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Constructing a New Monetary Condition Index for Iran[1]

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Abstract

Reliable measures of the size and direction of changes in monetary policy are very crucial for examining the effects of monetary policy on the economy. Monetary Condition Index (MCI) can be used as a tool to assess the stance of monetary policy. This index is defined as the weighted average of different monetary transmission mechanism relative to their values in a base period. The weights in MCI are the relative importance of each channel in transmitting monetary shocks in the economy. In this paper we construct a new MCI for Iran that characterizes three key innovations. First, for estimation of MCI's weights, we employ system of equations (VARX) in order to solve the problem of exogeneity arising from single equation method. Second, beside exchange rate and credit channel, it includes asset price channel. Third, we utilize a quarterly data set which seems more plausible for studying short-run dynamics regarding the monetary policy. Our estimated index over the 1991Q2-2014Q1 indicates that in more than 74% of quarters under consideration, monetary condition in Iran is easing relative to the base period (2004:2). The empirical results show MCI leads roughly 1 quarter ahead of inflation. Therefore, this index can be used as the leading indicator of the inflation rate.

Keywords: *Monetary Condition Index, Monetary transmission mechanism, Credit channel, VARX, Inflation forecasts.*

JEL Classification: *E51; E52; E58; C53*

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1. Introduction

Monetary policy affects economic activity and prices through different channels. The effectiveness of monetary channels depends on different factors, like: Degree of openness, financial market depth, etc. When there is more than one channel for monetary transmission, the extent of monetary tightening or easing may best be gauged by looking at all channels together. Iran's economy not only has characters of a small open economy, but it also has some structural specifications regarding the monetary policy compared to a conventional framework. For example, interest rates are determined by monetary authorities and not in the market; moreover, the rates do not adjust frequently in response to developments in the economy. Besides, the ratio of international trade to GDP is 40 percent, and the government is a dominant supplier of exchange – from exporting oil – in foreign exchange markets. Hence, we construct a Monetary Condition Index (MCI) in this paper for Iran's economy in order to provide a single indicator which summarizes the overall monetary condition.

In a conventional monetary theory, a short-term interest rate shows the state of monetary policy especially in a closed economy. However, output in an open economy may be affected not only by interest rate but also by exchange rate. Therefore, some recent studies have suggested constructing an MCI to serve as an indicator of monetary policy stance. An MCI has been used in early 1990s by the Bank of Canada as a measure to indicate how tight or loose monetary conditions are in the economy. Since then the use of MCI has become popular in several other countries.

Empirically, an MCI is calculated as the weighted sum of changes in a short-term interest rate and exchange rate relative to corresponding values in a baseline year. The weights ought to reflect importance of these variables (or channels) on economic activity and inflation. An MCI provides numeric information about the stance of monetary policy; moreover, a decrease in MCI

relative to the base year is interpreted as monetary tightening, and an increase in the index shows easing monetary policy.

The main contribution of this paper is threefold. First, since asset price is an important channel through which the Iran's monetary policy is transmitted, this paper extends the conventional MCI to capture this channel's effect. In other words, we constructed the MCI for Iran as a weighted sum of three monetary transmission channels consisting of exchange rate, credit, and asset price. As mentioned before, due to the fact that interest rate is not determined in the market, it is not included in the MCI. Second, for estimation of MCI's weights, we applied a vector autoregressive model with exogenous variable (VARX) [1] to identify and measure the importance of different monetary transmission channels in Iran. We employ a system of equations in order to solve the problem of exogeneity arising from single equation method used by previous studies in Iran. Third, we use a new quarterly data set over 1991Q2-2014Q1. It is worth noting that the number of papers which studied the different aspects of Iran's economy exploring this data set is very limited.

We found that the estimated MCI indicates that in more than 74% of quarters under consideration, monetary condition in Iran is easing relative to the base period (2004:2). The empirical results show MCI leads roughly 1 quarter ahead of inflation rate. Therefore, this index can be used as the leading indicator of the inflation rate.

The rest of this paper is structured as follows: Section 2 provides a review of monetary policy in Iran. In Section 3, we review the empirical literature on MCI and also mention some of weak points of studies done in this context. Section 4 provides the model used for deriving the weights of variables in MCI. Empirical results are presented in section 5. Finally, Section 6 summarizes the findings of the paper.

1. Vector auto regression with exogenous variables

2. Monetary Policy in Iran

The Central Bank of the Islamic Republic of Iran (hereafter the CBI) is a multiple mandate central bank. According to Monetary and Banking Act (1972), the main objectives of the CBI are: (***i***) to preserve the value of local currency, (***ii***) to preserve equilibrium in the balance of payments, ***(iii)*** to facilitate transactions and (***iv***) to enhance the economic growth. Although four mandates were assigned to the CBI, the priority of them has not been clarified yet. Not only is there no clear prioritization between them, but objectives is not clear with even chance of different interpretation about their implementations. For example, two different interpretations have been issued for the first objective. Some economists interpret that the first objective is about stability of prices denominated in local currency. In contrast, others interpret that the objective is about stability of nominal exchange rate.

For meeting the mentioned objectives, the CBI - as an institution responsible for the formulation and implementation of the monetary policy - has constantly faced obstacles. Some of these difficulties are related to the overall structure of the economy and inflow of oil revenues into the budget, and some others are attributable to the lack of efficiency of monetary instruments compatible with usury-free (interest-free) banking system. The CBI has a low degree of independence, and monetary policy is often dominated by fiscal policy. The government expenditure is mainly financed by the revenue from oil export and due to difficulty in predicting oil price for one year in advance, the government budget runs often in deficit and the CBI finances the deficit. The monetary policy is dominated by the fiscal policy, and also the CBI does not have an effective instrument for conducting monetary policy in compatibility with usury-free banking law.

In absence of an effective instrument, the CBI has mostly used direct intervention during the last three decades; including determining profit rates and credit ceilings. According to usury-free banking law, banks are forbidden from determining a fixed profit rate or an expected rate of return on banking

facilities in advance. Moreover, Money and Credit Council (MCC) [1] determines a minimum and maximum rate administratively. The MCC determines interest rates on deposit and loan in annual frequency, and these rates are rather inefficiently inflexible. [2] Figure (A1) demonstrates the difference between inflation rate and weighted interest rate on deposits and loans. As seen in this figure, inflation rate almost on the entire sample period is higher than nominal returns; so, real interest rate on deposits and loans are almost negative over the entire sample. Since real interest rates have been negative with a low degree of flexibility, interest rate channel does not play a significant role in transmission mechanism.

In previous decades, the CBI has attempted to use the indirect instruments along with direct instruments for conducting monetary policy. Reserve requirement ratio is one of the CBI's indirect instruments of monetary policy; its rate is determined annually by the MCC. However, the reserve ratio is rather inflexible for conducting monetary policy and also is costly for banking sector. From the 3rd Five-Year Development Plan (FYDP), the CBI was equipped by another instrument. The CBI was authorized to issue participation papers through the MCC approval.[3] However, the participation papers could not be exchanged in secondary markets and were utilized in very limited amounts by the CBI due to some legal and sharia issues.

In practice, controlling the growth rate of monetary base has been the main instrument or the operating target for the CBI. However, the CBI does not

1. Money and Credit Council is the most important institution in monetary policy decision-making. Based on the Monetary and Banking Law of the country, rectified at 18 Tir 1351 (July 9th,1972), the Council was in the position to consider and decide on the general policy of CBI, and to supervise the monetary and banking affairs of the country.
2. Determining the profit rate on loan decreases the effectiveness of price system in financial markets. In financial markets, the risk should efficiently be priced and reflected in the rate. When the profit rate is constant regardless of the aggregate or idiosyncratic risk associated with investment, the market may not allocate the resource efficiently.
3. Issuance of participation papers by the CBI is authorized upon the approval of the parliament according to the 4th FYDP.

have complete control in this instrument because fiscal policy has direct impact on the money base. If oil-revenue predicted in budget does not realize and the budget runs a deficit, the CBI will have to finance the deficit by lending to the government. Or, if the exchange rate in the market is lower than the rate in the budget, the CBI must accumulate net foreign asset and expand monetary base. Therefore, the presence of fiscal dominance undermines the CBI's control over its instrument.[1]

Analysis of the contribution of different factors to monetary base growth shows that on average, during 1988-98, growth in money base was mainly driven by the CBI net claims on public sector with the average share of 20 percent (figure A2). In other words, the CBI monetized budget deficits, and government credit was the main factor contributing to the growth of monetary base over that period. Nevertheless, this pattern did change during the last decade. Over 2002-2009, the CBI net foreign asset mostly contributed to expansion of monetary base (with the average share of 41 percent).[2] That is, the CBI has bought the oil revenue denominated in foreign currency from government and did not sell them to neutralize its effect on monetary base. The share of net foreign assets in monetary base growth is 50 percent over 2002-2006. Therefore, the way government finances its budget has affected the composition and the growth rate of monetary base over the entire sample.

In order to give an overall view on policy maker's preferences regarding the target variables, we compare the quantitative targets set in FYDPs for growth rate of broad money (M_2), inflation and real output (real GDP) and corresponding realized values. Figures (A3) to (A5) show the targets and realized figures over the whole sample. As seen in figure (A3), the realized

1. Since the 3rd FYDP, the CBI was forbidden to directly finance the government fiscal deficits, and the deficits must either be financed through selling of foreign currency to the CBI or raising revenue through public issuance of "Participation Papers". Note that selling of foreign currency (obtained from oil export receipts) to the CBI in order to finance government expenditure, even with no budget deficit results in base money expansion.
2. An exception is 2007 year in which central bank claims on banks was the most important factor and the CBI net foreign asset was the second factor in expanding monetary base.

growth rate of M_2 is significantly different from corresponding targets; that is, the CBI could not meet the targets. Fiscal dominance and low degree of central bank independence account for the higher growth of M_2. Figure (A4) compares target and realized CPI inflations, and it is not surprising that the realized inflation is higher than determined target. Similarly, figure (A5) compares realized growth rate to its targets announced in development plans. It is clear that accommodating output has a higher weight in the central bank loss function.[1] The low degree of central bank independence and absence of fiscal discipline along with high targets for economic growth in FYDP and supply-side structural problems lead to monetary and credit expansion.

It is worthwhile to mention that access to large amount of foreign reserve helps the CBI to put pressure on inflation by supplying foreign reserve in the market and controlling the increase in nominal exchange rate. As seen in figure (A6), the real exchange rate over the last decade appreciates remarkably.

It is worth noting that existence of positive two-digit inflation over the last three decades implies that monetary policy has been expansionary. Hence, an MCI may not be able to capture the absolute monetary stance because the index shows the monetary condition relative to a base period (or to the previous period).

1 Jalali Naini and Hematy (2013) estimate several forms of reaction functions (including linear and non-linear equations) for CBI. Based on their results, in the "low inflation" regime expansionary policies by CBI tend support economic activity. However, during "high inflation" regime, CBI does not exercise anti-inflation policy but such a stance cannot accommodate output growth.

3. Literature Review

In a closed economy, a monetary policy instrument, e.g. a short-term interest rate in many countries has summarized the monetary condition. For example, the monetary policy is contractionary when the interest rate is high, and the monetary policy is expansionary when the interest rate is low. Nonetheless, in an open economy the monetary condition may not be understood by observing a single variable because the condition may be affected by different channels. Consequently, instead of a single variable, a combination of variables as an index can be used to express the monetary condition in an open economy. Yet, choosing the variables and their relative weights in the index has been subject of disagreement.

Accordingly, bulk of papers on MCI focuses on the relevant variables and their relative weight in the index. If a central bank in an open economy uses a short term interest rate as a medium target, still the exchange rate through uncovered interest parity may have impact on economic activities. So, monetary policy generally operates through both interest rate and exchange rate in an open economy. In spite of that there is still the question how to determine the relative weight of these variables in a single index. Freedman (1994) proposed that the relative weight of variables in the MCI should reflect their relative effects on either aggregate demand or prices. Since Freedman proposed the way to calculate the relative weight in an MCI, many studies have calculated this index for different countries by different methods. Some empirical studies on MCI are summarized in table (1).

Most of studies consider a narrow MCI as the weighted average of interest rate and exchange rate. Nevertheless, there are numbers of studies which have taken into account the other monetary transmission channels including asset price and credit channels. These papers consider structural features of economies by adding or omitting some channels.

Table 1: Literature Review on MCI

Study	Country	Studied channels	Variables in MCI
Batini and Turnbull (2002)	UK	Interest rate and exchange rate	Real exchange rate, short-term real interest rate
Vuslat Us (2004)	Turkey	Interest rate and exchange rate	Short term real interest rate and real effective exchange rate
Wai-Ching Poon (2009)	Indonesia	Interest rate, exchange rate and asset price	Real interest rate, real exchange rate and share prices
Abubabkar and Yaaba (2013)	Nigeria	Interest rate, exchange rate and credit	Short term interest rate, exchange rate, growth rate of credit to private sector
Peng and Leung (2005)	China	Interest rate, exchange rate and credit	Short term interest rate, exchange rate, growth rate of credit to private sector
Kannan, Sanyal and Bhoi (2006)	India	Interest rate, exchange rate and credit	Short term interest rate, exchange rate, growth rate of credit to private sector

Source: Author's reviews

Before reviewing the calculated MCI for Iran, it is worth surveying the studies about transmission mechanism. Table (2) summarizes studies on monetary mechanism channels in Iran. Generally, four main channels were introduced in the literature through which monetary policy may influence aggregate demand: Interest rate, Exchange rate, Credit and Asset price. As shown in table (2), there is no consensus regarding the transmission channels

in Iran. While some studies emphasized the importance of all channels, there are some which focused on a subset of channels.

Table 2: Monetary Transmission Mechanism in Iran

Study	Period	Studied channel	Finding
Keshavars Hadad and Mahdavi (2005)	1991-2002	Asset (equity) price	Equity price channel is not effective.
Ranani, Komijani and Shahrestani (2009)	1989-2008	Asset (house) price	House price channel is effective.
Moshiri and Vashaghani (2011)	1988-2007	All 4 channels	All channels are ineffective
Komijani and Mehrabani (2012)	1990-2008	All 4 channels	All channels are effective

Source: Authors' reviews

There are two studies that calculated an MCI for Iran. Sadeghi et al. (2007) calculate an MCI using annual data over 1973-2006. The estimated coefficients for real interest rate and (logarithmic) real exchange rate respectively are -0.003 and 0.36. Thus, the relative weight of exchange rate to interest rate is trivial which means the interest rate does not affect the economic activities over the sample period.

Khorsandi et al. (2012) argue that in addition to interest rate and exchange rate channels, there is a credit channel which has an important role in transmission of monetary policies. They added balance of loans to the private sector as a third channel in the model and used annual data over 1959-2008. They estimate both aggregate demand and price equations for deriving weights of these three variables in MCI. They estimate the weight of credit to

exchange rate in aggregate demand and price equation to be respectively 0.13 and 1.29. So, the weight difference from these equations is remarkable and forces them to choose between them based on some criteria. On the other hand, they estimate the coefficient of interest rate in both equations to be non-trivial which is not in line with Sadeghi et al. (2007).

While these studies used annual time-series data, in the present paper we utilized a quarterly data set which seems more plausible for studying short-run dynamic regarding the monetary policy. On the other hand, in these two mentioned studies, MCI's weights derived from estimating the single equation (AD or price equation) but in this paper we employ system of equations (VAR) in order to solve the problem of exogeneity arising from single equation method used by mentioned studies.

MCI weights cannot be observed directly, so they are usually derived empirically from a model of the economy. We use VARX model for deriving MCI weights. In the next section, we explain the methodology and details.

4. VARX Model

A conventional model in and the monetary transmission literature consists of variables that represent (i) policy instrument, (ii) transmission channels, and (iii) final targets such as output and price level. The choice of VAR approach is also inspired by the existence of a large empirical literature using VARs to examine the monetary transmission mechanism in Iran. The VARX can be represented by,

$$Y_t \cong c \,.\, \prod_{q\cong 1}^{n} A_q Y_{t0q} \,.\, \prod_{r\cong 1}^{m} B_r X_{t0r} \,.\, \Sigma D_t \,.\, \eta_t \qquad (1)$$

Where, Y_t denotes an $n \times 1$ vector of endogenous variables observed in period t, and X_t is an $m \times 1$ vector of exogenous variables in period t. The endogenous variables are real nonoil GDP (y), consumer price index (p), house price (p_h), market exchange rate (e), bank claims on private sector (c) and monetary base (mb). House price is a proxy for asset price, bank claims on private sector is a proxy of credit provided by banking system and monetary base is the CBI's instrument.

House price, market exchange rate, and bank claims on private sector display three channels on monetary transmission mechanism (called asset price, exchange rate and credit channels respectively). We discard interest rate from the model since the rate is determined officially by the MCC and shows very infrequent changes in the sample. Therefore, the real interest rate, from difference of nominal rate and CPI inflation, only reflects changes in inflation and does not deliver additional information. Due to this fact, real interest rate is replaced by inflation rate in this model. Empirical studies on monetary transmission mechanism in Iran provide evidence that the house price channel plays a non-trivial role (Ranani et al., 2009). Consequently, we choose house price for identifying the asset price channel in Iran. In this model, X_t is a vector of exogenous variables, which in present paper just includes both revenue from oil-export and world output. The US output is used as a proxy for world output. Besides, D_t represents dummy variables for sanction and exchange rate unification in Iran.[1]

All series have been taken from the CBI data set. The frequency of the series is quarterly and the sample is over the period 1991Q2- 2014Q1. The natural logarithms of all time - series are taken to eliminate potential heteroscedasticity, and they are seasonally adjusted if needed[2].

As mentioned before, the interpretation of an MCI for Iran is not straightforward. Because monetary policy has been historically expansionary,

1 . The dummy for sanction is defined to be unity in 2012:1 through 2014:1. The dummy for exchange rate unification is defined to be one in 2002:2.

2 .We use census X12 adjustment method for removing the seasonal component of time series.

and there is no single period in the sample that contractionary policy is associated with deflation. Therefore, the calculated MCI gauges the relative change in - and does not show the absolute - monetary stance. A reduction in MCI should be interpreted as less expansionary policy, and an increase in MCI should be called an extra expansionary policy.

4.1. Time series properties of the data

We investigate the existence of unit root in variables by using Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests. These tests help to estimate the order of integration of each series. The order of integration would lead us towards the appropriate action; for example, these tests determine difference order for each series that converts it into stationary series before estimation of the model. As can be seen from the table (3), variables are all non-stationary; however, they are stationary, $I(0)$, in first difference. Hence, we can conclude that they are integrated of order one, $I(1)$. So we consider the log difference form of each variable in estimation.

In VARX model (1), we construct endogenous and exogenous vectors to contain variables in the first difference. This transformation of variables helps to avoid spurious regression, without the transformation the co-integration relationship among variables should be tested.

We use Choleski decompositions approach for identifying the monetary shocks in our model. The ordering of endogenous variables in Y_t was chosen on the basis of how fast a variable responds to shocks. It is assumed that output is the least responsive, followed by prices, then monetary transmission channels and finally monetary base.

The optimal lag order in the VAR system has been selected according to information criteria. AIC and LR criteria suggest two lags for endogenous variables in the VAR system, $n = 1$. Nevertheless, SB criterion was not informative since it suggested no lag at all.

Table 3: Unit Root Tests

	ADF test *			PP test		
Variables	**t-statistics**	**Prob.**	**result**	**t-statistics**	**Prob.**	**result**
Level						
y	-1.64	0.455	I(1)	-1.908	0.327	I(1)
p	-1.32	0.613	I(1)	-0.862	0.796	I(1)
e	-1.55	0.502	I(1)	-1.574	0.492	I(1)
p_h	-0.45	0.894	I(1)	-0.196	0.934	I(1)
c	-1.36	0.596	I(1)	-0.831	0.806	I(1)
mb	0.52	0.987	I(1)	0.520	0.987	I(1)
First difference						
$\Delta(y)$	-12.39	0.000	I(0)	-12.396	0.000	I(0)
$\Delta(p)$	-3.20	0.022	I(0)	-4.869	0.000	I(0)
$\Delta(e)$	-10.04	0.000	I(0)	-10.01	0.000	I(0)
$\Delta(p_h)$	-4.92	0.000	I(0)	-4.776	0.000	I(0)
$\Delta(c)$	-5.01	0.000	I(0)	-5.050	0.000	I(0)
$\Delta(mb)$	-11.53	0.000	I(0)	-11.429	0.000	I(0)

* In the ADF test allows only for intercept.
Source: Authors' calculations

Table 4: Lag Order Selection Criteria

Lag	Log L	LR	FPE	AIC	SC	HQ
0	1043.21	NA	3.09e-18	-23.29	-22.44*	-22.94
1	1115.75	126.73	1.34e-18*	-24.13	-22.26	-23.37*
2	1152.06	58.43*	1.36e-18	-24.13*	-21.24	-22.97
3	1185.09	48.59	1.53e-18	-24.07	-20.15	-22.49
4	1217.24	42.86	1.81e-18	-23.98	-19.05	-21.99
5	1247.84	36.57	2.34e-18	-23.85	-17.90	-21.46

Source: Authors' calculations

4.2. Marginal importance of channels

As explained earlier, the weights in MCI are the relative importance of each channel in transmitting monetary shocks in the economy of Iran. For examining the relative importance of channels, we followed the approach suggested initially by Ramey (1993).[1] This approach includes three steps. First, a benchmark VAR model (introduced in previous section) is estimated, and the impulse response of a target variable (output growth or inflation) with respect to a monetary policy shock is calculated. In the second step, it would be assumed that a variable which represents a specific channel is exogenous in the model. By this way, the benchmark model would be constrained, or the channel might not be effective in transmitting monetary shocks. Then, the response of the target variable to a monetary shock is calculated from the constrained model referred as the constrained response. In the last step, the percentage difference between the constrained and benchmark responses is

1. Morsink and Bayoumi (2001), and Endut and Morley (2005) also utilized this approach to determine the importance of monetary transmission mechanism.

measured. Formally, the marginal importance of channel i, s periods after the economy hits by a monetary shock can be written as the following:

$$MI_s^i = \frac{IRF_s^i(c) - IRF_s^i(b)}{IRF_s^i(b)} \quad (2)$$

Where IRF is the impulse response function of target variable with respect to a monetary shock. The impulse response functions in benchmark and constrained model, respectively denoted by b and c. Therefore, MI_s^i provides a measure of the relative importance of the excluded channel, i, in the transmission mechanism. A significant change in the path of the target variable implies that the channel which was excluded from endogenous variables is an important part of the transmission mechanism. Conversely, the closer the constrained response function is to the benchmark case, the weaker is the excluded channel. By applying stage two and three, the importance of all channels would be measured, and subsequently the relative weights of channels would be calculated.

It is clear that the relative importance and consequently weights of channels in MCI change through time. In order to tackle this issue, we calculate the relative weights over three time horizons: short, medium, and long-term. These three horizons are defined to contain 4, 20 and 40 quarters respectively. The normalized weights of monetary channels are reported in Table (5). These weights are normalized so that the weight of exchange rate equals to 1 in three time horizons.

Table 5: Relative Weights of Channels

	short-term		medium-term		long-term	
Channels	$\Delta(y)$	$\Delta(p)$	$\Delta(y)$	$\Delta(p)$	$\Delta(y)$	$\Delta(p)$
Exchange rate, $\Delta(e)$	1	1	1	1	1	1
Credit, $\Delta(c)$	0.08	0.32	0.05	1.13	4.78	1.92
House price, $\Delta(p_h)$	0.69	0.48	0.51	2.66	1.39	0.54

Source: authors' calculations

For output growth as a target variable, the exchange rate has the highest weight in short and medium terms. The weight of credit growth increases gradually as the time horizon expands, and it becomes the most important channel in the long-term. For the inflation as the target variable, exchange rate has the highest rate over short term. The weight of asset price inflation increases as the time horizon expands, and it becomes the most important channel affecting inflation in medium term. It is interesting that for both output growth and inflation, credit channel is the most important channel in the long-term.

5. MCI Calculation

As shown historically in section 2 and empirically in the previous section, the monetary policy would affect Iran's economy through three different channels: exchange rate depreciation, credit growth, and asset price inflation. Hence, MCI should have these channels included, and it would be defined as a weighted average of these channels, relative to a base period. Therefore, MCI could be written as

$$MCI_t = \big(\Delta(e_t) - \Delta(e_0)\big) + \theta_c\big(\Delta(c_t) - \Delta(c_0)\big) + \theta_{p_h}\Big(\Delta\big(p_{h,t}\big) - \Delta\big(p_{h,0}\big)\Big) \quad (3)$$

Where $\Delta(e_0)$, $\Delta(c_0)$ and $\Delta\big(p_{h,0}\big)$ are the growth rate of the exchange rate, credit and house price in a base year. The second quarter in 2004 is selected as the base or benchmark period.[1] It is worth noting that the level of MCI is not informative, since the index is constructed using differences between actual and an "arbitrarily" chosen base period. However, the variation in the

1. There is no theoretical reason to select the base period; it is rather an arbitrary decision. Since 2004 is selected as base year for computing national accounts, and Iran' economy has experienced a relatively low fluctuations, this choice seem to be reasonable to analyze monetary condition in Iran.

index shows the direction of change in monetary conditions comparing with the base period. According to MCI definition in (3), a rise (or decline) in the index is interpreted as an easing of (or contracting in) monetary conditions.

In this paper, we compute MCI using both real and nominal variables. In next section we introduce a criterion to select the best index among different definitions.

5.1. Comparison of different MCIs

The MCI could be constructed from different sets of weights reported in Table (5). Nevertheless, proposing different MCIs which may even provide absolutely different insights is not informative. Therefore, we test the ability of different indices in forecasting the inflation rate in order to select the best index. The forecast equation can be represented as follows:

$$\pi_{t+h} = c + \sum_{l=1}^{m} \gamma_l \, \pi_{t-l} + \sum_{q=1}^{n} \alpha_q \, \Delta\left(MCI_{t-q}\right) + \varepsilon_{t+h} \qquad (4)$$

Where π_t is inflation rate defined as $\pi_t = p_t - p_{t-4}$ where p_t is consumer price index in logarithmic form. The first difference of the index $\Delta(MCI_t)$, indicates the development in stance of monetary condition. h denotes the forecast horizon (so that h = 4 quarters).

We use out of sample forecast approach to test the predictive power of different indexes[1]. In order to choose among candidate MCIs, we compute the sample relative root mean squared errors (RMSE) of different forecasting equation (4), relative to the RMSE in benchmark model. If relative RMSE is less than one, the candidate forecast is estimated to have performed better than the benchmark. We define benchmark model as an autoregressive model.

1..Our out of sample forecast analysis is carried out using "pseudo-out-of-sample" calculations that rely on the same regression specification used above, but estimated recursively through the forecast period. Specifically, forecasts at time period *t* are constructed by estimating the regression coefficients using data from the beginning of the sample through period *t*; these estimated regression coefficients are then used to forecast π_{t+h}. The process is repeated to construct forecasts at time $t + 1$, and so on through the end of the sample (2014:Q1).

The lag lengths on the π and ΔMCI were chosen (at each forecast date) by SIC (Schwartz information criteria), a standard method for estimating lag-lengths. The out-of-sample forecasts were started in 2000 to allow for 36 quarterly observations in the regressions used for the initial forecast.

Based on regression results, the coefficients of candidate indices, $\Delta(MCI_t)$, are positive and significant. The positive coefficient of the change in MCI is consistent with the fact that expansionary monetary policy increases the inflation rate.

The relative RMSE of the inflation forecast is calculated for all models over a horizon of 4 quarters (h=4). Based on the result, the nominal MCI calculated with the weights derived from the IRF of $\Delta(y)$ in medium term has the lowest RMSE (Table 6).

Table 6: Relative RMSE of the Inflation Forecast

	$\Delta(\boldsymbol{y})$ **as target**		$\Delta(\boldsymbol{p})$ **as target**	
	Nominal	**Real**	**Nominal**	**Real**
Short term	0.705	0.959	0.707	0.982
Medium term	0.704	0.954	0.833	1.004
Long term	0.903	0.889	0.776	0.945

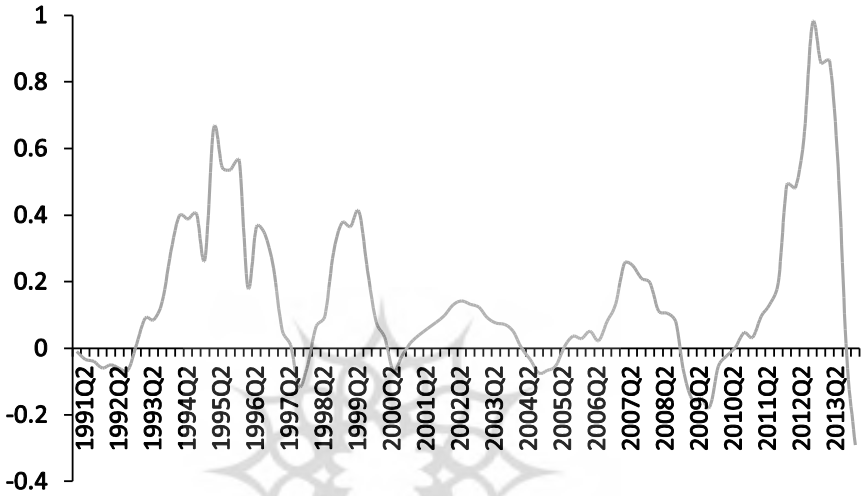
Source: Authors' calculations

Figure (1) shows the series of the best MCI which is calculated from the medium term weights and nominal variables. Based on MCI, in 68 quarters out of 92 quarters (whole period), monetary condition is easing relative to the base period (more than 74% of quarters).

Although the concept of an MCI is theoretically appealing, there are caveats in the empirical implementation. Weights applied to each variable can vary significantly depending on the model used, so that there can be

considerable uncertainty surrounding the appropriate weights. Thus, caution is required in interpreting the estimates.

Figure 1: The Selected MCI for Iran

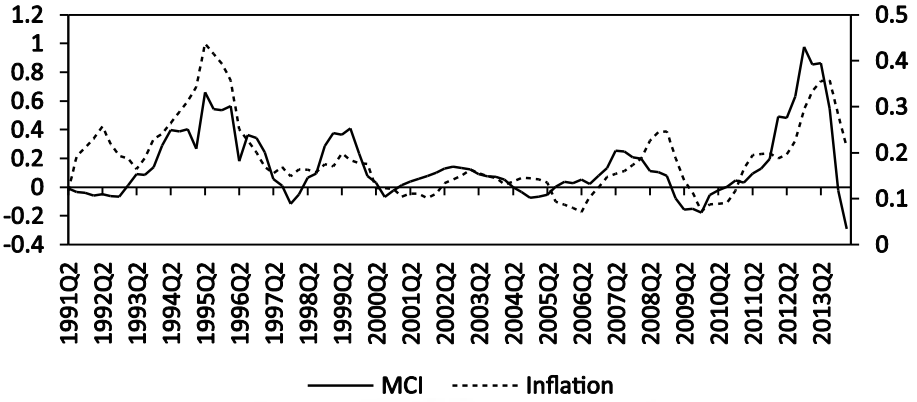


Source: Authors' calculations

5.2. MCI as leading indicator of inflation

Through comparing MCI's relation to inflation, we find that it can well reflect changes in inflation. Figure 2 shows series of MCI together with the inflation rate. As can be seen, these two series display a high degree of co-movement with each other.

Figure 2: MCI and inflation rate



Source: Authors' calculations

Analysis of cross correlation coefficient of MCI and inflation shows that MCI leads 1 quarter ahead of inflation [based on Table 7 the coefficient of the first lag (0.712) is the highest value]. Therefore, MCI can be used as the leading indicator of inflation.

Table 7: Cross Correlation Coefficient of MCI and Inflation

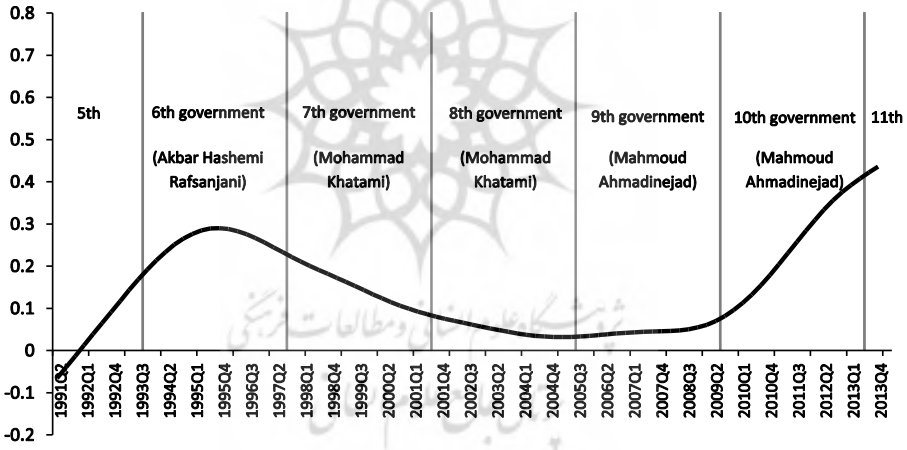
L	0	1	2	3	4	5	6	7
INF, MCI(-L)	0.682*	0.712*	0.688*	0.603*	0.471*	0.334*	0.184	0.039
INF, MCI(+L)	0.682*	0.547*	0.405*	0.293*	0.195*	0.137	0.089	0.013

* These correlations are statistically significant.
Source: Authors' calculations

5.3. Analysis of MCI during different presidential periods

In order to have a smoothed index for monetary condition, we use Hodrick Prescort filter to remove the cyclical component from the index. The shape of trend line (Figure 3) indicates changing stance of monetary policy by the monetary authorities during the decades under study. The MCI suggests a distinct easing of monetary conditions in 1991-1996 which contributed to high inflation rates. Although the monetary policy seems to be tightening during 1996 to 2005, the monetary authorities over 2005 - 2013 aimed at expanding monetary condition in order to accommodate economic growth.

Figure 3: The trend component of MCI during different presidential periods (fifth to eleventh governments)



Source: Authors' calculations

We also compare the trend component of MCI during different presidential periods. As can be seen in figure 3, during Akbar Hashemi Rafsanjani's presidential period, the monetary condition index indicates expansionary monetary policy. Expansionary policies were used during this period in order to rebuild the economy's infrastructures after Iraq-Iran war. In

Mohammad Khatami's first and second presidential periods, MCI has declined and reached the lowest value. The performance of the inflation rate during Khatami's government indicates that the lowest average of inflation rate through 5th to 10th governments occurs during the second presidential period of Khatami (13.7%). In 10th government, MCI increased sharply and reached the highest level during the sample. As a result of this easing monetary stance, the inflation rate started a sharp rise and reached nearly 40 percent.

Conclusions

In order to evaluate the monetary conditions in a country during different policy regimes there must be an indicator. The monetary conditions index is designed to serve as an indicator of monetary policy. It helps to evaluate the monetary policy stance. In other words, it shows whether monetary policy is tight, unchanged, or expansionary. This paper estimated Monetary Conditions Index (MCI) for Iran's economy by using quarterly data from 1991:2 to 2014:1. Since MCI is defined as a weighted average of different monetary transmission channels, at first stage we compute the relative importance of different channels in Iran. For this purpose, we used VARX model. We have constructed the MCI by utilizing the estimated weights of three channels in three time horizons (including short, medium, and long term). For selecting the best index, we compare the indexes based on their ability to forecast the inflation rate. According to forecasting equations, the nominal MCI calculated with the weights derived from the impulse response of the growth rate of real non-oil GDP to a monetary shock in medium term has the lowest RRMSE. This index indicates that in more than 74% of quarters under consideration, monetary condition is easing in Iran relative to the base period (2004:2).

For detailed analysis we compare the trend component of MCI during different presidential periods. The trend component of MCI is derived using Hodrick and Prescort (HP) filter. Based on the empirical result, we can divide

the trend component of MCI into 3 phases; First phase (1991:2-1996:2): in this period the monetary policy was expansionary and Iran's economy experienced a high level of inflation rate during this period; Second phase (1996:3-2005:2) which we can be called as the tightening stage of monetary condition –as a result of the contractionary monetary policy, the inflation rate stood below 20 percent– and finally, third phase (2005:3-2014:1), in which MCI had an increasing trend and reached its highest value during the sample.

Since CBI applies multiple instruments (such as quantity, price and administrative instruments) and none of them alone can adequately reflect changes in its monetary policy, conventional measures of monetary policy - the growth of monetary base as monetary instrument- have many drawbacks. Properly measuring the monetary policy changes is crucial to a better understanding of the conduct of monetary policy in Iran. To meet the challenge that no single policy instrument represents a good proxy of Iran's monetary policy, we construct a new composite measure to better gauge the changes in monetary policy. Based on our results, it is recommended that monetary researchers use MCI rather than an arbitrary selected instrument for analyzing the stance of monetary policy in Iran.

The possible policy implications which can be drawn are: First, the house price channel would be a source of information to be incorporated into the conventional MCI to set the operating target for the monetary policy instrument. Second, the movement in MCI reveals its role as a leading indicator of inflation in Iran. Thus, MCI provides more information about the policy stance than what is revealed by interest rates, exchange rates or credit independently. Third, The MCI tries to proxy different channels in the monetary transmission mechanism and is simple to construct a timely indicator. Monetary analysis for policy decisions requires a multi-dimensional and broad-based assessment of all information that may be relevant for price developments, and this MCI can provide complementary and timely information in this context.

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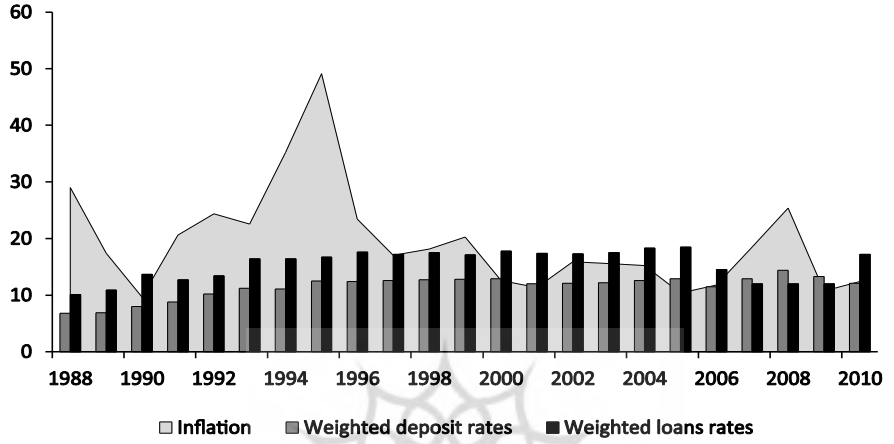
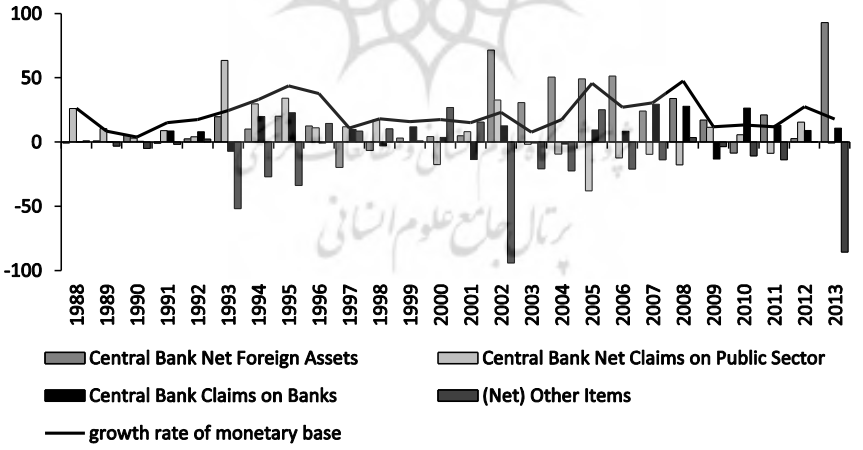
Appendix

Figure A1: Inflation and Interest Rate on Deposit and Loan



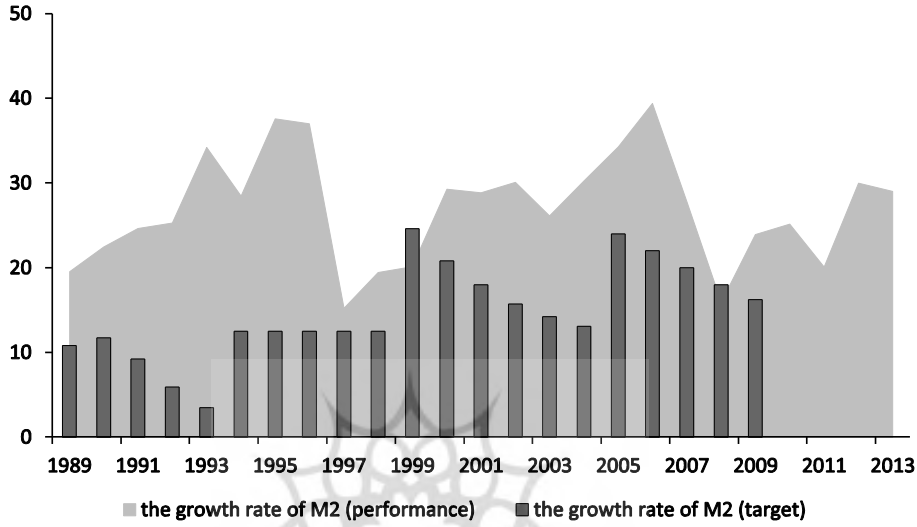
Source: CBI

Figure A2: Source of Monetary Base Growth



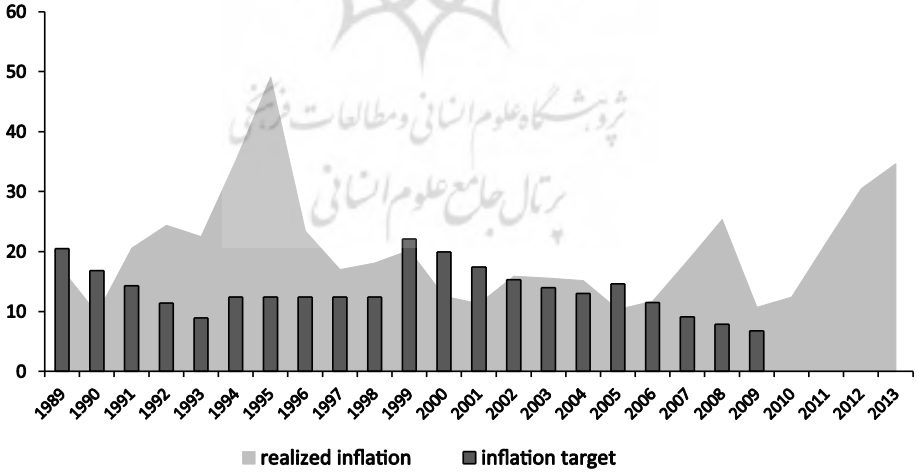
Source: CBI

Figure A3: Growth Rate of M2 (target and performance)



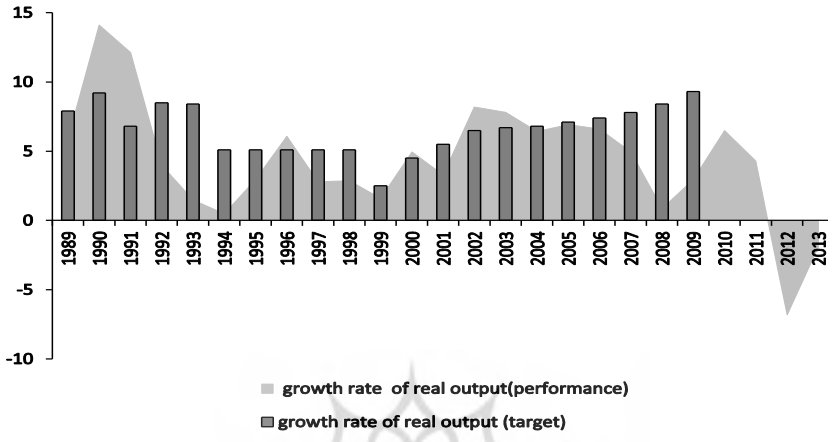
Source: CBI and FYDPs.

Figure A4: Target and Realized CPI Inflation



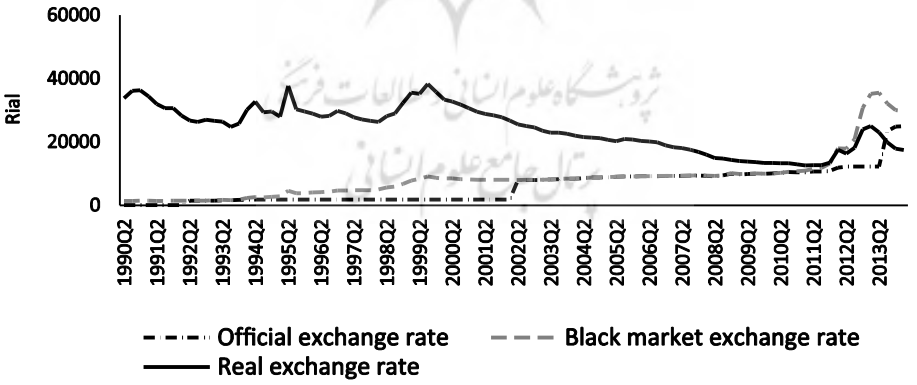
Source: The CBI and FYDPs.

Figure A5: Target and Actual Output Growth



Source: CBI and FYDPs.
Note: No quantitative targets announced after 4th plan (2009-2005)

Figure A6: Exchange Rate Fluctuations



Source: CBI