MONETARY CONDITION INDEX AND ITS RELATION WITH OTHER MACROECONOMIC VARIABLES: AN EMPIRICAL STUDY IN SELECTED MENA COUNTRIES

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Monetary policy - economic growth - monetary condition index - real interest rate - GDP
Abstract
This article aims to construct a monetary condition index (MCI) for five countries in the MENA region, namely Algeria, Bahrain, Egypt, Jordan, and Morocco, in order to interpret the stance of monetary policy in these countries. A broad MCI has been constructed by combining two transmission channels of monetary policy, the real interest rate and the real effective exchange rate, along with bank credit to the private sector. These three indicators of the monetary conditions are collected for these countries over the period 1995–2020 for all countries except for Bahrain, which has data from 1995 to 2015. Principal component analysis (PCA) is used to construct the monetary condition index (MCI). Then a vector auto-regression method is employed to explore the impulse response of MCI to consumer price index (CPI) and GDP. The results reveal that the MCI of Bahrain, Egypt, and Jordan can predict inflation and economic growth in the long run but cannot do that in the short run. However, in the cases of Algeria and Morocco, the findings show that MCI cannot predict inflation and GDP in the short and long run.

Keywords
Monetary policy - economic growth - monetary condition index - real interest rate - GDP
1. INTRODUCTION

The Monetary Conditions Index (MCI) was constructed for the first time by the Canadian central bank in the 1990s, and then many other central banks, such as Finland, New Zealand, Australia, Sweden, France, and the United Kingdom, applied this index to conduct their monetary policy. Moreover, the International Monetary Fund (IMF) and the Organization for Economic Cooperation and Development (OECD) applied the monetary condition index. The aim of the MCI is to aggregate the monetary indicators into a single policy index by giving each one a weight that is proportional to its influence on a reference variable relevant to economic policy, such as economic growth or inflation. Since both interest rate and exchange rate are main indicators of monetary policy and are considered to be the main channels of monetary policy that can affect inflation, that’s why the narrow form of MCI combines the real short-term interest rate and the real effective exchange rate (Hyder & Khan, 2007). These two variables are assumed to be the primary tools of monetary policy, which in turn affects the inflation rate (Qayyum, 2002).

The investing and spending behavior of economic agents is influenced by any fluctuation in the interest rate. Consequently, the variation in interest rates affects GDP. Otherwise, fluctuations in the exchange rate influence the spending behavior of the individual because any change in the exchange rate might be reflected in the relative price of domestic and foreign goods. When currency appreciates, this can lower the price of imported goods, while when currency depreciates, this can raise the price of imported goods (Qayyum, 2002). Popularly, inflation can be affected by both the interest rate and the exchange rate. Rising the aforesaid variables can diminish the growth and inflationary pressures, and a reduction in any one can boost the economic growth and the inflationary pressures. Kodra (2011). Therefore, an alteration in the index can refer to the tightening or loosening of monetary conditions. If MCI increases, then the monetary condition is tight, whereas if MCI decreases, then the monetary condition is loose (Memon & Jabeen, 2018).

It is important to notice that the more the economy is open, the more important the role of the exchange rate is in detecting monetary conditions (Joiner, 2006). However, the MCI can be extended by encompassing other financial indicators such as stock prices and credit (among others) in order to create a broad form of the MCI. In reality, the MCI, in all its forms, is supposed to be used as an indicator of the degree of loosening (easing) or tightening of monetary conditions as a whole. It helps to measure the contribution of monetary conditions stance to changes in economic growth or inflation, and it can be used as indicative of inflation since it traces the movement of interest rate and exchange rate (Memon & Jabeen 2018).

Given the importance of MCI in economic control, one of the objectives of this article is to construct a broad MCI for the selected countries. This can be essential when any shock happens; for example, financial problems resulted due to the Arab Spring and the Corona pandemic (IMF, 2021).

In terms of monetary policy reforms and exchange systems, some MENA countries pursued expansionary monetary policies aimed at stimulating the domestic banking sector to expand the granting of credit to the private sector. These policies were accompanied by the implementation of a package of measures, some of which included the provision of the necessary liquidity by a number of central banks at low interest rates to reduce the cost of the granted credit and the use of monetary policy tools to mitigate the negative repercussions of the Arab Spring crisis. The basic interest rates in most MENA regions have witnessed successive reductions that have brought interest rates in some MENA countries to low levels in order to face the Arab Spring crisis (World Bank, 2015). However, the COVID pandemic was represented by inflationary pressures that led to the raising of the interest rate in a number of central banks. (IMF, 2021).

During the period 2011–2016, some Arab central banks, especially in oil-importing Arab countries, implemented reforms with the aim of adopting more flexible exchange rate regimes, either in light of the pressures of the shortage of foreign exchange supply or in light of the keenness of some of them to increase the ability of exchange systems to absorb external shocks. In the context of a gradual transition towards the application of the managed exchange rate regime, other central banks have also continued to adopt reforms aimed at creating the
appropriate environment for the transition to inflation-targeting policies, such as Tunisia, Morocco, Algeria, and Egypt (Albatrawi, 2018).

The countries in the MENA region that are selected in this study are Algeria, Bahrain, Egypt, Jordan, and Morocco. These countries were chosen according to the availability of the required data for this study. The study examines the predictive power of MCI, since it is used to forecast inflation and growth. Afterwards, this study will shed light on the tightness or looseness of the monetary conditions experienced by the chosen MENA countries and show if MCI can be applied to portend CPI and GDP in the short and long run as well.

2. LITERATURE REVIEW

Between the 1950s and 1960s, central banks used to implement a fixed exchange rate system as the cornerstone of monetary policy, and for a long time, the short-term interest rate was the operational target of monetary policy. Then, the Canadian central bank combined interest rates and exchange rates in order to build the monetary condition index, "MCI," which is used to interpret monetary policy (Hataiseree, 1999).

Through the past twenty years, the MCI has spread to different countries to review monetary policy and interpret its impact on the economy. Using several approaches to estimation, different economists constructed the MCI ratio according to the characteristics of their countries. Numerous central banks, such as the Bank of Sweden, the Norges Bank, and the Bank of Iceland, and other businesses and organizations such as the IMF (“International Monetary Fund”) and the OECD (“Organization for Economic Co-operation and Development”), they all constructed the monetary condition index as an indicator of the monetary policy stance for various countries, and the index spread during the 1990s to interpret the monetary policy status. However, Canadian Bank and New Zealand Bank utilized the monetary condition index for an operational target. (Kannan et al. 2007).

Duguay (1994) applied quarterly data for Canadian banks during the period 1968–1990 to construct two models that show the linkage between change in interest rate and exchange rate with inflation and change in aggregate demand. Moreover, Dennis (1997) constructed the MCI for New Zealand, and the paper revealed that the monetary policy status is influenced by both the interest rate and the exchange rate; however, the real interest rate has a stronger influence on the monetary policy transmission channel than the exchange rate (Dennis, 1997).

On the other hand, in a small open economy like Turkey, different studies that used different techniques reached different results concerning the significance of interest rates and exchange rates in affecting monetary policy. Kesreyeli et al. (1999) used data from 1988 to 1999 in order to build MCI. He employed a price equation to estimate the MCI and concluded that the exchange rate has more weight than the interest rate in the short run in the monetary condition (KESRİYELİ et al. 1999).

It is also clear in the literature that the credit stance of the bank has an essential impact on monetary policy transmission. That’s why, when Mainlad China measured the MCI, they added the real credit growth to the weighted average sum of the real interest rate and the real exchange rate. The study aimed to evaluate the monetary condition in Mainland China, which influences the financial stability and monetary condition in Hong Kong and Asia too. The study revealed a remarkable rise in the MCI in 2004 and a rise in the real interest rate, which was reflected in tight monetary policy. Moreover, the rise in the MCI was inverted on an intense slowdown in real credit growth after a relaxed lending policy and a reduction in the real interest rate in 2002–2003 (Peng & Leung, 2005).

Over and above, Kanaan et al. (2006) constructed the monetary condition index (MCI) for India. In order to evaluate the status of monetary policy in India, the author took both a narrow “MCI” and a broad "MCI." The narrow MCI combines the two variables interest rate and exchange rate, while to construct the broad "MCI," the author added credit growth as a secondary indicator to the index. The results showed that interest rates are more influential than exchange rates in affecting monetary conditions in India. The result of the study also emphasized that “MCI” is a valuable index to interpret the monetary policy in India (Kannan et al.2007).
Khorsandi et al. (2012) employed three channels to evaluate the MCI for the Iranian economy: interest rate, exchange rate, and credit. His results show that the channel of credit was the most suitable for the conventional index.

Ali and Moheddine (2018) explored the impact of internal and external monetary conditions on the main Tunisian macroeconomic variables. They used regression analysis to find the weights of the domestic interest rate and the exchange rate over the period 1965–2015. Then they used the VAR model to analyze the effect of shocks on economic growth. Their findings indicate that the Tunisian economy is extremely influenced by external monetary conditions.

Furthermore, a study on the Gulf countries, namely Bahrain, Saudi Arabia, Oman, Kuwait, the United Arab Emirates, Iraq, and Qatar, constructed the monetary condition index after combining the interest rate and exchange rate together. The author used principal component analysis to construct the index, and then he used the vector-auto-regression method to examine the impulse response on CPI and GDP. The study concluded that MCI can be employed as an indicator to portend the CPI and GDP of Qatar, Oman, and Bahrain, while for Kuwait and KSA, the study didn’t show that conclusion. Another important conclusion of the study was that powerful monetary policy is necessary to reinforce the economic condition (Memon & Jabeen, 2018).

3. METHODOLOGY

The broad form of MCI used in this chapter consists of three main channels: interest rate, exchange rate, and bank credit to the private sector. As mentioned before, the narrow MCI contains only interest rates and exchange rates. The broad indicator takes into consideration the two variables of the narrow one, along with bank credit. In developing countries such as the ones involved in this study, the use of the broad indicator could be better to clarify the country’s monetary condition.

Theoretical foundations provide sufficient evidence to support the use of bank credit as another significant channel to transfer monetary policy (Kannan et al., 2007). The difficult step in constructing the MCI resides in the determination of the weights specified for each of the components of the index. Some empirical studies use principal component analysis to evaluate the MCI; others use regression analysis for this purpose.

In this study, the author calculates the MCI of each country in the MENA region using the Principal Component Analysis (PCA). Annual data relative to the five countries is collected over the period 1995–2020. EVIEWS 10 is used to access this index. The sources of the data used in this study are the World Bank, International Monetary Fund, Central Banks, and Ministries of Finance pertaining to the countries involved in this study.

PCA is based on the correlation matrix of the variables involved in the calculation of the index. The first step to this analysis is the normalization of the variables. The formula for normalization is written as follows:

\[ \frac{Actual\ value - Min\ value}{Max\ value - Min\ value} \]

Running the normalized values of different variables will lead to obtaining the Principal Components, and getting variables with significant variations, eigenvalues and factor loading values.

The next step consists of assigning weights using PCA. These weights are calculated as follows:

\[ W_i = \sum |L_{ij}|E_j \]

where, 
\( W_i \) is the weight of \( i^{th} \) indicator 
\( E_j \) is the eigenvalue of the \( j^{th} \) factor
$L_{ij}$ is the loading value of the $i^{th}$ unit of grouping on $j^{th}$ factor.

The index is computed using the following formula:

$$I = \frac{\sum X_i W_i}{\sum W_i}$$

where,

$I$ is the index of each unit

$X_i$ is the normalized value of the $i^{th}$ indicator

$W_i$ is the weight of the $i^{th}$ indicator

A composite index for each unit is calculated by taking the sum of the product of normalized observed value and their respective assigned weights, and then dividing it by the sum of all weights.

The objective of this section is to explore the influence of variables representing the monetary condition on economic growth and inflation. For this purpose, we estimate for each country a VAR model and depict the impulse responses of MCI on shocks from the inflation and GDP. The estimation approach of VAR models consists of using stationary variables. Consequently, all variables should be tested to determine their degrees of integration and make the required differences, if it is necessary.

To test the order of integration of individual time series Augmented Dickey and Fuller tests (1979) is used. These tests are utilized to test the existence of unit roots in the time series data.

The equation used for this test is written as follows:

$$\Delta y_t = \alpha + \beta T + \rho y_{t-1} + \sum_{i=1}^{n} y_t \Delta y_{t-i} + \epsilon_t$$

for $i = 0, 1, 2, \ldots, n$

where

$y_t$ is a time series to be tested for unit roots

$T$ is the time trend

$\epsilon_t$ is white noise error term

We test the hypothesis that $\rho = 0$

The result of the test is compared to critical values $\tau - Ratio$ of MacKinnon’s (1991).

The second step which is a significant step of analysis encompasses estimating VAR model that consists of three variables, namely inflation, GDP, and MCI. This model can be written as follows:

$$\pi_t = A_0^\pi + \sum_{i=1}^{p} A_1^\pi \pi_{t-i} + \sum_{i=1}^{p} A_2^\pi GDP_{t-i} + \sum_{i=1}^{p} A_3^\pi MCI_{t-i} + \epsilon_{1t}$$

$$GDP_t = A_0^{GDP} + \sum_{i=1}^{p} A_1^{GDP} \pi_{t-i} + \sum_{i=1}^{p} A_2^{GDP} GDP_{t-i} + \sum_{i=1}^{p} A_3^{GDP} MCI_{t-i} + \epsilon_{2t}$$

$$MCI_t = A_0^{MCI} + \sum_{i=1}^{p} A_1^{MCI} \pi_{t-i} + \sum_{i=1}^{p} A_2^{MCI} GDP_{t-i} + \sum_{i=1}^{p} A_3^{MCI} MCI_{t-i} + \epsilon_{3t}$$

where
πₜ is the current rate of inflation measured by $log CPI_t - log CPI_{t-1}$
GDP is real gross domestic product growth of a country under study
MCI is the monetary condition index
$A^j_k$ are $(1, 4)$ lag coefficients vectors that are to be estimated $j = 0, 1, 2, 3$ and $k = 1, 2, 3$
$ε_{kt}$ is white noise error term.
p is the lag that is determined using Schwarz Bayesian criterion.

These are three linear regressions equations. The first one explains the inflation, the second explains GDP and the last one is concerned with MCI. The variables used in this model should have the same level of integration. If the order of integration of the variables is $0$ then it is a standard VAR model. If the order of integration is $d$, the variables have to be differenced $d$ times in order $d$ time to be in stationary level. It is important to notice that having non-stationary variable in the regression model lead to spurious regression.

4. EMPIRICAL RESULTS

Five variables are used in this section to construct the monetary condition index and explore the impact of shocks from inflation and GDP on MCI for the five MENA countries, namely Algeria, Bahrain, Egypt, Jordan, and Morocco. The variables are: real interest rate, real effective exchange rate, MCI, inflation, real bank credit to the private sector, and GDP. The two latter are expressed in the local currency of each country. The data collected for the variables considered in this section vary from 1995 to 2020, except for Bahrain, which has data from 1995 to 2015. The variables involved are presented as follows:

\[ \pi_t \] is the inflation

\[ RIR \] is the real interest rate.
\[ REER \] is the real effective exchange rate.
\[ RBCPS \] is the real bank credit to the private sector, expressed in logarithmic form.
\[ GDP \] is the real gross domestic product growth.

4.1. Unit Root Test

Checking the stationarity of each variable for each country is the first step to take when having a time series. For this purpose, augmented Dickey-Fuller tests are used, and the obtained results for the variables in the five MENA countries are reported in Table 1. The findings indicate that the variables of each country are either stationary at level or at first difference.

<table>
<thead>
<tr>
<th>Variables</th>
<th>lag</th>
<th>$ADF$ test</th>
<th>Variables</th>
<th>lag</th>
<th>$ADF$ test</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\pi_t$</td>
<td>0</td>
<td>-7.520***</td>
<td>$\pi_t$</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>GDP</td>
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<td>-4.782***</td>
<td>GDP</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MCI</td>
<td>3</td>
<td>-2.574</td>
<td>MCI</td>
<td>1</td>
<td>-3.933***</td>
</tr>
<tr>
<td>RIR</td>
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<td>-3.439***</td>
<td>RIR</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>REER</td>
<td>0</td>
<td>-1.124</td>
<td>REER</td>
<td>0</td>
<td>-4.2832</td>
</tr>
<tr>
<td>RBCPS</td>
<td>2</td>
<td>-1.479</td>
<td>RBCPS</td>
<td>1</td>
<td>-6.107***</td>
</tr>
</tbody>
</table>

Algeria

<table>
<thead>
<tr>
<th>Variables</th>
<th>lag</th>
<th>$ADF$ test</th>
<th>Variables</th>
<th>lag</th>
<th>$ADF$ test</th>
</tr>
</thead>
<tbody>
<tr>
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<td>1.892*</td>
<td>$\pi_t$</td>
<td>0</td>
<td>-6.516***</td>
</tr>
<tr>
<td>GDP</td>
<td>0</td>
<td>-2.456</td>
<td>GDP</td>
<td>0</td>
<td>-4.831***</td>
</tr>
<tr>
<td>MCI</td>
<td>3</td>
<td>-1.309</td>
<td>MCI</td>
<td>0</td>
<td>-2.974***</td>
</tr>
</tbody>
</table>

Bahrain
Three variables are used to construct the monetary condition index for the five MENA countries, namely Algeria, Bahrain, Egypt, Jordan, and Morocco. The variables are: real interest rate, real effective exchange rate, and real bank credit to the private sector. The latter is expressed in the local currency of each country. The variables involved in the calculation of the MCI are presented as follows: RIR is the real interest rate, REER is the real effective exchange rate, and RBCPS is the real bank credit to the private sector, expressed in logarithmic form.

Principal component analysis (PCA) results for each MENA country are presented in tables from 1 to 5. PCA is considered to be a variable-relieving technique. It aims to reduce a large collection of variables into a smaller set of new variables that are called principal components. The latter expresses most of the variance in the original variables.

Principal component analysis results in a number of extracted components that is equal to the number of variables. In general, those principal components whose eigenvalues are greater than 1 must hold up. To calculate the monetary condition index for Algeria, Egypt, and Morocco, one extracted component is taken into consideration. However, in the cases of Bahrain and Jordan, one extracted component is taken into consideration.

### 4.2. Results of Principal Component Analysis

The principal component analysis results in a number of extracted components that is equal to the number of variables. In this case, three variables are employed to get three components.
and Jordan, two extracted components are considered for the computation of the MCI. Thus, there is a need to calculate a composite index for the MCI.

The graphical representation of the Monetary Condition Index (MCI) of the five countries in the MENA region is presented in figures 1, 3, 5, 7, and 9. The interpretations of these figures are performed for each country as follows: The MCI values range from 0 to 1. A higher MCI (close to one) reflects the tightness of the stance of monetary policy. However, a low value of MCI (close to 0) indicates a loosening of the stance of monetary policy.

4.3. Vector Auto-Regression Model

The next step is to investigate the response of MCI to shocks from inflation and economic growth. To do so, we use a vector auto-regression model with the purpose of generating the impulse responses of MCI to shocks from inflation and GDP. The lag of all VAR models for MENA countries is one. The graphical representations of the impulse responses pertaining to the five countries involved in this study are presented in figures 2, 4, 6, 8, and 10. The interpretation of the results concerning each country is reported as follows:

**Algeria**

Figure 1 shows that the sample period of the MCI of Algeria is from 1995 to 2020. The high values of the MCI from 1995 to 2007 reveal tightness in the monetary stance of Algeria. This period is followed by a loose monetary condition that stands until 2020.

Figure 2 displays the impulse response that shows whether the MCI of Algeria can predict inflation and economic growth up to the next 10 years. The findings indicate that MCI cannot forecast inflation and economic growth in the short run as well as in the long run. GDP has been opposite to MCI during the study period.
According to figure 3 the MCI of Bahrain from 1995 to 2020 illustrates tight monetary condition between 1995 and 2006, followed by loose monetary as revealed by the decrease in MCI that lasts till 2020.

Figure 4 generates the impulse response for Bahrain for the next 10 years. We notice that MCI cannot forecast inflation and GDP in the short run. During this short period, Inflation has been opposite of MCI. However, the results show that MCI can forecast inflation and GDP in the long run.


Figure 4: Response of Bahrain-Monetary Conditional Index to innovations from real GDP and inflation

**Egypt**

Figure 1 shows that the sample period of the MCI of Egypt is from 1995 to 2020. The low values of the MCI from 1995 to 2002, especially between 1998 and 2000, reveal looseness in the monetary stance of Egypt. This period is followed by a tight monetary condition that stands till 2012. Then a period of looseness appears from 2013 to 2020 that is violated by a peak tight in 2017.

Figure 6 generates the impulse response for Egypt for the next 10 years and reveals that MCI cannot forecast inflation and economic growth in the short run while it can in the long run.

Figure 5: Graphical representation of the Monetary Condition Index for Egypt
Response of monetary condition index (MCIE) to Innovations

Egypt

Figure 6: Response of Monetary Condition Index (MCI-EGY) to innovations

Jordan

According to figure 7, the MCI of Jordan vary from 1995 to 2020. The MCI between 1995 and 2011 fluctuates between tightening and loosening monetary policy with a peak for the tight in 2001 and a low value for the loose in 2008. Afterward, the MCI witnesses a tightening monetary policy that lasts to 2020.

Figure 8 shows whether that MCI can predict inflation and economic growth in the in the 10 future years. The results shows MCI for Jordan cannot forecast inflation and GDP in the short run while it can in the long run.
Response of COMPOSITE_INDEX (MCJ) to Innovations

Jordan

Figure 8: Response of the Monetary Condition Index for Jordan to innovations

Morocco

The graphical representation of the MCI from 1995 to 2020 is shown in figure 9. It illustrates loose monetary condition between 1995 and 2004 with a large decline in 2000. This period is followed by tight monetary condition that lasts till 2020 with a peak in 2012.

Figure 10 generates the impulse response for Morocco for the next 10 years and shows that MCI cannot forecast inflation and GDP in the short and long run. Inflation and GDP have been opposite of MCI during the study period.

Figure 9: Graphical Representation of the Monetary Condition Index for Morocco
5. CONCLUSION

This article set out to construct a broad monetary condition index (MCI) for five countries in the MENA region, namely Algeria, Bahrain, Egypt, Jordan, and Morocco, so as to forecast the impact of MCI on GDP and inflation. As a result, the response of the MCI to innovations in inflation and GDP indicates that the MCI of Bahrain, Egypt, and Jordan can predict inflation and economic growth in the long run, while it cannot do that in the short run. However, in the cases of Algeria and Morocco, the findings show that MCI cannot forecast inflation and GDP in the short and long run.

On the other hand, the MCI is considered to be an important tool for policymakers. It helps them develop the appropriate strategies for monetary policy and assess the general monetary condition. Furthermore, it warns the central bank when it wants to implement an expansionary monetary policy or a contractionary monetary policy. In other words, the central bank can measure the tightness of monetary conditions in the economy, therefore, the central bank can control the interest rate and exchange rate according to the conditions. Besides, this study sheds light on the tightness or looseness of the monetary conditions experienced by the chosen MENA countries.

Finally, this study faces a lot of limitations because of the unavailability of data; therefore, only five countries from the MENA region were selected for this study, so working on the availability of data is a necessity. For future studies, comparative analysis can be done to observe the difference between the MCI of MENA countries and that of other developed countries.

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