instrument affects targeted variables. The second one is the nature of the targets. The intermediate target is typically be unable nominal variable that can function as a nominal anchor to the system while the operational target will typically not be able to serve as the nominal anchor to the system.

For many years, the short term interest rate has been the operational target of monetary policy. More recently, the *"Monetary Conditions Index (MCI)",* which is a combination of the short term interest rate and the exchange rate, has become the operational target of monetary policy. This change in focus has increased interest in *quantifying* the effects of policy instruments on output and inflation and in using such estimates in the conduct of monetary policy.

## II. MONETARY CONDITIONS INDEX (MCI)

MCIs have become popular in several countries over the past few years as a way of interpreting the stance of monetary policy and its effect on the economy. The Bank of Canada pioneered the use of this concept in the early 1990s. The central banks of Sweden and Norway have also used it as a device for interpreting the changes in monetary policy (Freedman (1994); Hansson and Lindberg (1994)).

The intention of an MCI is, as the name suggests, to provide quantifiying information about the stance of monetary policy. The MCI is a weighted sum of changes in short term interest rates and exchange rates relative to the values in a baseline year, with the weights reflecting these variables' estimated on the longer term *target variable*, e.g. output or inflation. The change in MCI is interpreted as *"the degree of tightening or easing the monetary conditions"*. It captures, in a single number, the degree of pressure that monetary policy is placing on the economy, and therefore inflation.

Monetary policy influences inflation mainly through two channels: interest rates and exchange rates. The rise in interest rates or exchange rates causes the economy to slow down and lowers inflationary pressures. Similarly, a fall in interest rates or a decline in exchange rates generally stimulates the economy and may lead to higher inflationary pressures. Thus, the aim of construction an MCI is to take both of these channels into considerartion.

The Monetary Conditions Index at time *t,* $MCI_t$, is defined as the weighted sum of changes in the exchange rate (e) and in the interest rate (r) from their levels in a chosen base year (t=0)

$$\mathbf{MCI_t = w_e(e_t - e_0) + w_r(r_t - r_0)}$$

Where, $w_r$ and $w_e$ are weights for the interest and exchange rates respectively.

## III. CONSTRUCTION OF THE MCI

There are a variety of ways in which MCI can be measured. In Freedman (1994), the two ways of constructing MCI are stated; That is, MCI could be constructed in terms of the effect of the interest rate and exchange rate changes on either *"aggregate demand"* or *"prices".* In the first case, the weights used in the MCI are obtained from the estimation of an aggregate demand equation. The estimation results in this case give the effect of changes in exchange rate and interest rates on the real aggregate demand. The second case focuses on the effects of changes in exchange and interest rates on prices. In this case, the exchange rate has a greater weight because it has a direct effect on prices in addition to its indirect effect through aggregate demand.

In Canada, the MCI is constructed using the weights obtained from the estimation of an aggregate demand equation as specified in Duguay (1994) because the output gap, along with the expected inflation, is considered the principal driving force behind increases and decreases in inflationary pressures. Furthermore, changes in the aggregate demand are stated as the key determinant of changes in the output gap.

In constructing the MCI for Turkey, the weights are obtained from an estimation of price equation rather than as an aggregate demand equation because in Turkey the exchange rate is thought to be the driving force in the price adjustment process. Furthermore, the weights in the MCI are meant to reflect the 'linkage' between the operational target and the final target, which is inflation in Turkey.

## IV. EMPIRICAL ANALYSIS

Any MCI can only be as good as the underlying model from which the weights are drawn. In Eika et al (1996), it is indicated that the MCI can be a useful operational policy tool if some assumptions are satisfied by the empirical model from which the coefficients of the MCI are obtained. They also state that *"the weights for an MCI are not directly observable, but are derived from an empirical model. Both analytically and empirically this model makes strong assumptions about parameter constancy, cointegration, dynamics, exogeneity and the choice of variables. These assumptions are all testable in practice, but few such tests have been calculated for current MCI models"* (Eika et al. (1996)). In this paper, Canadian, Swedish and Norwegian MCIs are given as examples to confirm such difficulties in practice.

To begin with, "dynamics" in the relationship between variables implies different short run and long run multipliers and since weights in the MCI are obtained from these estimated coefficients, they depend on the dynamics of the model. Secondly, the time series properties of the data themselves bear importance in the construction of MCI. The empirical "nonstationarity" of many economic time series and the possible stable relations between the variables (cointegration) should be analysed before constructing a model, since in stationary data short run and long run coefficients are different. Thirdly, the postulated "exogeneity" of the policy instruments is potentially misleading and should be considered carefully. Because the MCI is defined for policy, nonconstant weights used in the MCI may mislead the interpretation, therefore "parameter consistancy" becomes important.

In the context of these discussions, this study begins with analysing the stationarity properties of the data. After that, possible cointegration relationships are examined in order to discover the long run relationships among the variables. Examining the properties of the long run coefficients and applying exogeneity test are the next steps in the empirical analysis. After that, the short run dynamics of the price equation is estimated by OLS. Finally, the weights obtained from this price equation are used in constructing the MCI for Turkey.

### IV.1. Unit Root Tests

Table 1 lists the results of tests of one or more unit roots in the variables. The analyses are performed using quarterly data and the sample covers the 1987Q1-1999Q1 period. The effective sample size depends on the dynamics of the estimated equations. Logarithms of all variables are used and equations also contain three seasonal dummies. The critical values for the null hypothesis of a unit root are reported by Fuller (1976).

**TABLE 1**
**UNIT ROOT TEST RESULTS**

| | Level of the Variable ($X_t$)[1,3] | | First Difference of Variable ($\Delta X_t$)[2] | |
|---|---|---|---|---|
| Variables | Coefficient | t-ratio | Coefficient | t-ratio |
| WPI | -0.09 | -1.62 | -0.65(2) | -2.61 |
| CPI | -0.09 | -1.86 | -0.73(3) | -2.56 |
| Exch. Rate Basket (FXB) | -0.08(1) | -2.01 | -0.51 | -2.71 |
| Interbank Rate (INT) | -0.95(2) | -3.34 | -2.05(1) | -8.17[*] |

(1) Estimated Model is: $\Delta X_t = \alpha + \beta T + cX_{t-1} + \sum_{i=1}^{k} d_i \Delta X_{t-i}$

(2) Estimated Model is: $\Delta\Delta X_t = \alpha + \delta \Delta X_{t-1} + \sum_{i=1}^{k} d_i \Delta\Delta X_{t-i}$

(3) The values in the parentheses are the lag lengths that residuals white noise.

(*) Significant at the 5 percent level.

The results suggest that the null hypothesis of the unit root cannot be rejected at the 5 percent level for all of the variables. In contrast, the unit root of the null hypothesis is strongly rejected at the 5 percent level for the first difference of interbank rate; hence, it is concluded to be integrated of order one. The unit root of the null hypothesis cannot, however, be rejected for the first difference of consumer price index (CPI), but the wholesale price index (WPI), and the exchange rate basket (FXB), which is calculated as 1 unit of US dollars and 1.5 unit of DM, and they are concluded to be integrated of order two.

### IV. 2. Cointegration Analysis

After the order of integration has been determined, the cointegration properties of the series are analysed using the Johansen estimation procedure in the context of following equation;

$$\Delta X_t = \prod X_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + \lambda D_t + \varepsilon_t \qquad (1)$$

where, $X_t$ contains I(1) series, $D_t$ contains three centred seasonal dummies, $\Pi = 1-\pi_1-\pi_2-\ldots\pi_k$ and $\Gamma_i$'s are linear combinations of the $\pi_i$'s. Since $\Delta X_t$ is stationary and individual levels in $X_{t-1}$'s are non-stationary, a relation between $\Delta X_t$ and $\Pi X_{t-1}$ implies one or more stationary linear combinations. If rank of $\Pi$ is r with 0<r<p, then we can write $\Pi=\alpha\beta$, where $\beta$ is a matrix of cointegrating vectors and $\alpha$ is a matrix of the error correction coefficient, the weights with which each cointegrating vector enters the equations of the error correction mechanism. This can also be interpreted as the speed of adjustment to a long run equilibrium (Johansen: 1988).

The process of price adjustment is the key element in determining the influence of monetary policy on real variables. In an open economy, the exchange rate has an important role in this adjustment. The exchange rate influences price formation directly, while it affects aggregate demand indirectly via international competitiveness in export and import demand. An appreciation has an impact on import prices and also tends to restrain export prices and the prices of domestic goods that compete with imports. As a result, a depreciation (appreciation) leads to an increase (decrease) in prices in the internationally oriented sector inclining firms to

reconsider production costs. Therefore, a positive relation between exchange rates and inflation is expected in the cointegrated relation[1].

Another important variable in a price equation is interest rates. Investment and consumption are both affected by a change in the interest rate. An increase in this rate adds to the capital costs of firms and lowers the present value of their future profit. A rise in the real interest rate therefore tends to weaken investment. Consumption also tends to fall if the real interest rate rises, leading aggregate demand, and hence inflation, to decrease. Therefore, a negative relationship is expected between inflation and interest rates in the cointegration relation.

The standard statistics and estimates for the Johansen procedures are reported below. Among the variables are inflation (for both $\Delta$CPI and $\Delta$WPI), interbank rates and change in exchange rate basket ($\Delta$FXB). In both systems, the appropriate lag length in the VAR system is obtained using the Akaike Information Criteria, which gives a third order of VAR for the first system with WPI inflation and for the second system with CPI inflation.

The maximum eigenvalue test results for the system with WPI inflation in Table 2 indicate the presence of one cointegrating vector. Since we there is a single cointegrating vector, normalizing it with respect to one of its elements is sufficient to identify it. In this case,

[1] The corporation of the output gap provides information on the impact of excess demand on the inflation process. An innovation in this variable brings about a price change of the same sign as the shock; that is, a positive relation is expected between inflation and excess demand. As a cost variable, the wage rate is also expected to have a positive sign in the inflationary process. Therefore, the output gap and the wage rate, in addition to exchange and interest rates, were also taken into account in performing the cointegration analysis. However, the only significant relationship that has been investigated is that between inflation, exchange rate basket and interbank rate. Therefore only the results of the long run relationship among these three variables are reported in this paper.

the statistical analysis of the estimated cointegration vector, the t ratios of $\alpha$ coefficients and the weak exogeneity test in Table 3, shows that the cointegration vector can be normalized with respect to $\Delta$WPI. This identified cointegration vector lends itself to meaningful economic interpretations. The sign of the coefficients in the first vector were as expected; that is foreign exchange basket is positively related to inflation and interest rate is negatively related to inflation.

**TABLE 2**
**COINTEGRATION ANALYSIS OF WPI INFLATION**

Variables in the System: $\Delta$WPI-$\Delta$FXB-INT (VAR=3)

| Null | Alternative | Maximal Eigenvalue Test | Trace Test | Critical Value (Max. Eigen. 90 %) |
|---|---|---|---|---|
| r=0 | r=1 | 20.91 | 41.40 | 18.90 |
| r=1 | r=2 | 12.39 | 20.48 | 12.91 |
| r=2 | r=3 | 8.09 | 8.09 | 6.50 |

Note: Critical values are from Osterwald-Lenum (1992)

**TABLE 3**
**ESTIMATES OF LONG RUN COEFFICIENTS, ADJUSTMENT COEFFICIENTS AND TEST OF WEAK EXOGENEITY ($\Delta$WPI)**

| | Long Run Coefficients ($\beta$) | Adjustment Coefficients ($\alpha$) | T Values For $\alpha^{(*)}$ | Test of Weak Exogeneity $^{(**)}$ |
|---|---|---|---|---|
| $\Delta$WPI | 1.00 | -0.61 | -2.96 | 4.51 |
| $\Delta$FXB | 1.197 | 0.21 | 0.51 | 0.16 |
| INT | -0.111 | -2.72 | -0.79 | 0.32 |

(*) Critical value at 10 percent level is 1.7.
(**) Critical value at 5 percent level is 3.84.

The test results for the system with CPI inflation in Table 4 indicate the presence of one cointegrating vector. In this case, the statistical analysis of the estimated cointegration vector in Table 5 shows that the cointegration vector can be normalized with respect to ΔCPI. The identified cointegration vector lends itself to meaningful economic interpretations; that is the foreign exchange basket is positively related to inflation while interest rates are negatively related to inflation.

**TABLE 4**
**COINTEGRATION ANALYSIS OF CPI INFLATION**

Variables in the System: ΔWPI-ΔFXB -INT (VAR=3)

| Null | Alternative | Maximal Eigenvalue Test | Trace Test | Critical Value (Max. Eigen. for 90 %) |
|---|---|---|---|---|
| r=0 | r=1 | 22.91 | 44.81 | 18.90 |
| r=1 | r=2 | 12.86 | 21.90 | 12.91 |
| r=2 | r=3 | 9.04 | 9.04 | 6.50 |

Note: Critical values are from Osterwald-Lenum (1992)

**TABLE 5**
**THE ESTIMATES OF LONG RUN COEFFICIENTS, ADJUSTMENT COEFFICIENTS AND TEST OF WEAK EXOGENEITY (ΔCPI)**

| | Long Run Coefficients (β) | Adjustment Coefficients (α) | T Values For α(*) | Test of Weak Exogeneity (**) |
|---|---|---|---|---|
| ΔCPI | 1.00 | -1.12 | -4.91 | 9.07 |
| ΔFXB | 0.472 | 0.70 | 1.26 | 1.02 |
| INT | -0.003 | 5.99 | 1.31 | 1.07 |

(*) Critical value at 10 percent level is 1.7.
(**) Critical value at 5 percent level is 3.84.

The above results of cointegration analysis and the exogeneity test results suggest that the following long run relationships can be defined for the 1987Q1-1999Q1 period in terms of the prices, interbank rate and exchange rate.

$$\Delta WPI = 1.197*\Delta FXB - 0.111*INT \qquad (2)$$

$$\Delta CPI = 0.474*\Delta FXB - 0.003*INT \qquad (3)$$

**IV.3. Estimation Results**

In this part of the study, short run dynamics will be examined using an econometric framework that takes into consideration the long run relationship between economic variables. Therefore, in light of the results of cointegration analysis, this section develops a single equation error correction model for the price equation which takes into account both the short and long run relationship among the variables in the system. The estimated equation takes the following form:

$$\Delta p = \alpha_0 + \alpha_1 \Delta INT + \alpha_2 \Delta fxb + \alpha_3 \sum_{i=1}^{k} \Delta p_{t-i} + \alpha_4 EC_{t-1} + \varepsilon_t \qquad (4)$$

where *"Δ"* indicates first difference of the variable and;

$p$: Inflation rate

$INT$: Interbank rate

$fxb$: Change in foreign exchange basket

$EC$: Error correction term.

In the context of this equation, short run dynamics is estimated by OLS, whereas long run dynamics is captured by introducing the error correction term to the equation obtained from equations (2) and (3) for WPI and CPI respectively. All the variables are in logarithmic

forms and have been made stationary by taking necessary differences.

**TABLE 6**
**ESTIMATION RESULTS FOR WPI INFLATION**

| Dependent Variable: $\Delta p_{WPI}$ | | |
|---|---|---|
| Explanatory Variables | Coefficient | t-Ratio |
| Constant | 0.05 | 5.16 |
| $\Delta fxb$ | 0.83 | 8.97 |
| $\Delta$INT | -0.08 | -8.66 |
| $\Delta$INT(-2) | -0.04 | -4.17 |
| $EC_{WPI}(-1)$ | -0.80 | -5.98 |
| R-Squared= 0.86<br>R-Bar-Squared= 0.84<br>DW- statistic= 1.99<br>F-statistic F(7,38) = 33.95 (0.000)<br>Test For Serial Correlation: F(4,34)=0.92 (0.462)<br>Functional Form: F(1,37) = 0.015 (0.902)<br>Normality: Chi-Sq (1)= 5.24 (0.073) | | |

Note: Values in parenthesis are the lag lengths of the variable.

Table 6 above shows the estimation results for WPI inflation. The sign of the coefficients of the variables are as expected. The error correction term obtained from the cointegrated vector (equation (2)) has a significant coefficient indicating that, after a given shock, the system adjusts itself to the long run equilibrium[2].

In Table 7, the estimation results for CPI inflation are stated. The signs of the coefficients are as expected and are quite similar to those of the WPI inflation equation. The error correction term obtained from the cointegrated vector (equation (3)) has a significant negative coefficient.

[2] The output gap and the wage rate were also included in the short run equation, but they have been found statistically insignificant, therefore not included in the final equations.

**TABLE 7**
**ESTIMATION RESULTS FOR CPI INFLATION**

| Dependent Variable: $\Delta p_{CPI}$ | | |
|---|---|---|
| Explanatory Variables | Coefficient | t-Ratio |
| Constant | 0.07 | 6.80 |
| $\Delta$fxb | 0.28 | 3.36 |
| $\Delta$INT | -0.03 | -3.75 |
| $\Delta$INT(-2) | -0.03 | -3.90 |
| $EC_{CPI}$(-1) | -0.89 | -7.03 |
| R-Squared= 0.86<br>R-Bar-Squared= 0.83<br>DW- statistic= 1.69<br>F-statistic F(7,38) = 34.45 (0.000)<br>Test for Serial Correlation F(4,34)=1.09 (0.375)<br>Functional Form F(1,37) =0.10 (0.744)<br>Normality Chi-Sq (2)=13.70 (0.001) | | |

Note: Values in parenthesis are the lag length of the variable.

The diagnostic statistics do not indicate any problem in terms of autocorrelation, model specification and functional form. Moreover, according to the CUSUM tests, the estimated coefficients stay within the given range, indicating parameter consistency.

A common point in both of the equations is that the exchange rate has a large coefficient relative to the interest rate. This high coefficient indicates the importance of exchange rate in a price adjustment mechanism. That is, the exchange rate has a greater weight compared to interest rate in short run and this explains the sensitivity of inflation to the exchange rates in Turkey. Exchange rates have a direct effect on prices by increasing cost of production, while interest rates effect investment decisions and through this channel decrease aggregate demand and have a indirect effect on

prices. Investment decisions can be postponed to a longer run when the interest rates rise, but the production decision is not affected and this is reflected in production costs in the short run.

## V. CONSTRUCTION OF THE MONETARY CONDITIONS INDEX FOR TURKEY

Two real indices have been constructed using a fixed base of 1000 for May 1990 and January 1997. The reason for choosing 1990 is that, the Central Bank announced its monetary policy for the first time in that year and all the targeted variables stayed within the announced range. Therefore, this year was successful from a monetary policy point of view. In 1997, financial markets were relatively stable and the Central Bank adopted an exchange rate policy parallel to the inflation rate.

The MCI is constructed for Turkey by using monthly data for the 1988 and March 1999 period. The real MCI is defined as:

$$\textbf{Real MCI}=((RINT-RINT_{BASE})+(C_{ER}/C_{INT})*(\log(REER_{BASE}))-(\log(REER)*100))+1000$$

Where; RINT: Real interest rate

$RINT_{BASE}$: Real interest rate at base year

REER: Real effective exchange rate

$REER_{BASE}$: Real effective exchange rate at base year

$C_{ER}$: Coefficient of exchange rate obtained from CPI equation

$C_{INT}$: Coefficient of interest rate obtained from CPI equation

The construction of the real MCI uses real interest rates which have been calculated from the monthly average interbank rate (at compound bases) and the real effective exchange rate index, with

base levels of 6.99 % and 1 respectively for January 1997 and an interest rate of 7.95 % and an exchange rate of 1 for May 1990.

An increase in the MCI is interpreted as a tightening of the monetary condition while a decrease in the MCI means that the monetary condition is easing relative to the base year. When we look at Figure 1 and Figure 2, it is observed that the MCI generally fluctuates around the base year, indicating that the Central Bank implemented a tight monetary policy except during a period of financial crises which was an exogeneous factor to the Central Bank. An increase in the MCI is observed, nearly after the second half of the year 1998, indicating a tightening monetary policy.

## VI. CONCLUSIONS

The MCI is a very useful practical tool in the conduct of monetary policy. In practice, the actual effect of any given movement in interest rates and exchange rates will differ according to the reasons causing them to change, the extent of the supply and demand in the economy, and the extent of any existing sectoral imbalances. Apart from these facts, the nature of the underlying empirical structure is important in interpreting movements in MCIs. This simple trade off between exchange rate and interest rate may be misleading. Different mixtures of monetary conditions might give different outcomes for prices and output. For such reasons, MCIs should be used with care and should not interpreted as a mechanical way of constructing monetary policy.

In Turkey, despite the high rate of real interest and real appreciation, which reflects the tight monetary policy as seen in the MCI figures, inflation and output growth are still at very high level. Real appreciation causes input costs to decrease as reflected in the

high elasticity of the exchange rate in the price equations estimated above. However, this fall in the cost of the production is not reflected as a reduction in prices due to price rigidity. This in turn prevents profit margins from decreasing, leading to an expansion in output. At the same time, expansionary fiscal policy and high interest rates, through income effect, cause a rise in spending, reflecting an expansion in aggregate demand, which in turn put pressure on prices[3]. All of these facts reduce the impact of monetary policy implemented by the Central Bank as indicated by the increase in the MCI. Increases in price levels and the output growth should not be interpreted as the result of the monetary policy implemented by the Central Bank. Under such conditions, the Central Bank has adopted a relatively tight monetary policy since 1997, as indicated by the MCI, but this was not enough to cool down the economy because of the expansionary policies.

[3] Results of the studies for developed countries show that short term interest rates can be used as a monetary policy tool more effectively than other means of monetary policy to attain price stability and a stable rate of production growth in developed countries. However, Kesriyeli and Yalcin (1998) find out that in a country with chronic high inflation rate like Turkey, it is not expected that short term interest rates can be successful in decreasing inflation rate. High real interest payments on debt stock, resulted from the high PSBR, have caused a significant transfer of resources from public to private sector. This has resulted in the recovery of domestic demand through income and wealth effect. Besides this, capital inflow attracted by high real interest rates, is another factor that is responsible for high domestic demand. The fact that Turkish economy achieved a high investment and a production level above the potential growth rate during the 1995-1998 period supports this argument.

**FIGURE 1**
**MONETARY CONDITIONS INDEX**
**JANUARY 1988-MARCH 1999**
**(1990=1000)**

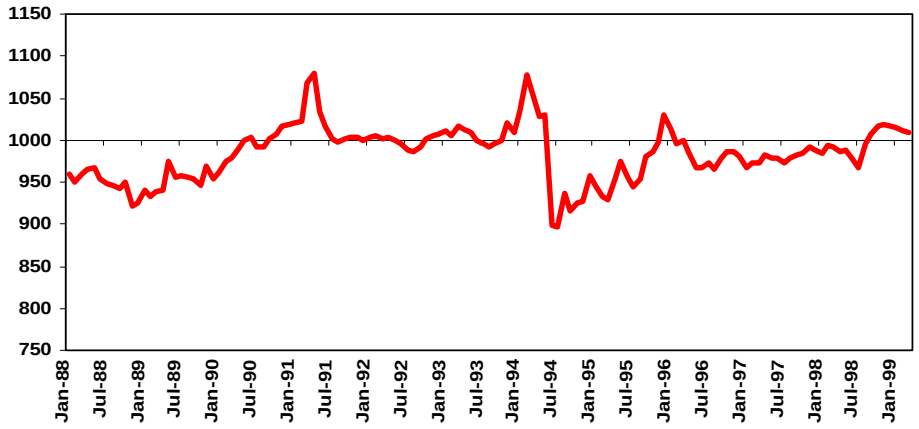
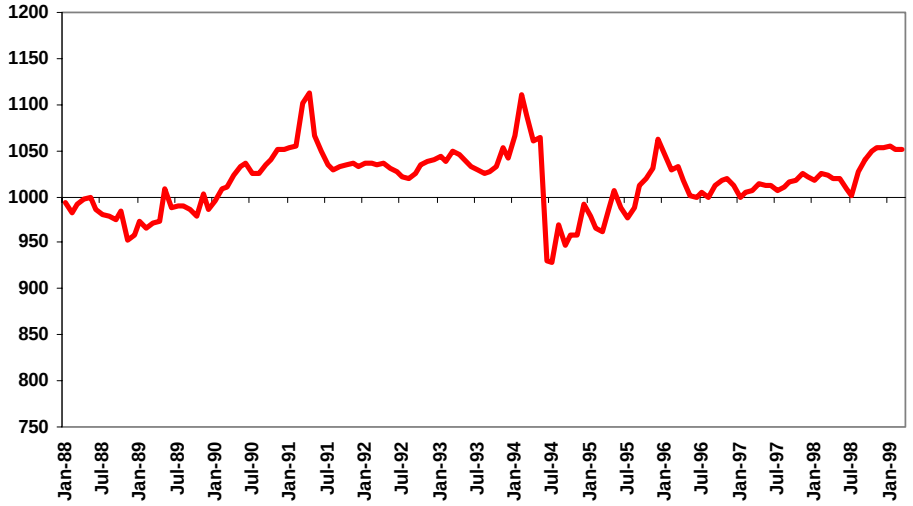



**FIGURE 2**
**MONETARY CONDITIONS INDEX**
**JANUARY 1988-MARCH 1999**
**(1997=1000)**



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