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Developing an Index for the Optimal Monetary Conditions in Arab Countries

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Executive Summary

This paper attempts to develop an index that capturing the optimal situation of the monetary policy, named "the Optimal Monetary Policy Index OMPI". We adopt two-fold models; the first-round model helps obtaining the weights of each individual variable[1], while the second-round model provides a policy interpretation for the index.

The paper is eager to construct the OMPI using panel technique, named "panel-based index,". It also attempts to build the OMPI through time-series technique, named "time-series-based index". It is found that the time-series based index tends to be more consistent and accurate than the panel-based index. Furthermore, the time period and data frequency considered in the paper, differ across techniques. In the panel-based index, the paper uses annual data spans from 1970 to 2019. In time-series based index, the paper employs monthly time series data from January 2013, yet last in different time spots across countries.

The optimal conditions occur when the index reaches the zero value from both sides. The result was raised from the notion that our analysis works on the differences between the actual value and the variable's optimal trend.

[1] *mainly variables representing the channels for the monetary policy transmission mechanism. The paper here relies on two channels (interest rates, and exchange rate) given their data availability. And there is always room to incorporate the other two channels as their data available.*

Introduction

Over decades, monetary policy diagnostic tools have been the center of policy-oriented debates among economists and policymakers, emphasizing the monetary policy formulation process, which transmits through different targets, namely operational and intermediate. Such channels facilitate the transmission mechanism to influence aggregate demand and subsequently attain the optimal level.

The optimal monetary situation occurs when a central bank meets its natural level of the core objectives. In other words, it is when the inflation rate, and output, reach the SteadyState [2]. However, as such conditions are less possibly happening on the ground, the paper attempts to interpret the monetary stability from the standpoint of a unified index combining interest rate fluctuations and exchange rate volatility at the same time.

Beforehand, there is a need to distinguish between monetary stance and monetary conditions since it would smoothly make our arguments much more consistent as the paper goes on. Usually, the monetary policy stance points to whether the policy is tight, loose, or neutral. This stance is continuously subject to monetary policy actions and decisions steering the policy rate (nominal interest rate).

Assessing the monetary policy stance is contingent on country-specific factors; hence, it necessitates an indicator that reflects the core economic variables and pools them in a unified index. Generally, there is a consensus that the short-term interest rate is a prevalent indicator widely used among economists to assess the monetary conditions. In the nineties, this policy tool, constructed by John Taylor, depends on the actual inflation and its cyclicality over time, plus the output gap. However, the monetary policy's pass-through affects aggregate demand and price levels through short-term interest rates and currency value changes.

On the other hand, the monetary condition refers to how well the policy stance affects the aggregate demand through the monetary policy

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[2] *Statistically, a steady state condition is where a variable act optimally. In other words, is where the actual variable equals the its optimal trend. For instance, the output reaches out the steady state when it is subtracted from the potential output, which will result in zero. Economically, the actual condition deviates from the desired level; in such a case, monetary authorities endeavor to bring it back to its optimal level. It probably happens when a demand shock hits the economy, and the market is not responding to the movement in policy variables (interest rate and exchange rate). The central bank will then encourage an adjustment in monetary conditions by changing its policy rate.*

transmission mechanism. In this regard, interest rates (short and long term) act besides the exchange rate, domestic credit, and asset prices as channels for the real economy. The way these transmission channels are employed depends on the central bank's nominal anchor, whether it is the price level the currency value, or sometimes the monetary aggregates.

This paper investigates the monetary conditions in some Arab economies by developing and applying an index that captures the market's fluctuations. The index is likely to cover two[3] of the four monetary policy transmission channels (interest rate, exchange rate), in addition to the objectives that central banks are eager to achieve (price stability, financial stability, exchange rate stability, and inclusive growth).

Accordingly, The OMPI has been brought about considering both interest rate fluctuations and exchange rate volatility. Compares to other monetary indexes, it flexibly enables central bankers to incorporate variables other than the ones mentioned above; this depends on the nature of variables forming the index, which subsequently determines whether the index is on the nominal or real term.

This paper considers variables on the real term as it targets examining the monetary conditions, not the stance. Though, there is always room to calculate them both. In this context, the paper follows a different approach to other studies addressing the index, as indicated in the methodology & modeling section.

Literature Reviews

Researchers examined what's so-called Monetary Conditions Index (MCI) extensively across works of literature. Some are raising supportive arguments, encouraging central bankers to employ it as a holistic and concrete measurement for the monetary stance such as *(Freedman, C. 1994), (Batini, & Turnbull, 2000),* and *(Ericsson, Jansen, Kerbeshian, & Nymoen 1999)* while few others show related shortfalls, like *(Grande, & Giuseppe, 1997).*

In this context, a couple of scholars analyzed the MCI, such as *(Ericsson, Jansen, Kerbeshian, & Nymoen, 1999),* to be used practically as an operational target for the monetary policymaking process, evaluating its sensitivity to crisis and specific shocks inherently. *(Freedman, C. 1994)* argue that it is preferable to employ MCI as an operational target for the monetary policy

[3] The other two channels have not been included due to data unavailability.

rather than the short-term interest rate due to the holistic approach that captures the shocks beyond exchange rate fluctuations *(Batini, & Turnbull, 2000)*, propose MCI for the UK's authorities to use it as a core index for measuring the stance of the UK's monetary policy.

(Abdul Qayyum, 2002) argues that it helps to evaluate the monetary policy stance. Theoretically, MCI is considered a movement in the two crucial variables: the interest rate and exchange rate from the base period. Moreover, MCI seems to be a valid indicator than concentrating on the interest rate, considering the exchange rate's impact as a channel for the monetary policy transmission mechanism (Osborne-Kinch, & Holton, 2010). The paper authored by *(Neil, Eilev, Neva, & Ragnar, 1999)* provides a couple of characteristics that motivate central bankers to use MCI in their monetary policy formulation. One of these attractive features and its simplicity and flexibility is that focusing on the exchange rate and interest rate facilitates understanding the market dynamics, especially from the monetary side. However, *(Grande & Giuseppe, 1997)* have criticized the use of MCI by addressing some shortcomings related to MCI, showing that it is subject to a bit of drawback, especially in the case of supply-side shocks.

Furthermore, policymakers and economists advise not to dismiss the exchange rate volatility in assessing the monetary stance or conditions for small open economies. As the primary purpose of computing MCI is to combine interest rate and exchange rate fluctuations in a unified variable.

Previously, there have been efforts in capturing the monetary conditions. Several scholars have enormously relied on qualitative techniques to accurately capture the conditions, such as *(Romer & Romer, 1989) (Freidman & Schwartz, 1963)*, who proposed the "Narrative approach" which depends on reading meeting minutes of the Federal Open Market Committee (FOMC), *Romer and Romer, (1989)* determined a set of dates at which policymakers appeared to shift to a more anti-inflationary stance. Similarly, *(Boschen and Mills, 1990)* adopt "FOMC's documents reading" as an approach to categorize the monetary stance each month as tight, loose, or neutral depending on policymakers' relative weights reducing unemployment rates and inflation.

On the other hand, the quantitative approach measures the monetary stance quantifiably and uses prior information about central bank operating procedures to develop a data-based index. For example, (*Bernanke & Blinder, 1992)* argued that over the past 30 years, the Fed had implemented policy changes through changes in the Federal fund rates to capture the policy stance. Likewise *(Vein Sims 1992)* used short-term rates as a monetary indicator for cross-sectional analysis.

Several scholars use the quantity of non-borrowed reserve as an alternative for the short-term interest rate. *(Christiano & Eichenbaum, 1992), (Strongin's 1992), & (Cosimano and Sheehan,1994).* They argue that Fed is constrained to meet total reserve demand in the short run but can effectively tighten policy by reducing non-borrowed reserves and forcing banks to borrow more from the discount window; therefore, it might be a useful indicator over the recent period.

Furthermore, the monetary condition index MCI was first initiated by the Bank of Canada in the 1990s; soon later, other central banks began to adopt it, some as an operational target, others as an optimal target. MCIs have widespread use among different institutions and countries. According to *(Ericsson, Jansen, Kerbeshian, & Nymoen, 1999),* The central banks of Norway, Sweden, and Reserve Bank of New Zealand each have published an MCI and (to varying degrees) use it in conducting monetary policy.

The Reserve Bank of New Zealand started from June 1997, adopting the MCI as an operational target to publicly describe monetary conditions. *(The Reserve Bank of New Zealand, 1996).* While other central banks such as Norway and Sweden employ it partially as an indicator of monetary conditions when they formulate their monetary policy. *(* (Hansson and Lindberg 1994)*)*

Additionally, not only central banks tend to calculate the MCI, it is also for international institutions' interest. The IMF and OECD use it to evaluate the monetary policy stance across member states. European Central Bank ECB [4] as well constructs the index over most of the members in the union. (Dornbusch, , Favero, and Giavazzi 1998). On top of all that, the business sector is not isolated from MCI usage as they are considered apart from the monetary system in an economy *(e.g., Deutsche Bank, Goldman Sachs, JP Morgan, and Merrill Lynch)*. *Neil, Eilev, Neva, & Ragnar (1999).*

Across the Arab region, there is no that much of literature investigating the index in Arab countries. Except for *Ali & Younsi (2018)*, who employ the VAR Panel model to compute a similar index for the Tunisian economy based on the weighted domestic interest rates and exchange rates on the estimated

[4] *The MCI is calculated as a weighted average of the real short-term interest rate and the real effective exchange rate relative to their value in a base period. the relative weights of the interest rate and the exchange rate component are 6:1. These weights reflect each variable's relative impact on GDP after two years and are derived from simulations in the OECD's Interlink model.*

coefficients (1965 – 2015). As a group of countries *(Memona & Jabeenb 2018)* tries to construct the MCI for gulf countries, they found that its sensitivity to prices and output varies across countries; in some countries, the response over the short-run, while in others, appears in the long-run.

The Methodology

The paper applies VAR & VECM models [5] taking advantage of annual data available from (1980 – 2019) for four Arab countries, namely *(Kuwait, Egypt, Algeria, and Mauritania)*. The aim here is to construct the Optimal Monetary Policy Index (OMPI) for the four countries on an annual basis. All panel regression models run in this study have been subject to different econometric testing based on the purpose behind. For example, Inflation Panel Regression Model IPRM or "First-round Model" was tested against the fixed and random effects as its ultimate purpose is to obtain weights. In contrast, the OMPI panel regression model as a Second-round Panel Model is run to figure-out its vulnerability to different shocks.

Separately, the paper is also eager to apply VAR or VECM techniques on country-level monthly data (time series) to obtain weights for 5 Arab countries *(Egypt, Morocco, Tunisia, Qatar, and Oman)* over the period Jan. 2013 – Dec. 2020. All individual country models in this part have been subject to different time-series tests. *(country-level analysis P.).*

Previous studies, such as *(Romer and Romer 1989) (Bernanke and Blinder 1992) (Bernanke and Mihov, 1998)*, and *(Abdul Qayyum 2002)* used interest rate & exchange rate to construct the MCI. In contrast, this paper gives room for other variables to join the first-round model, especially those representing the monetary policy transmission mechanism such as credit and asset prices as a complement for interest rates and exchange rate.

In addition to the interest rates, and exchange rate, the paper seeks the availability of data related to credit growth and asset prices and how possible they can be complementary to the index. Though the paper considers interest rates, and the exchange rate assumed their heavyweights empirically for the time being. On the other hand, this study relies on different data sources, annual time series related to Exchange rates, inflation rates, economic growth, domestic credit, and interest rates have

[5] *The VAR and VECM are applied based on the pre-testing results. in some countries, we apply VAR because the preliminary results point to stationarity, while in others we applied VECM because variables are non-stationary.*

been drawn from the economic data base of the Arab Monetary Fund, national authorities, and the world bank, while monthly data are mainly being collected from the IMF data base.

The paper sets up a couple of assumptions beforehand. On one side, the model assumes that the index works for different types of countries. Therefore, the four chosen countries are diverse in terms of the economic structure and policy regimes, whether it is oil importer or oil exporter. The objective here is to test the index's validity and its dynamic behavior to different economies. On the other side, although variables could be measured on real or nominal terms alike, the paper assumes that all variables are in the twofold model.

Modeling

In the first step, the paper attempts to run a panel regression model as simple as constructing the index after considering the model validity against several econometric tests.

It is worth noting that the modeling part of this paper is twofold. The first-round model assists us in finding the weights or what so-called coefficients. There are two ways through both of which one can obtain these coefficients. The model can be a time series model; in such a case, there is a sort of flexibility to choose whatever approach deems appropriate, that depends on the monetary policymakers who can judge by their means the proper method and variables based on the domestic conditions, which may vary from country to another. Alternatively, the panel data technique could be applied to have the weights for both periods and cross-sections.

On the other hand, the second-round model helps a lot to find an interpretation that is empirically and theoretically consistent. It investigates the sensitivity of the index against monetary policy objectives. However, such variables are subject to change depending on policymakers' partialities, whether they want to capture the index in nominal or real terms.

$$OMPI_{ti} = \beta_0 + \beta_{inf}(inf - \overline{inf})_t + \beta_y(y - \bar{y})_t + \beta_{cr}(cr - \bar{cr})_t \quad (1)$$

Equation (1) is typically representing the second-round model, where $(inf - \overline{inf})_t, (y - \bar{y})_{t,} (cr - \bar{cr})_t$ refer to the steady-state of the inflation, output, and banking credit to the private sector. while $\beta_0, \beta_\pi, \beta_y, \& \beta_{cr}$ are parameters for the monetary policy objectives. In theory, and according to the short-term fluctuations model, the Fisher equation identifies the determinants of inflation as, previous expectations of the market E_{t-1} towards the current inflation rates π_t, in addition to the output gap $(Y_t - \bar{Y}_t)$. *(Mankiew, 2013)*

$$\pi_t = E_{t-1}\pi_t + \varphi \cdot (Y_t - \bar{Y}_t) + \nu_t \qquad (2)^6$$

However, on the ground, things are different. Hence, the paper initially focuses on variables representing the monetary policy transmission mechanism channels, at least in the first-round model. Yet, it is up to policymakers to consider other variables consistent with the domestic monetary conditions.

$$\pi_{ti} = \beta_0 + \beta_1\pi_{i,t-1} + \beta_2 ex_{t,i} + \beta_2 ir_{t,i} + \nu_{t,i} \qquad (3)$$

Equation (3) typically represents the first-round model, where the inflation rate π_{ti} in country *i* at time t is determined by previous inflation $\pi_{i,t-1}$, real exchange rate $rex_{i,t}$, long term interest rate $ir_{i,t}$, While $\nu_{i,t}$ refers to the error term, which could contain other variables.

$$OMPI_{it} = \sum_{T=1}^{T} \alpha_{ir_{it}}(ir_{it} - \overline{ir}_{it}) + \alpha_{ex_{it}}(ex_{it} - \overline{ex}_{it}) \qquad (4)$$

Equation (6) shows the typical formula used here to calculate the index. Where $(ir_{it} - \overline{ir}_{it}) = ir^*_{it}$ is the equilibrium short-term interest rate, while $(ex - \overline{ex}) = ex^*_{it}$ is the equilibrium exchange rate, and α_{ir}, & α_{ex} refer to weights. The formula could include other variables, such as credit and asset prices. The choice of variables, on the other hand, depends on country-specific factors. However, in general, variables representing channels of the monetary transmission mechanisms and policy objectives are nominated to be strong candidates.

Noteworthy steps for constructing the OMPI

The paper in this part provides details about the structure of the index. The index contains different stages. e.g., the expected value, weights and variables, measurement, and finally, modeling. The following steps are within twofold:

I. The First-round Model:

This paper tends to run two different models *(see modeling P.)*. Each one is likely to contain similar or different variables depend on how well the model investigations are evolving. Initially, variables representing channels for the monetary policy transmission mechanism (interest rate, exchange rate) are

[6] *Mankiew. G (2009), "Macroeconomic: dynamic model of aggregate demand and supply", Seventh Edition, Harvard University, May.*

the core ones forming at least the first-round model, thinking about involving others.

The first-round model allows for the preliminary information required to construct the index, such as the expected value and weights. This model consists of the inflation rate as a dependent variable, interest rates, and exchange rate as explanatory variables. *(see modeling P.).*

Expected value

The first step towards constructing the index is straightforward: finding the expected value for the respected variables (interest rate & exchange rate). To this end, scholars employ different methods to potentially determine the expected value, such as having the optimal trend using Hodrick-Prescott (HP) or Baxter-King (BK) filter; some use in-sample forecasting. While others estimate the expected value as a historical average of the considered variables. *(Goodhart & Hofmann, 2001).*

In this context, the paper applies the Hodrick Prescott Filter HP filter, given its popularity among economists and its ability to remove short-term fluctuations associated with the business cycle. In very extreme cases, some employ seasonal adjustment on a variable subject to some distortions over time (e.g., inflation, exchange rate, ..., est). By having each variable's trend comparable with its actual value, we are almost ready to move on to the next step.

Weights and variables

Weights and variables must be carefully selected to construct the index precisely as they are considered sensitive to that choice. Notwithstanding, and to the best of my knowledge, it tends to be rare that there is a well-agreed weight as a standard for constructing the OMPI, especially when it comes to scaling the monetary conditions across countries where favorable factors exist. Therefore, this paper chooses to bring about its weights for each indicator by applying the Panel data technique to test for the heterogeneity across states.

Some scholars obtain weights and variables in different ways. *Abdul Qayyum (2002)* gets weights from regressing inflation against the nominal interest rate and nominal exchange rate. While *(Blot_ Levieugey, 1999)* obtains them from regressing the inflation rate against the steady state of respective variables (interest rate and exchange rate).

II. The Second-round Model:

In this model, we are almost halfway from having the index ready. The model uses the information from the first-round model to measure the index and then regress it against the policy objectives.

The index measurement:

The measurement of the index requires a couple of experimental trials, paving the way to develop the following formula eventually.

$$OMPI_{it} = \sum_{T=1}^{T} \alpha_{x_{it}}(x_{it} - \bar{x}_{it}) + \alpha_{y_{it}}(y_{it} - \bar{y}_{it}) \dots\dots\dots\dots + \alpha_{n_{it}}(n_{it} - \bar{n}_{it}) \qquad (5)^{7}$$

Equation (5) is the proposing formula to measure the index where $(x_{it} - \bar{x}_{it}) = x_{it}^{*}$ is the equilibrium value of x for country i in time t, while $(y_{it} - \bar{y}_{it}) = y_{it}^{*}$ is the equilibrium value of y for country i in time t. While $(n_{it} - \bar{n}_{it})$ points to other likely variable. Moreover, $\alpha_{x_{it}}, \alpha_{y_{it}}, and\ \alpha_{n_{it}}$ refers to weights obtained from the first-round model. Constructing the index is a good progression. Nevertheless, still much left to be done concerning policy interpretations. To this end, there is a need to run another panel model for OMPI considering monetary policy objectives; this is called the second-round model.

The Index modeling

The question then is, why do we need to run the second-round model? Thoughtfully, to assist policymakers in their endeavor to take policy actions based upon a unified index (OMPI). Peer in mind that the variables could be similar to those included in the first-round model. However, to have a concrete and flexibly interpreted results, it tends to be worthen to figure out how responsive OMPI to monetary policy objectives (e.g., price stability, inclusive growth, financial stability).

$$OMPI_{it} = \left(proxies\ for\ the\ monetary\ policy\ objectives\ ^{8}\right) \qquad (6)$$

[7] *x, y, & n are variables that randomly been chosen to explain the index's formula.*

[8] *More about proxies for monetary policy objectives can be found on page 14 (OMPI, policy objectives, and shock magnitude)*

Country Level Analysis

Here, we try to construct the index on individual country bases *(time-series based index)* rather than considering them as a group *(panel-based index)*. In other words, the paper investigates the monetary conditions in respective countries and uses monthly time series data starting from January 2013 up until 2020 in some countries, while in others, the time series last in 2018.

Countries involved in this part include *Tunisia, Oman, Egypt, Algeria, Morocco, Qatar, and Saudi Arabia*, which are mostly not similar to the sample of countries considered previously in the panel models (*Algeria, Egypt, Kuwait, & Mauritania*), noticeably some countries have been investigated twice such as *Egypt, & Algeria*. This part also includes different variables such as Money Market Rate *MMR*, Nominal Effective Exchange Rate *NEER*, Real Effective Exchange Rate *REER*, and Consumer Price Index *CPI*.

Here, we follow as same steps as previous in panel-based index. *(see Noteworthy steps to construct the index).* For each individual country, the paper introduces First-round Time-series Model. As part of the model, we obtain the expected value or the desired level for each variable in time *t*, and for each country *i*. Subsequently, we run the first-round model by regressing the inflation against the monetary policy channels, the purpose here is to have the weights. Peer in mind that variables used in time-series based index tend to be more holistic and accurate than variables used in the panel-based index *(e.g., Nominal effective exchange rate NEER rather than nominal exchange rate NER, or real effective exchange rate REER instead of real exchange rate RER)*. Expected values and weights of the two channels (variables) are considered the core ingredients of the index in which they are internalized *(see equation 6)*.

In the Second-round Time-series Model STM, there has been an interest in figuring out the response of the index to policy objectives (shocks) for each country. Given the higher frequency data in this part, the paper tested the index against the price shock (inflation). It is found that the OMPI is highly sensitive to price shocks in *Egypt, Tunisia, and Morocco*. However, it tends to respond to the impulse minimally in *Qatar and Oman.*

The First-round Time-series Model shows robust fallouts across selected countries, including high significant t-statistics, high adjusted R-squared value. The adjusted-R square in *Tunisia, Algeria, and Morocco* are higher than in *Oman, Qatar, and Saudi Arabia*. The reason is that in countries where R-square is low, there have been two explanatory variables MMR, and NEER, while in the rest three countries (MMR, REER, and NEER) are determining the level of prices.

The coefficient sign of variables varies across countries. In some countries like *Tunisia*, the model shows a negative relationship between price levels and interest rates. In contrast, in other countries, *Algeria, Tunisia, Oman, Qatar, and Saudi Arabia*, there has been a positive relationship between interest rate in the money market and overall prices.

The coefficient signs of the NEER[9] across countries look consistent with the economic evidence. With further devaluation, prices are expected to rocket up unless authorities provide back defense packages. In oil exporters, because the currency value pegged against the dollar, it is likely to fluctuate against other foreign currencies like Euro and Yen. On the other hand, REER[10] is the nominal adjusted for inflation in trading partners. Hence, there has always been room for the variable to take either a positive or a negative sign.

To wrap up this part, the first round time series model finds that the index's trend (optimal value)[11] for all selected countries fluctuate narrowly around Zero value or with narrow band, which is evidence that whenever the actual value of the index heading to zero, it implies that monetary condition is getting closer from the optimal situation.

The positive value points that the interest rate's actual values and exchange rate’s actual value above the desired level. In such a case, monetary authorities need to bring down rates to the optimal and depreciating the currency value. On the other side, the index's negative value means that the actual values of interest rate and exchange rate below the optimum. In such a case, the central bank needs to hike the policy rate and depreciate the exchange rate to push the monetary condition up to the optimum (zero value).

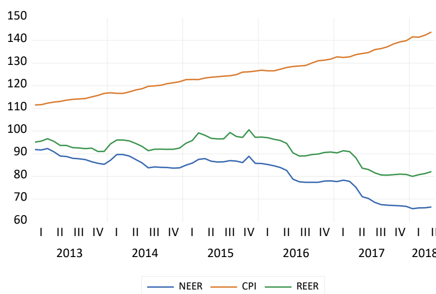
[9] *Variables in the section are holistic compared to other variables included in the next section (panel-based index). For instance, NEER is different from the nominal exchange rate.*

[10] *Refers to the value of the domestic currency against the weighted average of the values of foreign currencies, whereas nominal exchange rate is against one foreign currency (e.g. $US). On the other hand, REER points to the nominal effective exchange rate determined by a relative trade share of the domestic currency against each country within the index.*

[11] *we provide a evidence which helps us interpreting the index persuasively. We assume that the trend of the OMPI is the optimal value for the index.*

Tunisia:

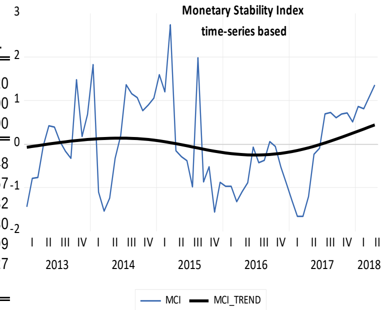
Here, we use monthly time series data to estimate the Tunisia First-round model, the data spans for 64-month starting from January 2013 to April 2018. The inflation rate, the money market rate, nominal effective exchange rate, and real effective exchange rate have been included in the model.



Tunisia's First round model

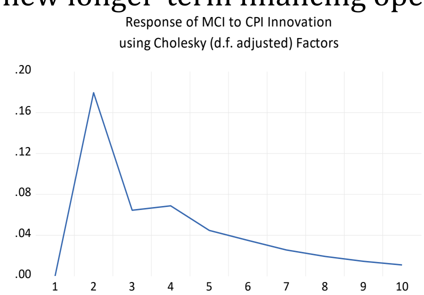
Variable	Coefficient	Std. Error	t-Statistic	Prob.
MMR	-2.335327	1.124038	-2.077623	0.0420
NEER	-1.095599	0.063906	-17.14401	0.0000
C	225.8608	9.256694	24.39973	0.0000

R-squared	0.857865	Mean dependent var	125.4148
Adjusted R-squared	0.853205	S.D. dependent var	8.793967
S.E. of regression	3.369308	Akaike info criterion	5.313032
Sum squared resid	692.4862	Schwarz criterion	5.414230
Log likelihood	-167.0170	Hannan-Quinn criter.	5.352899
F-statistic	184.0848	Durbin-Watson stat	0.139727
Prob(F-statistic)	0.000000		



Tunisia's first-round model shows robust and significant results for both individual variables and the entire model. Adjusted-R square is as high as 85.32 percent, which means interest rates and nominal effective exchange rates predominantly explain the inflation dynamic in Tunisia. As can be seen, the index is well-away from the steady state. Attributable to the depreciation of the Dinar nominal effective value against foreign currencies that reach 66 Dinar for one US$ in April 2018 from 91.8 Tunisian Dinar for one US$ in January 2013 (IMF data).

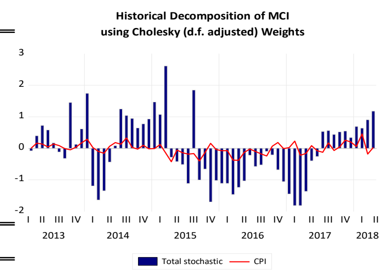
In the last four years, this depreciation was accompanied by monetary policy actions, when the Central Bank of Tunisia CBT expanded the narrow band corridor within which the policy rate fluctuates to allow for more volatility, pushing the interbank rates up to the corridor ceiling. In 2018, the interest rate was cut twice by (+75 bps) and (+100 bps) in March and June, respectively, causing the rate to increase up to 6.75 percent. In February 2019, the central bank cut the policy rate by (+100 bps) because of the Dinar depreciation. In December 2018, the bank introduced a new longer-term financing operation in foreign currency. (AMF, 2019).



Variance Decomposition of CPI:

Period	S.E.	MCI	CPI
1	0.412172	7.841844	92.15816
2	0.574447	8.769865	91.23014
3	0.709406	10.00431	89.99569
4	0.829409	11.02196	88.97804
5	0.939423	11.90453	88.09547
6	1.042309	12.64898	87.35102
7	1.139707	13.27962	86.72038
8	1.232750	13.81404	86.18596
9	1.322247	14.26881	85.73119
10	1.408815	14.65753	85.34247

Cholesky Ordering: MCI CPI



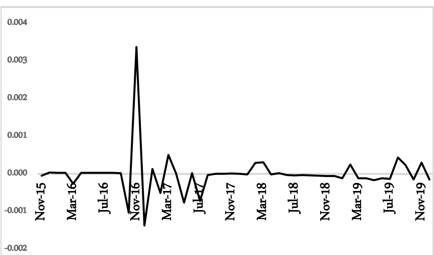
According to the Engle-granger test, Tunisia's Second-round Model T-SRM reveals no cointegration between CPI and OMPI. The model also finds that there is long-run and short-run causality running from the *OMPI* to *CPI*.

In conclusion, it is argued that the magnitude effect on the index is robust. In other words, the index responds robustly to the price shock in the short run, while in the long run, it approaches the value zero. On the other hand, in the short run, the price shock to the index accounts for around 8 percent and gradually increases over the long term to reach nearly 15 percent in the 10th period.

Egypt:

In the last few years, Egypt has been undergoing economic reforming programs in coordination with the IMF. A couple of policy actions have been taken by the government to bounce the economy back on the track (AMF, CBE, 2019). As far as the first-round model is concerned, exchange rate devaluation and policy rate changes are vital in this model. Here, I use the monthly time-series data range between November 2015 and December 2018; the data includes nominal exchange rate, monetary policy rate, and CPI (m/m percentage change). *(IMF data)*

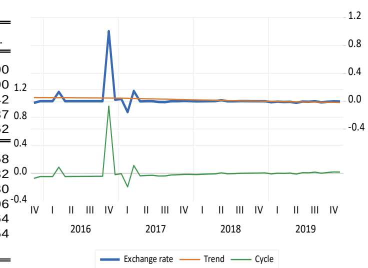
Optimal Monetary Policy Index in Egypt



Egypt's First-round model

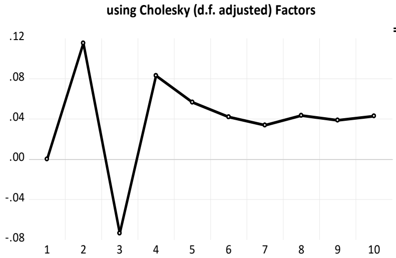
Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF(-1)	1.017931	0.043064	23.63767	0.0000
IR	-0.005958	0.002210	-2.696642	0.0100
EX	0.003329	0.001751	1.900963	0.0642
D1	0.023406	0.013859	1.688869	0.0987
C	0.034321	0.018197	1.886060	0.0662
R-squared	0.940905	Mean dependent var		0.168758
Adjusted R-squared	0.935276	S.D. dependent var		0.085232
S.E. of regression	0.021684	Akaike info criterion		-4.724230
Sum squared resid	0.019748	Schwarz criterion		-4.527406
Log likelihood	116.0194	Hannan-Quinn criter.		-4.650164
F-statistic	167.1786	Durbin-Watson stat		1.859954
Prob(F-statistic)	0.000000			

Nominal Exchange Rate in Egypt (EP vs US$)



Egypt's first-round model specification, in general, seems to be satisfied given the *P-value* of F-statistic, which is statistically significant. Coefficient signs of the variables look to some somehow consistent with the economic theory, especially when it comes to investigating individual countries. Moreover, adjusted R-squared matters a lot in the time-series analysis as it points to the determinants of inflation in a country. In this model, the adjusted R-squared is high (0.935276) which means the first-round model involves factors other than the interest rate and exchange rate. The model reveals that there is short-run causality running from the exchange rate and interest rate to inflation in the short run. While the causality over the long run has not been detected.

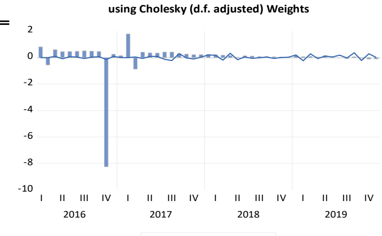
Response of OMPI to price shock using Cholesky (d.f. adjusted) Factors



Variance Decomposition of INF:

Period	S.E.	MCI	INF
1	1.312100	0.349703	99.65030
2	1.321131	1.289283	98.71072
3	1.324215	2.828952	97.17105
4	1.355887	2.256566	97.74343
5	1.357091	1.939852	98.06015
6	1.358404	1.716003	98.28400
7	1.360324	1.519044	98.48096
8	1.361046	1.363042	98.63696
9	1.361670	1.240307	98.75969
10	1.362402	1.135919	98.86408

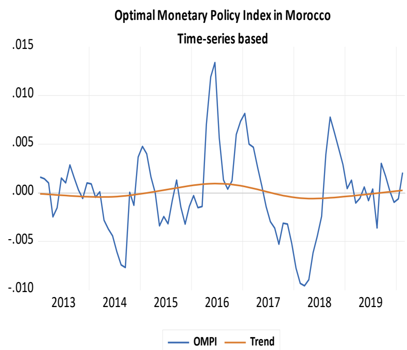
Historical Decomposition of OMPI using Cholesky (d.f. adjusted) Weights



we regress the index against the inflationary gap in the second-round model to check the price shock magnitude. The model reveals that there is cointegration between the index and inflation rate. Then VECM has been employed. Accordingly, there is long-run causality running from the shock to the index. Yet, not in the long run. The price shock accounts minimally to the index in the short run 0.35 percent, increase over the medium term, and then decrease in the long run from 1.9 percent in period 5 to 1.4 percent in period 10. Finally, we can notice that the devaluation time is emerging in the index over the impulse response and the variance decomposition.

Morocco:

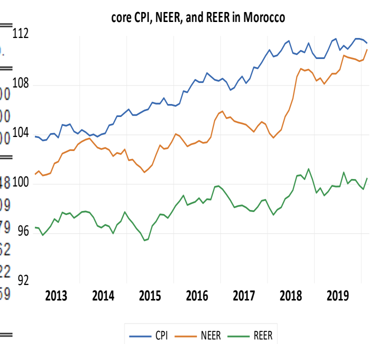
In January 2018, Morocco shifted to a more flexible exchange regime that aims to strengthen the economy's immune system and its ability to absorb shocks. To fulfill the shifting condition, the bank has widened the band from ± 0.3 to ± 5 percent and maintain the dirham's reference basket. In July 2019, a new law came into force to reinforce the central bank autonomy, stating its sole responsibility for defining and conducting monetary policy (AMF, 2019). Here, the model employs monthly time-series data from January 2013 to February 2020. Variables included are money market rates, nominal effective exchange rate, and core CPI.



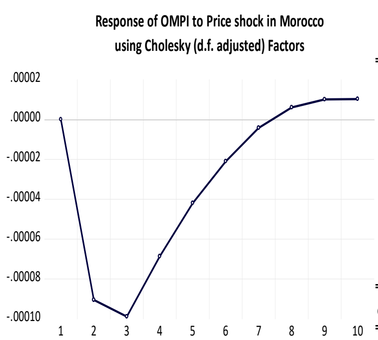
Morocco's First-round Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MMR	-0.044781	0.003051	-14.67750	0.0000
NEER	0.004329	0.000350	12.35770	0.0000
C	4.338734	0.041634	104.2108	0.0000

R-squared	0.914326	Mean dependent var	4.679448
Adjusted R-squared	0.912262	S.D. dependent var	0.025209
S.E. of regression	0.007467	Akaike info criterion	-6.922379
Sum squared resid	0.004628	Schwarz criterion	-6.836762
Log likelihood	300.6623	Hannan-Quinn criter.	-6.887922
F-statistic	442.8968	Durbin-Watson stat	0.379459
Prob(F-statistic)	0.000000		



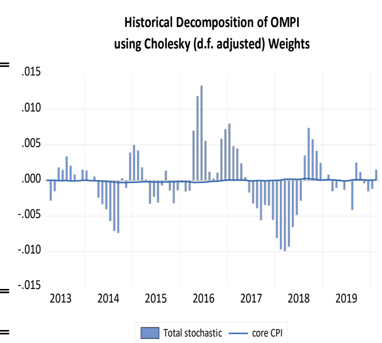
Morocco's first-round model shows robust and significant results for both individual variables and the whole model. Adjusted R-square is as high as 91.2 percent, which means that interest rates and nominal effective exchange rates predominantly drive Morocco's inflation dynamic. As can be seen, the OMPI is well-away from the steady state. Attributable to two main factors. First, the depreciation of the Dinar's nominal effective value against foreign currencies reached 110.94 Dirham in February 2020 from 108.38 Dirham in January 2019. (IMF data)



Variance Decomposition of CPI:

Period	S.E.	MCI	CPI
1	0.421389	0.513292	99.48671
2	0.564448	0.341947	99.65805
3	0.639877	0.660427	99.33957
4	0.719212	1.980837	98.01916
5	0.801121	3.889508	96.11049
6	0.877279	5.883788	94.11621
7	0.948739	7.689224	92.31078
8	1.016321	9.151370	90.84863
9	1.079649	10.25445	89.74555
10	1.138897	11.05981	88.94019

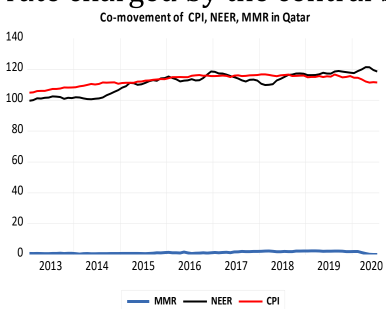
Cholesky Ordering: MCI CPI



Morocco's second-round model as well shows robustness. According to VECM, long-run causality runs from the index to the price shock underpinned by the decomposition of the shock and the index. The contribution of the price shock to the index is very minimal in the short run and increases proportionately over the long run. Yet, the short-run causality has not been proved.

Qatar:

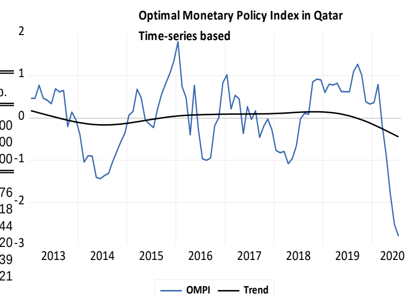
Since July 2001, the central bank has been pegging the domestic value against the US dollar instead of the SDR was in effect since 1975 (QCB 2020), taking advantage of the exchange rate as a nominal anchor for its monetary policy formulation process. Hence, the monetary policy objective in Qatar is to keep the exchange rate stable against the US dollar. On the other hand, the interest rates framework focuses on the average overnight interbank rate (AOIR) as the operating target. Qatar's money market rate is the interest rate charged by the central bank on standing facilities provided by the bank.



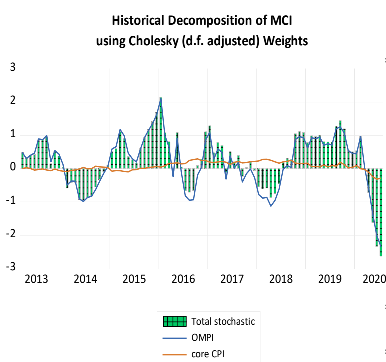
Qatar's First-round Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MMR	1.933501	0.310516	6.226728	0.0000
NEER	0.294434	0.032542	9.047875	0.0000
C	77.75308	3.423203	22.71354	0.0000

R-squared	0.747888	Mean dependent var	113.1676
Adjusted R-squared	0.742158	S.D. dependent var	3.264418
S.E. of regression	1.657612	Akaike info criterion	3.881044
Sum squared resid	241.7956	Schwarz criterion	3.963820
Log likelihood	-173.5875	Hannan-Quinn criter.	3.914439
F-statistic	130.5253	Durbin-Watson stat	0.149621
Prob(F-statistic)	0.000000		



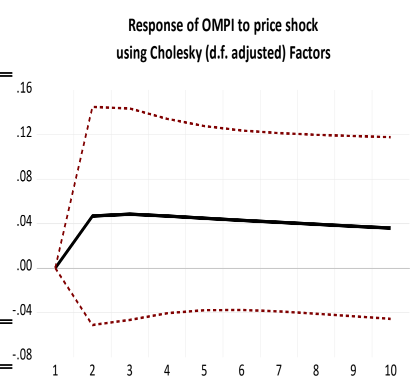
Here, I have used monthly time series data spans for 91-month from January 2013 to July 2020. Variables included in the first-round model are the inflation rate as an independent variable and money market rate and nominal effective exchange rate as explanatory variables. Although the autocorrelation is low, the model expresses significant results for individual variables, hence the entire model. Adjusted R square is somehow high, yet still, other variables need to be included.



Variance Decomposition of CPI:

Period	S.E.	MCI	CPI
1	0.503907	1.996575	98.00342
2	0.685182	1.884018	98.11598
3	0.815379	1.898308	98.10169
4	0.917727	1.949020	98.05098
5	1.001647	2.011751	97.98825
6	1.072174	2.077787	97.92221
7	1.132411	2.143401	97.85660
8	1.184447	2.206825	97.79318
9	1.229778	2.267187	97.73281
10	1.269525	2.324075	97.67592

Cholesky Ordering: MCI CPI

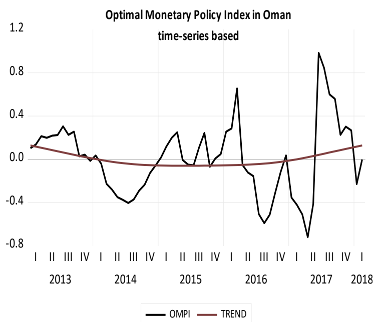


Qatar's second-round model based on the VAR method tells us the long-run causality between the index and CPI that's evidenced in the model. The price shock in Qatar to the index account for 1.99 percent in the short-run and increase over-time to reach 2.3 percent in the 10th period.

OMAN:

Oman has a fixed regime by pegging the domestic currency's value against the UD dollar to achieve policy objectives such as inclusive growth, stable inflation, and sounds and stable financial sector. According to the US Fed rate, the central bank of Oman's monetary policy implementation consists of setting the policy rate and standing facilities' rate to ensure adequate liquidity in the System.

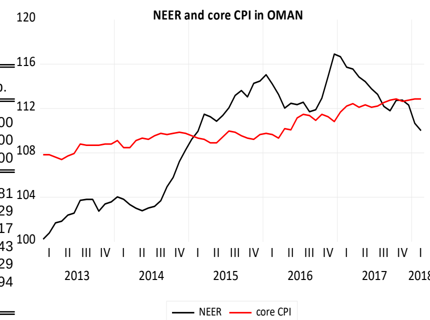
Oman's weighted average OIR increased from 0.19 percent in December 2015 to 2.14 percent in December 2018 and further to 2.77 percent in July 2019 before declining marginally to 2.74 percent in August 2019. The weighted interest rate on local currency deposits and lending increased by 102 basis points and 67 basis points, respectively, from December 2015 to August 2019. although domestic interest rates remain mostly aligned to those prevailing in the USA, they tend to vary somewhat from those in the USA.



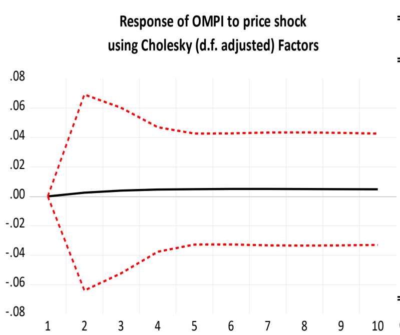
Oman's First-round Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MMR	2.603772	0.265130	9.820733	0.0000
NEER	0.131208	0.020313	6.459323	0.0000
C	94.76469	2.178057	43.50882	0.0000

R-squared	0.806518	Mean dependent var	110.0881
Adjusted R-squared	0.799959	S.D. dependent var	1.573729
S.E. of regression	0.703865	Akaike info criterion	2.182717
Sum squared resid	29.23014	Schwarz criterion	2.285643
Log likelihood	-64.66423	Hannan-Quinn criter.	2.223129
F-statistic	122.9688	Durbin-Watson stat	0.498094
Prob(F-statistic)	0.000000		



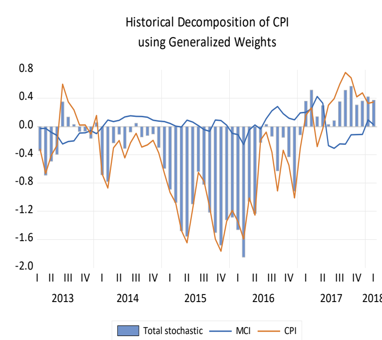
The increase in domestic interest rates, following the normalization of the monetary policy in the USA, helped the currency peg by incentivizing capital inflows and discouraging capital outflows. However, the upward movements in interest rates were not in sync with the domestic business cycle that has been going through a subdued and uncertain phase.



Variance Decomposition

Period	S.E.	MCI	CPI
1	0.247032	8.067983	91.93202
2	0.321942	8.494050	91.50595
3	0.345972	7.530328	92.46967
4	0.352512	6.486215	93.51379
5	0.354064	5.636898	94.36310
6	0.354405	4.984839	95.01516
7	0.354492	4.484801	95.51520
8	0.354533	4.095423	95.90458
9	0.354567	3.786284	96.21372
10	0.354600	3.536071	96.46393

Cholesky Ordering: MCI CPI



Oman's second-round model tries to figure out the response of the index to the price shock. The model reveals no cointegration between the index and inflation rates. VAR second round model is estimated to figure out the magnitude of the price shock to the index. It reveals the long-run causality running from the index to price levels.

Panel-based Index

In this part, we figure-out the possibility of constructing the OMPI for a group of countries together instead of individual countries as previously described.

Although the first-round panel model initially revealed statistically significant results and consistent with economic and empirical literature, some heterogeneity in the model requires applying the Hausman Test. After ensuring available core ingredients, the index then is ready for calculation based on the formula stated in equation (4).

The model fulfills the panel cointegration condition, given that the exchange rate and interest rate are both non-stationary at the level and stationary at the first different.

Appendix (2) shows different panel regression models, where we need to decide whether the random or fixed effect model is appropriate. Here Hausman test has been applied to check for the heterogeneity, where the null hypothesis indicates that random-effect is suitable, and the alternative points out that the fixed-effect is appropriate.

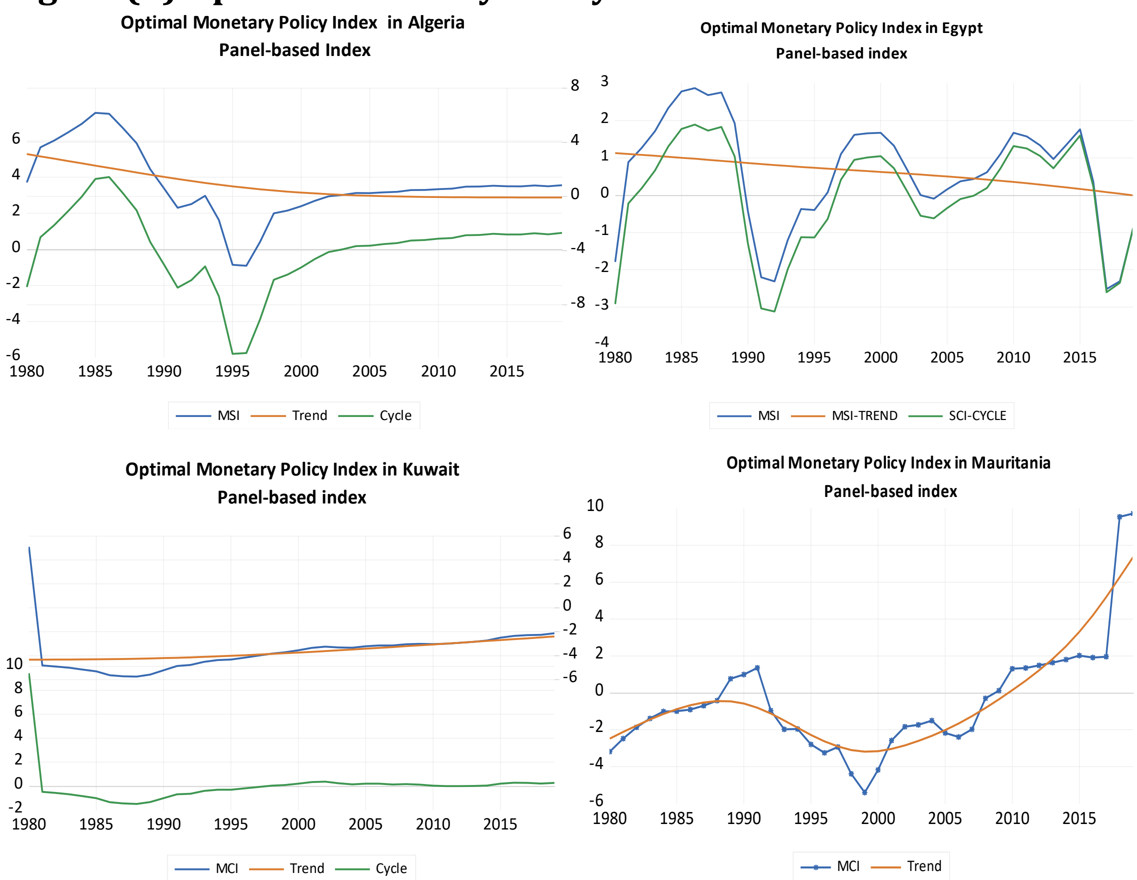
The model reveals that the P-value for the Hausman Test is equal to (0.0239). This result indicates the rejection of the null hypothesis and acceptance of the alternative. In other words, the fixed-effect model is appropriate. In this context, the work shows that the panel fixed effect model is statistically significant based on the F-statistic value. It is also significant in terms of individual variables of the REER and real interest rate. If regression (C) is the appropriate model, there would be a need to recall the regression (C) and deal with its coefficients as weights. The first-round panel model also reveals long-run and short-run causality running from the real interest rate and real effective exchange rate to the inflation rate, based on the negative sign, and significant t-statistic of error correction term.

According to Kao Residual Cointegration Test, we reject the null hypothesis given the p-value of the t-test (0.0007); accordingly, the argument here is that there is no cointegration between variables. Thus, we can accept the alternative hypothesis. In such a case, VECM is highly recommended instead of VAR, which allows us to test for the short and long-run causality between variables.

The Wald test has also been applied to check for the cause over the short term. Simultaneously, the long-run causality between the dependent variable and explanatory variables is evidenced based on the sign of the error correction term and its P-value. Thus, The VECM model shows a long and short-run causality running from the real interest rate and the real exchange rate to the inflation rate.

Let us recall equation (5) to construct the Monetary stability index, given the availability of weights and the steady-state values. Then, the index would be built-up and regressed against policy objectives for more elaboration and concrete interpretation.

Figure (1) Optimal Monetary Policy Index in some Arab countries



Source: Author estimation based on different data sources (IMF, AMF, World Bank, National authorities)

Figure (1) shows that the optimal index trend does not show the same pattern across four countries over time. In Egypt, for instance, the direction takes linear shape with downward sloping, whereas upward sloping in Kuwait. While in Algeria, the trend gets flattered, starting from above 4 percent in 1980 and zero value in 2005. However, in Mauritania, the trend is fluctuating in the negative region. Additionally, there is no typical sign one can judge. Hence, we conclude that constructing the index using the panel technique seems inaccurate due to heterogeneity and variation of the trend across countries. In a different part of this paper, we will construct the index using time series data to see how different the panel-based index is in terms of accuracy, interpretation, validity, and responsiveness to shocks.

OMPI, Policy objectives, and shocks magnitude:

Understanding the dynamic response to different shocks and the policy objectives is the must and indispensable. The paper discusses how a one standard deviation shock is affected by reactions of the three policy shocks identified here: credit shock, output shock, and price shock.

It is preferable to check the link between the index and the core policy objectives, price stability, exchange rate stability, and inclusive growth *(see second-round model)*. Therefore, the paper is eager to regress OMPI against the inflationary gap, output gap, and credit gap. The main aim is to figure out how well the OMPI responds to the monetary policy objectives and their impulse response; this would be our goal, which is to accurately scale the economic conditions through such an index and its magnitude effect.

It is worth noting that the preliminary tests for the validity of the VAR & VECM panel model have been undertaken (e.g., unit root test, cointegration test, and the causality test over the long run & and the short run). Subsequently, OMPI is non-stationary at the level and stationary at the first difference; then we test for the cointegration between OMPI and the policy objectives. The shock response and variance decomposition tests are applied to describe how well the index responds to one of the three shocks. (price, output, credit).

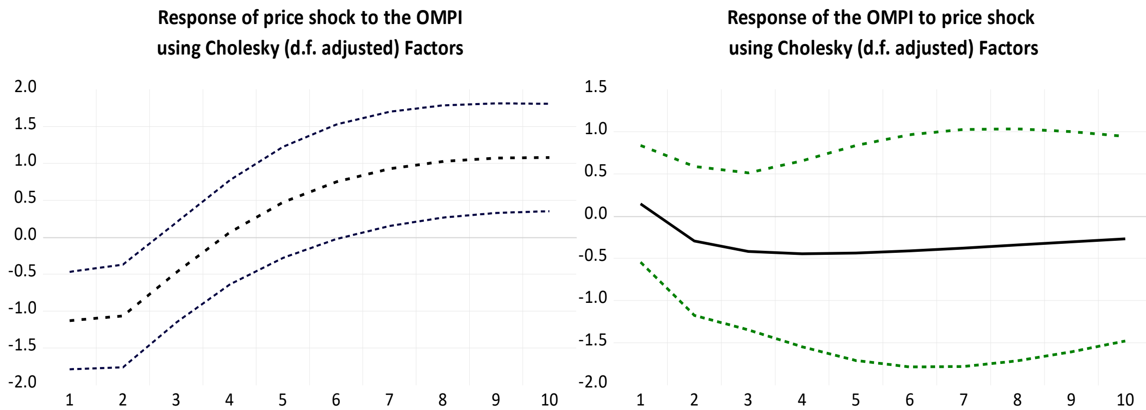
OMPI, Inflationary gap, and price shock:

With the strong tendency of a central bank to achieve price stability, the Inflation gap assumes the differencing between actual inflation (Y-to-Y percentage changes in CPI) and the targeted one by the monetary authority at period (t).

This paper finds that both the OMPI and inflation gap cointegrate to one another based on the P-value of the Kao Residual Cointegration Test equals 0.0003. peer in mind that this result allows for as much heterogeneity as possible among individual countries and allows us to test for the long run and short-run causality following VECM. Additionally, the model reveals a long-run cause running from the OMPI to the inflation gap. Nevertheless, no evidence for the short-run relation.

We find that the effect of the exchange rate and interest rates shared in one index reaches out to the inflation rate in the longer-term, considering the negative relationship between the index and the inflation gap. As the OMPI increases, the inflation rate tends to approach the steady state from either side. At this juncture, the OMPI is mainly driven by the exchange rate, which may counterweight the interest rate impact on the inflation dynamic. It occurs in countries where exchange rate volatility determines inflation; or imported inflation is dominating the economy.

Figure (2) Response to prices shock



Source: Author's estimation based on different data sources (IMF "international financial statistics", AMF "Economic data base", World Bank "world bank open data, National authorities). annual time series related to Exchange rates, inflation rates, economic growth, domestic credit, and interest rates have been drawn from the economic data base of the Arab Monetary Fund, national authorities, and the world bank, while monthly data are mainly being collected from the IMF data base.

Figure (2) shows how the index responds to a one-standard deviation shock of price level within a 95 percent confidence interval. It shows that a one Standard Deviation shock (innovation) to the index indicates an elastic downward slope of inflation until the 2^{nd} period, since then and until the 10^{th} period, the response of the price shock to the index remains perfectly elastic, which means the index would most likely hurt prices over the longer term.

The variance decomposition on inflation is undertaken as well, which reveals that in the short-run, in period one, the inflation shock accounts for 96.6 percent variation of the fluctuation in inflation *(its own shock)*, while shock to the monetary index cause around 0.108 percent fluctuation in inflation, and 3.3 percent shock to the credit growth.

Table (1) Variance Decomposition of Inflation

Period	S.E.	OMPI	Credit Growth	Inflation	output
1	4.226187	0.107692	3.304400	96.58791	0.000000
2	5.462570	0.384659	7.722174	91.88087	0.012296
3	6.154598	0.641487	8.443795	90.36505	0.549666
4	6.546617	0.971823	8.657655	89.67660	0.693925
5	6.771814	1.188462	8.840516	89.28814	0.682883
6	6.905653	1.326782	8.941546	89.04645	0.685223
7	6.986903	1.435945	8.983653	88.88419	0.696214
8	7.036292	1.521898	9.005558	88.77197	0.700572
9	7.066328	1.585118	9.018697	88.69435	0.701834
10	7.084685	1.631214	9.025549	88.64041	0.702827

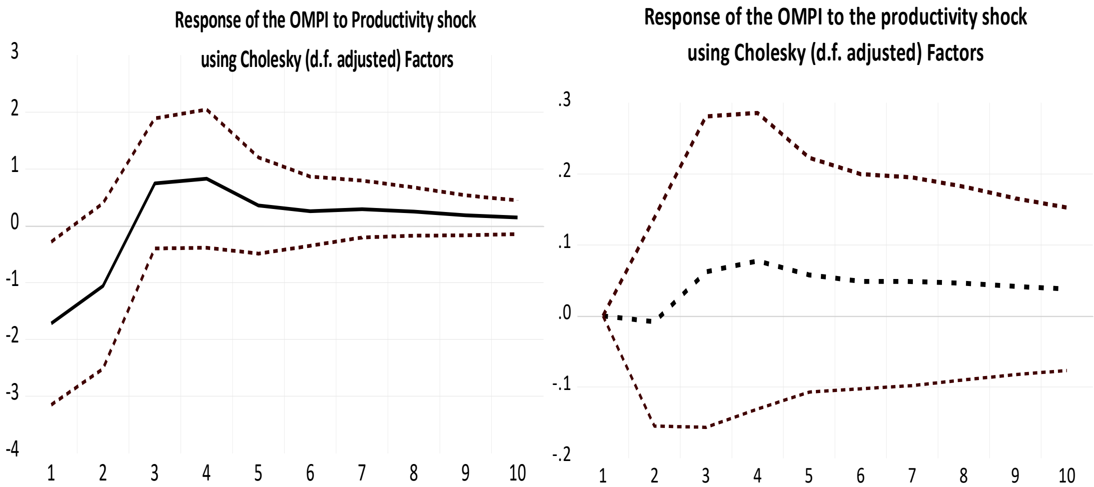
Source: Author estimation based on different data sources (IMF, AMF, World Bank, National authorities)

OMPI, output gap, and Productivity Shock:

In addition to the price and financial stability, central banks also target inclusive growth over a longer time. Thus, it is crucial to see how our innovative index response to the GDP gap. In theory, the output gap moves in the same direction as the interest rate and exchange rate, in the sense that higher interest rates are likely to discourage borrowing from banks and then encourage capital flight leading to currency depreciation, which causes expansion for the output gap.

The second-round model reveals cointegration between the OMPI and output gap, given the Kao test's significant value, which is Engle-Granger based. The model also confirms the long-run causality running from the OMPI to the output gap referenced by the error correction term negativity and significance relation. However, no short-term cause is recognized based on the coefficient diagnostic test applied. According to the fixed-effect model, there has been a positive relationship between OMPI and the output gap, meaning that as OMPI gets closer to zero value, the GDP is most likely approaching the steady-state.

Figure (3) Response to output shock.



Source: Author's estimation based on different data sources (IMF "international financial statistics", AMF "Economic data base", World Bank "world bank open data, National authorities). annual time series related to Exchange rates, inflation rates, economic growth, domestic credit, and interest rates have been drawn from the economic data base of the Arab Monetary Fund, national authorities, and the world bank, while monthly data are mainly being collected from the IMF data base.

Figure (3) points that one Standard Deviation SD shock (innovation) to the index shows an increased pattern from the negative region in the 1st and 2nd period and approaching the steady state in the 3rd period and remained positive with noticeable change until started to decrease in the 5th period. Since then, the shock response goes positively straight until period 10th, this indicates that the index responses to one-standard deviation shock of output within 95 percent confidence interval in anticipation of negative shock over the short and long run.

Table (2) Variance Decomposition of Output:

Period	S.E.	OMPI	Credit Growth	Inflation	output
1	9.023602	3.647533	0.620596	0.326993	95.40488
2	9.091491	4.958973	0.702950	0.350461	93.98762
3	9.388674	5.169074	1.016726	0.551998	93.26220
4	9.436995	6.057785	1.014436	0.613558	92.31422
5	9.459710	6.240422	1.042863	0.619242	92.09747
6	9.464830	6.324716	1.045219	0.628217	92.00185
7	9.470682	6.418053	1.043991	0.635715	91.90224
8	9.474258	6.485250	1.043357	0.638398	91.83299
9	9.476245	6.522558	1.043249	0.639349	91.79484
10	9.477508	6.546660	1.043024	0.639844	91.77047

Cholesky Ordering: OMPI CRGRO INF GDP

Source: Author's estimation based on different data sources (IMF "international financial statistics", AMF's Economic data base", World Bank "world bank open data, National authorities). annual time series related to Exchange rates, inflation rates, economic growth, domestic credit, and interest rates have been drawn from the economic data base of the Arab Monetary Fund, national authorities, and the world bank, while monthly data are mainly being collected from the IMF data base.

In the short run (period one), the shock magnitude to the monetary index from GDP accounts for around 3.65 percent of the output fluctuations. These percentages increase over the long run. In period 10, for instance, the output shock influences the index by 6.5 percent. While the shock on banking credit slightly minimal, ranging between 0.62 percent in period 1 and 1.04 percent in period 10.

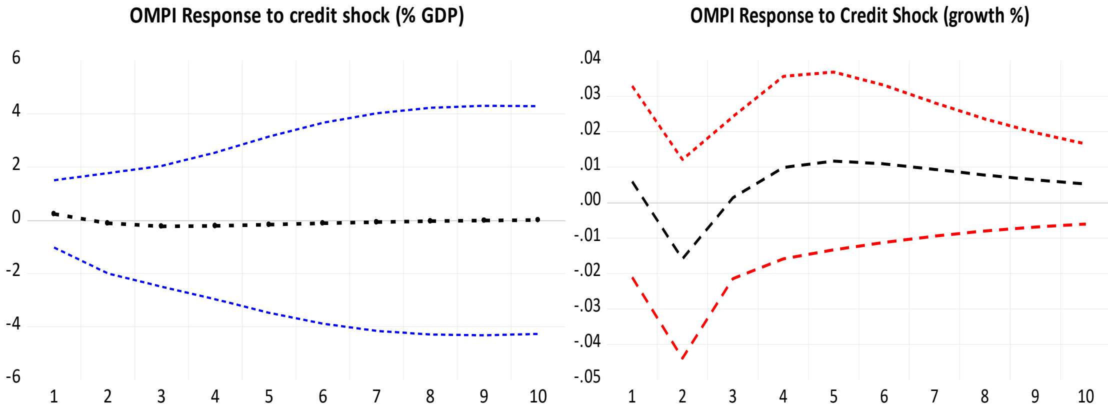
OMPI, credit gap, and credit shock:

Here, the paper considers domestic credit as a channel for the monetary policy transmission mechanism. Credit to GDP is a crucial indicator for gauging the banking system robustness and also a valid indicator for the monetary policy implementations. When a central bank, for example, raises the policy rate, money market interest rates are also likely to rise. Short term funding costs of financial intermediaries will increase, and ultimately financial intermediaries are likely to pass on the higher costs to their borrower by charging them higher lending rates.

Raising the lending rate could lower the borrower's ability to repay their debt (borrowers would encounter higher monthly debt repayment while their revenue might slow in line with an economy facing a higher interest rate. Consequently, banks and other lenders might add a higher premium to their lending rate to compensate for raising credit risk when the interest rate is rising, or they might extend credit more cautiously in general. Overall, banks might be more cautious in providing credit in an environment of rising interest rates.

The second-round model finds cointegration between OMPI and credit to GDP, and the causality running from the OMPI to the credit to GDP is confirmed, while the short-run causality does not exist. I consider, credit to GDP gap as a proxy for financial stability, although there are other indicators. For example, credit growth tends to be a strong candidate better-representing credit shock instead of the credit-to-GDP ratio.

Figure (4) Response to credit shock



Source: Author's estimation based on different data sources (IMF "international financial statistics", AMF "Economic data base", World Bank "world bank open data, National authorities). annual time series related to Exchange rates, inflation rates, economic growth, domestic credit, and interest rates have been drawn from the economic data base of the Arab Monetary Fund, national authorities, and the world bank, while monthly data are mainly being collected from the IMF data base.

As observed in Figure (4), a one Standard Deviation SD credit shock (innovation) to the index shows a consistent pattern over the entire period associated with slight variation. Initially, there had been an identical elastic downward slope of a positive credit-to-GDP shock in the first period, switched to the negative side in the first half of period 2, remain stable since then, and gradually returned to the steady-state. This result indicates that the credit shock to the index is inconsequential with the tendency of no impact over the short and long-time horizon.

Table (3) Variance Decomposition of Credit Gap:

Variance Decomposition of Credit Gap (% of GDP)

Period	S.E.	OMPI	Inflation	Output	Credit to GDP
1	6.482319	0.182880	3.012457	0.998185	95.80648
2	8.150612	0.117954	5.455124	0.705785	93.72114
3	8.550221	0.261288	7.931485	0.723236	91.08399
4	8.637540	0.386381	9.204772	0.803566	89.60528
5	8.657937	0.443576	9.513508	0.804943	89.23797
6	8.668153	0.464330	9.516486	0.828875	89.19031
7	8.671550	0.468915	9.510677	0.833369	89.18704
8	8.672205	0.469378	9.515453	0.833599	89.18157
9	8.672327	0.469420	9.517924	0.833595	89.17906
10	8.672374	0.469461	9.518201	0.833597	89.17874

Cholesky Ordering: OMPI INFGAP GDPGAP CREDITGAP

Source: Author's estimation based on different data sources (IMF "international financial statistics", "AMF's Economic data base", World Bank "world bank open data, National authorities). annual time series related to Exchange rates, inflation rates, economic growth, domestic credit, and interest rates have been drawn from the economic data base of the Arab Monetary Fund, national authorities, and the world bank, while monthly data are mainly being collected from the IMF data base.

It is worth to complement that credit shock associate the banking sector insolvency when its total liabilities exceed its total assets. In our variable, things tend to be different as the paper is considering the credit-to-GDP ratio. Alternatively, things perhaps get better when considering credit growth instead of credit to GDP ratio. In other words, internalizing credit growth provide consistent results in terms of both impulse response and variance decomposition.

Concluding remarks

We conclude from the preceding analysis that the nexus between the interest rate and the exchange rate is robust and significant. In this regard, a higher interest rate attracts capital inflow, which causes currency appreciations making the currency value much more vigorous against the dollar, affecting both sides of the firms' balance sheet (assets and liabilities).

It is worth remarking that as inflation rate and output, at the steady-state levels, the nominal interest rate should be at the natural level, which means monetary policy tends to be neither loose nor tight; it is neutral. However, real interest rates are likely to increase whenever actual inflation and output exceed their desired levels.

On the other hand, the nexus between the inflation rate and the exchange rate is controversial, but it is more likely to lean on the positive side. However, things might often go against the wind occasionally. In other words, the relationship is biased and takes into consideration country-specific factors. In countries with peg regime, the central bank's policy action drives inflation by anchoring expectations; this is the case of oil exporters such as GCCs, where the policy stance follows the USA's policy direction. For example, when the central bank tight the monetary policy, aggregate demand tends to slow down, leading the inflation rate to decrease.

In the case of oil importers adopting or shifting to a flexible regime, the exchange rate's magnitude effect counterweights the interest rate. Currency depreciation is furthermost likely to hurt the prices unless backup packages provide. However, the interest rate might reach out to inflation well before the exchange rate does.

From the standpoint of the optimal monetary policy index, the optimal conditions occur when the index reaches the steady-state level from both sides. As the index goes towards the positive region, the second-round effect is getting much tighter and vice versa.

In conclusion, the index reflects both interest rate and exchange rate movement and their impact on aggregate demand. As the index goes into the negative region, the interest rate is most likely lowered, which means monetary policy is loose and vice versa. Sometimes, monetary policymakers inherently slow down demand to strengthen the currency value by raising the policy rate, subsequently causing market rates to rise. In such a case, consumption would switch away from domestically produced goods, and services provided cheaper imported goods than in the past.

As noticed from the previous analysis, the OMPI takes the negative and positive signs over the chosen period in the selected countries. The value "zero" of the index means that monetary conditions are optimally stable. As the index gets away from the steady state, the economic conditions then get to be severer.

As can be observed, there is no typical sign one can judge. Hence, we conclude that constructing the index based on panel technique seems far from the evidence. The time-series-based index is much more consistent; the index's optimal value fluctuates around zero in a relatively narrow band, not exceeding one percent on both sides; this sensitivity to zero has been homogeneous for all sample countries.

The paper also finds out that the magnitude effect on the index varies across countries. in countries adopting a flexible regime, exchange rate variation plays a key role. For instance, in times of devaluation, the index response immediately with no time lag, as in Egypt. The government implemented the devaluation in 2016; the index simultaneously goes positive. While in countries with a pegging regime, the policy rate significantly affects the index and tends to offset the exchange rate's response.

One of the findings concludes that the OMPI is highly sensitive to price shock in Egypt, Tunisia, and Morocco. However, the response is minimal to the shock in Qatar and Oman. It is evident that the index's response to the price shock is uneven across Arab oil importers and Arab oil exporters. In other words, the index response is more robust in countries with a flexible exchange rate regime than in countries with a pegging system.

Appendix (1) Unite Root Test for Real Interest Rate and Real Exchange Rate

Method	Real Effective Exchange Rate				Real Interest Rate			
	Level		First different		Level		First different	
	Statistic	Prob.**	Statistic	Prob.**	Statistic	Prob.**	Statistic	Prob.**
	Null: Unit root (assumes common unit root process)							
Levin, Lin & Chu t*	-0.81509	0.2075	-5.22518	0.0000	-0.35643	0.3608	-7.70681	0.000000
	Null: Unit root (assumes individual unit root process)							
Im, Pesaran and Shin W-stat	-0.36594	0.3572	-5.34388	0.00000	-0.20068	0.4205	-6.87863	0.000000
ADF - Fisher Chi-square	8.76445	0.3626	44.27	0.00000	6.71939	0.5672	58.2051	0.000000
PP - Fisher Chi-square	5.66807	0.6844	37.4558	0.00000	5.47602	0.7057	66.6378	0.000000

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Source: Author estimation based on different data sources (IMF, AMF, World Bank, National authorities)

Appendix (2) Testing for Random and Fixed Effect Model

Independent variable	Algeria CPI	Morocco Log (CPI)	Tunisia CPI	Oman CPI	Qatar CPI	Saudia Arabia CPI	Egypt Inf
INF(-1)							(1.017931)***
Std. Error							0.04306
t-Statistic							23.63767
P-value							0.00000
Dummy (Devaluation)							(0.023406)*
Std. Error							0.01386
t-Statistic							1.68887
P-value							0.09870
MMR	(2.914465)**	(-0.044781)***	(-2.335327)**	2.603772**	(1.933501)**	(1.611924)*	(-0.005958)***
Std. Error	0.51225	0.00305	1.12404	0.26513	0.31052	0.36807	0.00221
t-Statistic	5.68953	-14.67750	-2.07762	9.82073	6.22673	4.37941	-2.69664
P-value	0.00000	0.00000	0.04200	0.02700	0.04987	0.08405	0.01000
NEER	(-1.480591)*	(0.004329)***	(-1.095599)**	0.131208***	0.294434***	0.239924***	0.00333
Std. Error	0.06620	0.00035	0.06391	0.02031	0.03254	0.03033	0.00175
t-Statistic	-22.36672	12.35770	-17.14401	6.45932	9.04788	7.91000	1.90096
P-value	0.00000	0.00000	0.00000	0.00314	0.00360	0.00383	0.06420
Intercept	253.455	4.3387	225.8608	94.7647	77.7531	87.9501	0.03432
	5.962067	0.0416	9.2567	2.1781	3.4232	3.0320	0.01820
	42.51126	104.2108	24.3997	43.5088	22.7135	29.0074	1.88606
							0.06620
R-squared	0.9611	0.9143	0.8579	0.8065	0.7479	0.7946	0.94091
Adjusted R-squared	0.9597	0.9123	0.8532	0.8000	0.7422	0.7876	0.93528
F-statistic	690.9328	442.8968	184.0848	122.9688	130.5253	114.1273	167.17860
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: These regressions were estimated using monthly time series data for six Arab countries (Algeria,Morroco, Tunisia, Oman, Qatar, Saudia Arabia, and Egypt). the time series length differ across countries, it starts from Jan. 2013 and ends in different time sports. The P-values are given in parentheses under the individual coefficients, which are statistically significant at *10%, **5%, or ***1% significance level. the bluse shaded figures are the weight used to construct the time-series based index.

Appendix (3) Variables coefficients across countries (individual time-series model)

	Regression (A) None – None	Regression (B) None -fixed	Regression (C) Fixed – fixed	Regression (D) Fixed- Random	Regression (E) Random – Fixed	Regression (F) Random/Random
Intercept	-1.9695460	-1.1490610	-7.4677550	-6.1645610	-6.8835680	-5.7468300
Std. Error	1.1123520	0.9101470	2.6418320	2.3814380	2.3326060	3.4623380
t-Statistic	-1.7706140	-1.2625000	-3.1111830	-2.5885870	-2.9510200	-1.6598120
Prob.	0.0786000	0.2093000	-0.0055000	0.0106000	0.0038000	0.0989000
REER	0.0314850	0.2476190	0.0259990	0.0274460	0.0253410	0.0269680
Std. Error	0.0057500	0.0495650	0.0074410	0.0062390	0.0068390	0.0059730
t-Statistic	5.4759910	4.9958720	3.4939960	4.3988670	3.7052590	4.5150270
Prob.	0.0000000	0.0000000	0.0007000	0.0000000	0.0003000	0.0000000
RIR	0.2952540	0.0358630	0.8998040	0.7722980	0.8582300	0.7426590
Std. Error	0.0766690	0.0042390	0.1432010	0.1560510	0.1423130	0.1552200
t-Statistic	3.8510080	8.4609020	6.2835120	4.9490240	6.0305730	4.7845620
Prob.	0.0002000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Error Correction Term			-0.1101080			
			0.0435850			
			-2.5262720			
			0.0119000			
Cross-section						
Algeria	-	-	4.5057140	3.9599430	4.2902650	3.7928900
Egypt	-	-	2.3328710	2.6889720	2.4079340	2.7236040
Kuwait	-	-	1.4724370	0.9298530	1.2340840	0.7618420
Mauritania	-	-	-8.3110230	-7.5787670	-7.9322840	-7.2783360
years	**2010 -2016**	**2010 -2016**	**2010 -2016**	**2010 -2016**	**2010 -2016**	**2010 -2016**
F-statistics	14.4433100	4.2706770	4.7663980	24.8050700	2.7778770	15.5411500
P-value	(0.00002)**	(0.000000)***	(0.000000)***	(0.000)***	(0.00000)***	(0.000001)***
Adjusted R-squared	0.1446400	0.4575190	0.5103500	0.4281100	0.3143390	0.1546250
Chi-Sq. Statistic (Hausman Test) P-value				0.0587*****	0.0162****	0.0239******
Chi-square (Wald Test) P-value			0.0099000			

Note: These regressions were estimated using panel data for four Arab countries (Kuwait, Egypt, Algeria, and Mauritania). Regression (1) through (6) use annual cross sectional data for all the period (1980 - 2019). The data set is described in Appendix (1) to (6). The *P-value*s are given in parentheses under the individual coefficients, which are statistically significant at *10%, **5%, or ***1% significance level. **** cross section effect, *****period random effect ******cross section / period random effect . the bluse shaded figures are the weights used to construct the panel-based index.

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