

Money Demand and Inflation: Evidence from Iran

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Abstract

This study examines money demand and inflation dynamics in the Islamic Republic of Iran using data for the period 1990-2001 and tests whether the disinflation during 2000-2001 represents a structural break in the data. A long-run money market equilibrium condition is identified and the short-run behavior of the inflation, measured in terms of non-administered component of the consumer price index (CPI) is modeled conditional on the disequilibria in the money market. Estimation results indicate that the stabilization of the exchange rate on account of strong oil revenues during 2000-2001 buoyed the demand for domestic money and contributed to the decline in inflation. Tests of model stability do not point to a structural shift in the inflation equation during the period of analysis.

JEL Classification: C51, E31, E41.

Keywords: Iran, Inflation, Money Demand, Exchange Rate

I. Introduction

Inflation in the Islamic Republic of Iran has historically been moderately high, and the main source of inflation in the long run has been the financing of large government deficits by monetary expansion. Twelve-month inflation in terms of the consumer price index (CPI) was in the double digits throughout the 1990s, registering an average of 25 percent from 1990 to 1999. However, despite sustained high growth of money supply, the period 2000-2001 witnessed a significant decline in inflation, to an average of about 12 percent.

The marked disinflationary trend has raised the question of whether there has been a structural break in inflation dynamics and whether low inflation can be sustained despite high growth in the monetary aggregates—for instance, by restricting the producer price inflation of the goods and services provided by public sector enterprises. An understanding of the nature of the decline in inflation is crucial to guide monetary policymaking, especially given the increased importance of the latter under the unified exchange rate system. The purpose of this study is to examine money demand and inflation dynamics in Iran based on a quarterly data set for 1990/91-2001/02, and to test the hypothesis of whether the recent disinflationary process has been associated with a structural break in the estimated relationships.

The study estimates a long-run money market equilibrium condition and analyzes the impact of disequilibria in the money market on changes in the inflation of consumer prices that are not administered by the public sector. A long-run money market equilibrium condition is identified in the form of a cointegrating vector among real M1 balances, output, CPI inflation, and the rate of depreciation of the Iranian Rial in the parallel foreign exchange market. Given that the rate of inflation is found to be the only variable in the cointegrating relationship which adjusts in response to disequilibrium in the money market, the short-run behavior of the change in the inflation of the non-administered component of CPI is modeled conditional on the disequilibria in the money market and the other variables that potentially impact inflation. The stability of the estimated inflation equation is analyzed in view of the decline of inflation despite the sustained increase in the money stock during the period from 2000/01-2001/02. The results of statistical tests do not point to a structural shift in the equation that governs inflation dynamics.

The paper is structured as follows. Section II briefly overviews the main macroeconomic developments in the Islamic Republic of Iran during the period from 1990/91 to 2001/02. Section III describes the model underlying the analysis and presents the results of the cointegration analysis. Section IV presents estimation results for the inflation equation and tests of model stability. Section V concludes.

II. Background

The Iranian economy experienced considerable volatility during the 1990s, driven by large external shocks and structural changes induced by shifts in domestic policies relating to the administrative allocation of resources, trade and exchange restrictions, and distortions in the pricing system including exchange rates, interest rates, and domestic energy prices.

Macroeconomic management in the aftermath of the 1980-88 Iran-Iraq war was largely guided by three successive Five Year Development Plans, starting in the fiscal year 1990/91. While the first two development plans envisaged a bold structural reform agenda to open up the economy and remove impediments to growth, the outcome was not favorable due to the slow implementation of reforms, bunching of scheduled debt repayments, and oil price shocks combined with economic sanctions on international trade and investment.

However, the implementation of the current Third Five-Year Development Plan (TFYDP, 2000/01-2004/05) is taking place in an environment of relative macroeconomic stability and a favorable process of consensus building towards reforms.

The postwar reconstruction phase under the First Five-Year-Development Plan was marked by rapid economic growth of over 7 percent during the first two years (1990/91- 1991/92). The sharp economic recovery was mainly driven by public investment programs financed by monetary expansion and short-term external debt, and aided by a policy of economic liberalization. The latter included progress in liberalizing domestic prices and foreign exchange restrictions and culminated in the first attempt at exchange rate unification in March 1993. However, the overly expansionary financial policies generated large macroeconomic imbalances, and combined with the impact of a negative oil price shock in 1993, led to severe balance of payments problems. In response, a series of measures were undertaken, including the compression of imports, the reinstatement of the multiple exchange rate system and the administrative allocation of foreign exchange. The level of imports was compressed by about 50 percent from its peak in 1991/92 to only US\$13 billion in 1993/94 and remained relatively low for much of the 1990s.

Against this background, the Second Five Year Development Plan initiated in 1995/96 focused on rationalizing relations with external creditors, containing inflation, and reducing the external debt stock and lengthening its maturity. While expansionary policies were adjusted downward, the intensification of U.S. sanctions following the passage of the Iran-Libya Sanction Act (ILSA) in August 1995 resulted in instability in the macroeconomic setting. This was accentuated by a sharp rise in year-on-year CPI inflation to a peak of 59 percent in May 1995, leading to further tightening of exchange restrictions to stem the run on the foreign exchange market. For much of the 1995/96-1999/2000 period, the economy remained constricted by structural impediments, lack of access to external markets, and excessive compression of imports, which restrained the development and growth of the private sector. As a result, economic performance during the 1993/94-1999/2000 period was weak, with an average overall real GDP growth rate of 3.3 percent and the real non-oil sector growth averaging at 3.7 percent.

The TFYDP was formulated to initiate abroad economic adjustment program aiming at reducing the role of the public sector in the economy, encouraging the development of private sector activities, and liberalizing the trade regime. The Plan's macroeconomic framework was designed to reduce the unemployment rate to 11.5 percent by 2004/05, by targeting a real GDP growth rate of 6 percent annually. Progress in implementing the ambitious agenda of the TFYDP has been encouraging, and was facilitated by the stabilization of the macroeconomic situation since 1999/2000, strong oil prices since 2000/01, as well as a stronger commitment to fiscal responsibility and an impressive reduction in external debt. The period from 2000/01-2001/02 witnessed a sharp drop in the inflation rate despite sustained strong money growth, mainly on account of the effect of trade liberalization and an increase in real money demand with the stabilization of the foreign exchange market, as will be discussed in the rest of the paper.

III. Theoretical framework and cointegration analysis

The supply of money is assumed to be exogenous. The demand for real monetary balances, mlp , is assumed to depend on real GDP (as a proxy for real expenditure), y , and a vector comprised of measures of the opportunity cost of holding money. For the case of narrow money, two such proxies are the rate of inflation, $dcpi$, and the rate of depreciation of the Rial against the U.S. dollar in the parallel market, $dpar$. The money market equilibrium condition can be stated as:

$$P = f(y, dcpi, dpar) \tag{1}$$

The disequilibrium in the money market in period t is:

$$ECMM_t = mlp_t - f(y_t, dcpi_t, dpar_t) \tag{2}$$

The long-run relationship between mlp , y , $dcpi$, and $dpar$ from 1990:Q3 - 2001:Q4 is estimated in the form of a cointegrating vector, as unit-root tests indicate that all the variables in the relationship are integrated of order one.

Table 1: Unit root augmented Dickey-Fuller test statistics

	Level		First difference	
	Lag	Test statistic	Lag	Test statistic
mlp	6	-0.46	6	-4.48**
Y	5	-3.42*	5	-4.16**
$Dcpi$	6	-2.35	4	-3.65**
$Dpar$	5	-2.35	5	-3.26*
$dcpin$	6	-2.46	6	-3.66**

Note: The asterisks * and ** indicate that the test statistic is significant at the 5 percent and 10 percent levels, respectively.

The Johansen (1988) trace statistic is used to determine the number of cointegrating vectors among the

variables. The trace statistic indicates that there is at most one cointegrating vector at one percent confidence. The estimated long-run money demand equation takes the form:

$$mlp = 0.78 + 0.57y - 0.60dpci - 1.36dpar \quad (3)$$

A coefficient smaller than unity on output in the long-run money market equilibrium relationship indicates a declining rate of velocity in the long run, which is consistent with the Iranian experience from 1990-2001. The demand for real money is estimated to be very sensitive to the rate of exchange rate depreciation and the rate of inflation. The model predicts that the reversal of the trend of depreciation at the parallel market from the third quarter of 1999 onwards has boosted real M1 demand, indicating that the growth in real M1 from 1999:Q3 - 2000:Q4 has in fact been exceeded by an increase in the demand for real M1 balances.

Tests of weak stationary indicate that y , mlp , and $dpar$ are weakly exogenous to this co-integrating relationship, implying that the inflation rate, $dpci$, is the variable in the system which adjusts to the disequilibrium in the money market. The changes in the inflation rate impacts the equilibrium in the money market through two channels. First, an increase in the price level decreases the real value of a given level of the outstanding money stock, reducing the excess of supply over demand for nominal monetary balances. Second, and working in the opposite direction, a higher inflation rate, implying a higher opportunity cost of holding domestic currency against goods, reduces the demand for real money, increasing the excess of money supply over money demand. It can be shown, however, that given the estimated magnitudes of the parameters of the money demand function, the net effect of inflation is always to reduce the excess real supply of money, as long as inflation remains above zero.

IV. Short-run inflation dynamics

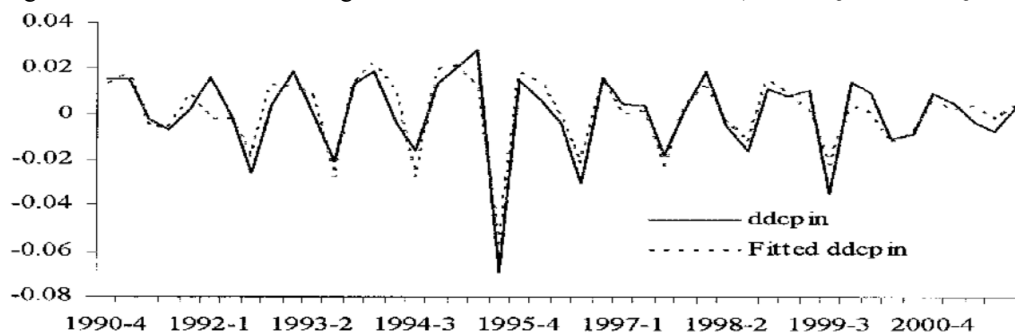
Given that inflation is the only variable in the money market relationship which is not weakly exogenous to the cointegrating vector, its dynamics can be consistently analyzed by estimating a single error-correction equation. An important consideration in the analysis of Iranian CPI inflation dynamics is that the prices of a number of subsidized goods are administered by the government, and the level of price adjustments are guided mainly by political and social considerations. Since it is the non-administered component of CPI that adjusts to market forces, including disequilibria in the money market, the dependent variable in the equation is taken to be the change in the non-administered component of CPI, while the change in the inflation of the administered component is included as an exogenous variable. An error-correction equation for the first difference of non-administered CPI inflation ($ddcpni_t$) which includes as explanatory variables the current values and the four lags of the first difference of real money demand, output, the parallel market depreciation rate, the administered CPI inflation rate, the four lags of the non-administered CPI inflation rate, as well as the first lag of the error correction term, $ECMM$, is estimated by ordinary least squares. It is worth mentioning that the direct impact of the parallel market exchange rate depreciation on inflation is likely to be associated with two different channels. The first stems from the importance of the market determined exchange rate in the formation of inflationary expectations, as has been the case in many high inflation economies. Second, from early 2000 onwards, the parallel market exchange rate has tracked closely the Tehran Stock Exchange (TSE) rate, which has been the main determinant of imported goods prices -and therefore tradable prices- in the CPI.

By removing the variables with statistically insignificant coefficients from the general error-correction equation, the following specific inflation equation is obtained for the period 1990:Q4 - 2001:Q4:

$$ddcpni_t = 0.005 - 0.51 ddcpin_{t-1} - 0.28 ddcpin_{t-2} + 0.07 dy_{t-1} + 0.06 dy_{t-2} + 0.03 dy_{t-3} \\
(0.001^{**}) \quad (0.001^{**}) \quad (0.08^{**}) \quad (0.02^{**}) \quad (0.02^{**}) \quad (0.02^{**}) \\
+ 0.22 ddpar + 0.15 dmlp_{t-2} + 0.13 ECMM_{t-1} - 0.02 Q3. \\
(0.04^{**}) \quad (0.06^{**}) \quad (0.03^{**}) \quad (0.01^{**})$$

The coefficients in the equation have the expected sign and are highly significant. The change in the administered component of CPI inflation is omitted from the equation as it does not impact non-administered inflation significantly, most likely because expenditures on subsidized goods and services constitute only a minor share of consumer and firm budgets given their very low prices, and therefore changes in these administered prices do not have significant cost-push effects. The first two lags of the change in inflation enter with large negative coefficients, reflecting the tendency for mean reversion in the change of inflation, which is a stationary variable. The seasonal dummy variable for summer months is significantly negative, indicating that inflation declines during the summer, most likely due to the increased supply of agricultural food products. The three lags of output growth enter the inflation equation with positive coefficients, suggesting that increased real income and aggregate demand have inflationary consequences in the short run. Lagged excess monetary balances, twice lagged real money and the contemporaneous rate of parallel market exchange rate depreciation have a positive impact on inflation. The fitted and actual values of the rate of change of inflation are graphed in Figure 1.

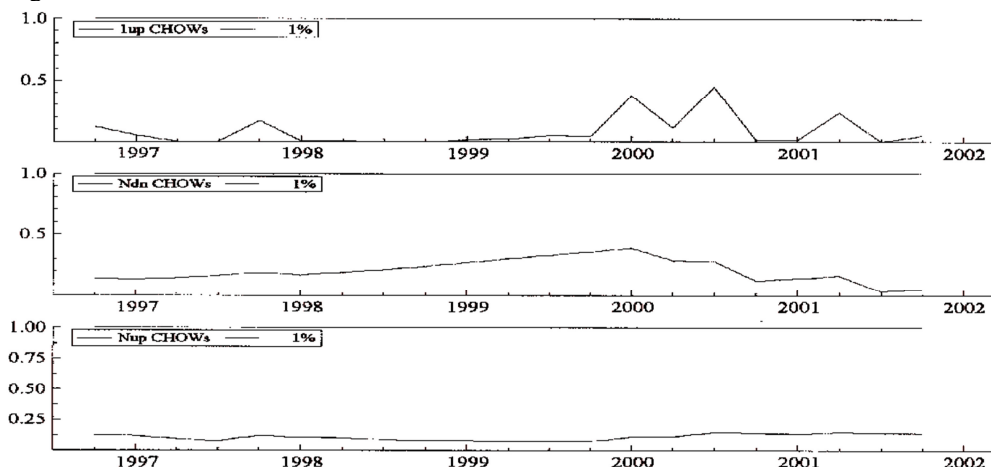
Figure 1: Actual and fitted changes in non-administered CPI inflation, 1990: Q4 – 2001: Q4



The model appears to fit the data quite well, and the residuals for the period 2000-01 do not appear to be excessive. To statistically test the stability of the equation over time, a number of recursive tests were carried out.

Three types of Chow-forecast tests were carried out for the subsample 1995:Q4 to 2001:Q4. Intuitively, these procedures test model stability by comparing the within and post sample residual variances. The first test, the 1-Step Chow test compares the one-step ahead forecast error variance for all sample points after the given initialization period with the error variance within the sample. The Break-point Chow test and the Forecast Chow tests compare the out-of-sample forecast error variance for varying forecast horizons with the within sample error variance. The 1-Step Chow statistic test is plotted in the first panel of Figure 2. The Break-point and the Forecast Chow tests for regressions with the forecast horizon decreasing from 1995:Q1—2001:1 to 1995Q:1 and increasing from 1995: Q1 to 1995: Q 1-2001: Q1 are presented in the second and third panels of Figure 2, respectively.

Figure 2: Chow test statistics



The one percent significant values of the test statistic are normalized to one (as an adjustment to the varying degrees of freedom). The test statistics never exceeded one, implying no rejection of the hypothesis of model constancy over the sample period.

V. Conclusion

This study presents a simple quarterly econometric model of long-run money demand and short-term inflation dynamics in Iran from 1990-2001, and analyzes whether the decline in inflation since early-2000 against a background of strong monetary growth represents a structural break in the modeled relationships. It is first established that real M1 balances have a long-run relationship with real output and a vector of opportunity cost variables proxied by the inflation rate and the rate of depreciation of the Rial against the dollar in the parallel market. The estimated money demand equation indicates that the reversal of the trend of depreciation at the parallel market and high output growth have boosted the demand for real M1 after mid-1999, implying that the strong growth of the M1 stock from 2000-2001 has not resulted in large excess liquidity supply and inflationary pressures. It is estimated that the inflation rate adjusts to money market disequilibrium in the short-run, and the estimated error-correction model for the inflation rate shows that lags of the first differences in inflation, output, depreciation of the parallel market rate and the money market disequilibrium term are all statistically significant determinants of the CPI inflation rate.

A battery of stability tests and break-point tests are carried out to gauge whether there was any

structural change in inflation dynamics during the latter part of the sample. All tests point to the relative stability of the coefficients and stable forecast error variances, indicating a lack of statistical evidence towards a structural break in inflation dynamics. This implies that the behavior of inflation in 2000-2001 has been consistent with the relationship of inflation with its determinants over the past decade.

The estimated model suggests that the disinflationary process from 2000-2001 was mainly effected by the stable and slight appreciation trend of the parallel market exchange rate, which appears to have a strong influence on inflationary expectations. In addition to its role in curbing inflationary expectations in the short term, the appreciation trend of the parallel exchange rate has led to an increase in the relative real rates of return on domestic currency denominated assets, which, combined with strong output growth, is estimated to have buoyed the demand for domestic currency to the extent that the growth of money supply did not result in a significant money market disequilibrium, in effect reducing the inflationary impact of the growth in money supply.

A number of other factors that have not been captured in our model due to the lack of adequate data are also likely to have exerted downward pressures on CPI inflation. First, favorable weather conditions in 2000 and 2001 have led to strong agricultural output and reduced the inflation of agricultural food prices, which amounted to a total weight of 31 percent in the CPI. Second, the gradual easing of trade barriers and increased import penetration have relaxed supply constraints in the tradable sector, and the stability of the Iranian Rial against the U.S. dollar in the official foreign exchange market and the strength of the U. S. dollar against other currencies have curbed the relative price of imports. With increased competition from imports despite the remaining tariff protection, domestic producers of tradable appear to have had little scope to raise prices, bringing the inflation of tradable consumer goods to single digit levels in the fiscal year 2001/02. Finally, the annual price increase limit applied to goods and services provided by public sector enterprises was reduced from 25 to 10 percent from March 2000 onwards. As supported by the lack of any statistically significant structural change in inflation dynamics during 2000, these price controls alone are unlikely to have been binding in significantly altering the inflation rate, but they might have had some restraining impact.

The results of the analysis indicate that a strong increase in the demand for real monetary balances on account of a marked increase in the relative rate of return on domestic currency assets appears to have alleviated the inflationary impact of the nominal money supply growth from 2000/01-2001/02. However, there seems to be little scope for much further growth in real money demand in the future, as it is unlikely that the relative rates of return on Iranian Rial assets can increase any further. Given that the stock of real M1 appears to be close to the equilibrium rate at the end of our sample period, this implies that continued strong money supply growth can rapidly lead to disequilibrium in the money market and put upward pressure on inflation.

The estimated model indicates that the exchange rate is a significant determinant of inflation. In the period ahead, any portfolio reallocation away from domestic currency holdings prompted by a perceived unsustainability of the policy stance could increase the parallel market premium given the relatively closed capital account, and translate into higher inflation. In this context, the building-up of disequilibria and misalignments relating to relative prices and the real exchange rate during periods of booming domestic demand would necessitate sharper exchange rate and inflation adjustments when external and domestic conditions become less favorable, underscoring the need to avoid imprudent fiscal and monetary policies even if their adverse effects are not immediately felt in the form of higher inflation.

Future work could usefully extend the analysis to a general equilibrium setting, where the determinants of inflation, the real exchange rate, and output could be explored in a multivariate framework. This would be useful in understanding whether and how inflation adjusts to disequilibria in the foreign exchange and goods markets as well as the money market.

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