Online Annex. Monetary Policy: Where does ME&CA Stand?

Annex 1. Monetary Policy Survey Results and Analysis

In January 2023, the Middle East and Central Asia Department's Regional Analytics and Strategy Division conducted a survey on the role of monetary policy in taming inflation with IMF country teams. The questionnaire gathered information on the mechanisms and instruments that central banks deployed to signal and implement their desired policy stance during the 2021–22 surge in inflation as well as complementary policies governments may have enacted.

Monetary Policy Instruments and Actions

Policy Rates

Two-thirds of ME&CA central banks (21 out of 30 respondents) use a policy rate to signal their monetary policy stance (Figure 2.1). Except for Iran, those countries not using a policy rate are low-income countries (LICs) and fragile and conflict-affected states (FCS). All central banks (except Algeria and Iraq) raised their policy rates over the past two years by varying degrees as inflationary pressures surged (Figure 2.2). Among exchange rate floaters, Pakistan and Kazakhstan raised their policy rates the most (by 1,000 and 775 basis points), responding to inflation spikes and severe depreciation pressures on the domestic currency. All central banks with managed exchange rates raised interest rates, two (Egypt, the Kyrgyz Republic) by 800 basis points. Central banks operating under fixed exchange rate regimes also raised their policy rates. GCC countries (with currencies pegged to the US dollar and, in the case of Kuwait, pegged to a basket of currencies) increased their interest rates in line with the Federal Reserve. Morocco, Tajikistan, and Uzbekistan raised their policy rates the least, partly due to smaller inflation increases and, in the case of Tajikistan and Uzbekistan, because of positive real interest rates that were higher than in several other countries.

Reserve Requirements

Nearly three-quarters of central banks in the region use reserve requirements on domestic currency liabilities as an instrument of monetary policy; slightly more than half use them on foreign currency liabilities (see Figure 2.1). Most central banks kept reserve requirement rates unchanged relative to their averages in the first half of 2021, even as inflation accelerated in 2021–22. While seven raised reserve requirements rates on domestic currency liabilities and four on foreign currency liabilities (Figure A1.1) during 2021–22, in most instances the changes were related to policy normalization following the pandemic or financial stability considerations.

Other Central Bank Actions

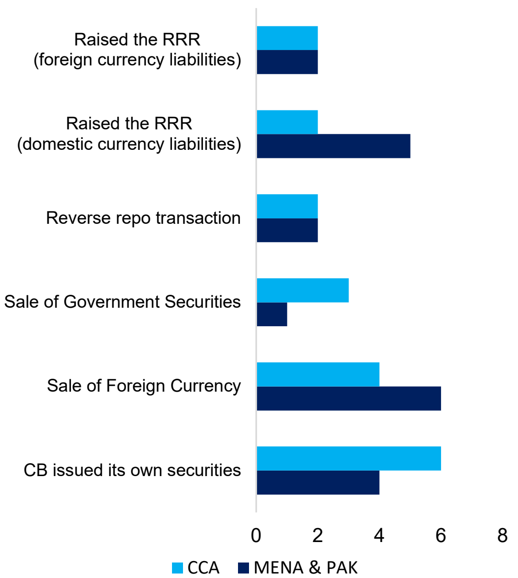
Beyond raising policy interest rates and reserve requirements, the region's central banks also took other actions to tame inflation over the past two years (Figure A1.1). To mop up excess liquidity from the market and drive interest rates higher, central banks issued their own securities (10) and engaged in the sale of government securities and reverse repurchase agreements (four). Countries also intervened in foreign exchange markets by selling foreign currencies (10) to shore up their currencies and prevent pass-through to inflation and mop up excess domestic currency liquidity. Annex Figure 1.1 suggests that most central banks in the region do not engage in market transactions for monetary policy purposes, which may reflect a lack of institutional and technical capacity necessary to undertake such transactions; this can, in turn, hamper the effectiveness of monetary policy transmission.

Macroprudential Measures

ME&CA central banks have made limited use of macroprudential tools as part of their efforts to reduce inflation (Figure A1.2). The most common measures were increased loan-loss provisioning (four), increased liquidity coverage (five), and other measures to control credit growth (four). However, about half of these actions were related to the unwinding of pandemic-related measures. These results suggest substantial scope for the region's central banks to increase their macroprudential toolkit and policy levers, which could support efforts to fight inflation.

Figure A1.1. ME&CA Central Bank Actions in 2021–22

(Number of Countries)

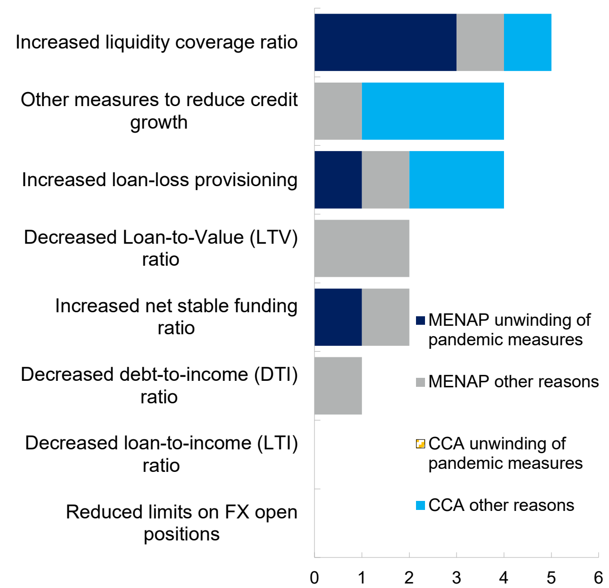


Sources: IMF desk survey.

Note: CCA = Caucasus and Central Asia; ME&CA = Middle East and Central Asia; MENA & PAK = Middle East and North Africa, and Pakistan. CB = central bank; RRR = reserve requirement ratio.

Figure A1.2. Macroprudential Measures Taken since 2021

(Number of countries)



Sources: IMF desk survey.

Note: CCA = Caucasus and Central Asia; MENAP = Middle East and North Africa, and Pakistan. FX = foreign exchange.

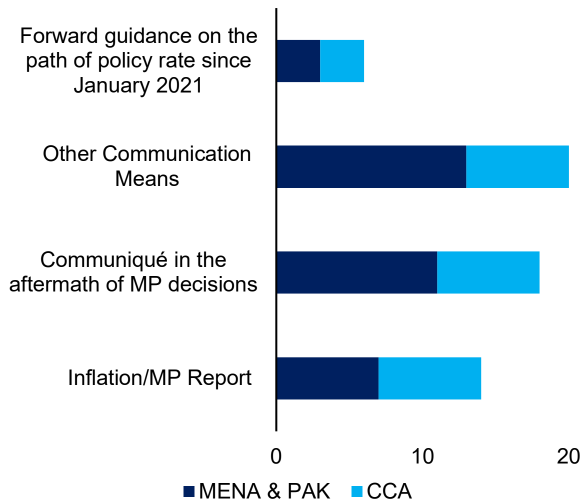
Central Bank Communication

Transparency and good communication are important pillars of a modern and effective monetary policy framework. Most ME&CA central banks issue an official communiqué after a monetary policy meeting and employ other forms of communication such as interviews and social media posts. However, fewer than half regularly publish a publicly available inflation or monetary policy report, and only a handful provide forward guidance on interest rates (Armenia, Georgia, Kazakhstan, Kuwait, Oman, Pakistan; see Figure A1.3), a practice increasingly used by central banks with modern monetary policy frameworks. Thus, there is substantial scope for countries to improve central bank communication and elevate its role as a policy tool. It is essential that stakeholders can identify the main communication vehicle for monetary policy.

Policy Mix

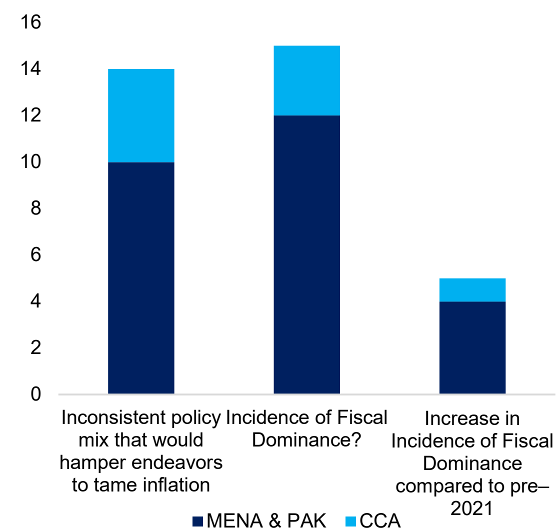
Fiscal dominance is pervasive in ME&CA (Figure A1.4). According to IMF country teams' assessments, fiscal dominance affects roughly half of ME&CA countries, including a diverse group of countries across the region (five FCS, two LICs, and eight others). This may contribute to an inconsistent policy mix that could hamper central bank efforts to tame inflation. Fiscal dominance is assessed to have increased in a few countries (five) over the past two years amid accelerating inflation and heightened central bank focus on reducing it. In other countries, fiscal dominance has eased as higher oil prices have supported budget revenue. Yet, deteriorating fiscal conditions in some oil-importing countries and limited access to capital markets—due to tightening global financial conditions—may have increased pressures on central banks to monetize fiscal deficits.

Figure A1.3. ME&CA Central Bank Communications
(Number of countries)



Sources: IMF desk survey.
Note: CCA = Caucasus and Central Asia; ME&CA = Middle East and Central Asia; MENA & PAK = Middle East and North Africa, and Pakistan. MP = monetary policy.

Figure A1.4. Policy Mix Inconsistency
(Number of countries)



Sources: IMF desk survey.
Note: CCA = Caucasus and Central Asia; MENAP = Middle East and North Africa, and Pakistan.

Evidence of fiscal dominance

Fiscal dominance is defined as subordination to fiscal policy of monetary policy and its primary goal of maintaining price stability, generally with the objective of contributing to the financing of the fiscal deficit. It may be difficult to measure the presence of fiscal dominance, depending on the form it takes. Direct lending to the government above statutory limits is the most direct and obvious form, but it is not a necessary condition for fiscal dominance to be present. Examples of more subtle forms include placing controls on interest rates; having directed lending to the government (central, state, or local) or to other public entities (nonfinancial or financial corporations) from state development banks, state-controlled commercial banks, and even from commercial banks (through moral suasion); failing to fully sterilize capital inflows to allow liquidity in the financial system to increase; remitting to the government the central bank's profits or operating surpluses even if this comes at the expense of the central bank's capital position (for example, making a negative capital position even larger in absolute terms); and the retrocession of SDRs to the government when there is no legal basis for it, among others.

Of the 29 IMF country teams that responded to the survey on monetary policy instruments and actions, 14 assessed their respective countries as having experienced fiscal dominance at some point over the past two years (2021–22). Of these 14 countries, five assessed that the incidence of fiscal dominance had increased compared to pre-2021. One way to corroborate the teams' assessments of the presence of fiscal dominance is to analyze the evolution of central bank net claims on the government. Figure 2.3 (Chapter 2) compares the average of the central bank net claims on the central government and public nonfinancial corporations, expressed as a share of the monetary base and broad money. Of the 21 countries for which these data are available, the difference between those countries in which the IMF country teams assessed there to be fiscal dominance and those in which they assessed there not to be fiscal dominance is very large and economically significant, in the order of 50 percent of the monetary base or 23 percent of broad money.

Annex 2. Estimating Inflation Expectations and Natural Real Policy Rates

Model to Interpolate WEO Data and Projections to Derive Inflation Expectations[1]

Annualized quarterly growth of a variable, z_t, can be approximated as:

$$x_t \approx 400(\ln(z_t) - \ln(z_{t-1}))$$

This is assumed to follow a random walk:

$$x_t = x_{t-1} + \varepsilon_t$$

where ε_t is white noise.

Annual year-on-year growth, x_t^a, is:

$$x_t^a = \frac{1}{4}(x_t + x_{t-1} + x_{t-2} + x_{t-3})$$

Annual average growth, x_t^{aa}, is:

$$x_t^{aa} = \frac{1}{4}(x_t^a + x_{t-1}^a + x_{t-2}^a + x_{t-3}^a)$$

The Kalman filter is used to estimate the unobserved quarterly observations in the model described above using annual data and one-year-ahead projections from IMF World Economic Outlook (WEO) databases. Over the annual projection horizon *H*, annual average growth of variable *z* is observed four times a year, and these estimates are updated in each quarter of each year. All estimates of annual average growth are taken directly from WEO projections made in Q1, Q2, Q3, and Q4 (the January WEO update, the April WEO, the July WEO update, and the October WEO, respectively).

Specifically, in quarter *q* of each year *h* over the projection horizon, there are projections for annual growth of the variable for each year up to five years ahead, so that for each quarter *q* and annual projection horizon *h* the observable variable in quarter *t* is:

$$x_{(q=1,2,3,4,\ \ h=1,2,3,4,5),t}^{aa} = \frac{1}{4}(x_{t-q+1+4(h-1)}^a + x_{t+1-q+1+4(h-1)}^a + x_{t+2-q+1+4(h-1)}^a + x_{t+3-q+1+4(h-1)}^a)$$

where all quarters other than quarter *q* of each year are treated as unobserved over the projection year *h*. In the following, these estimates are used to interpolate for unobserved quarterly observations.

Model to Estimate Natural Policy Interest Rates

Trends and Definitions

The output gap y_t is measured in percentage points and is defined to be the difference between 100 times the log of real GDP Y_t and 100 times the log of potential real GDP $\bar{Y}_t$:

$$y_t = Y_t - \bar{Y}_t$$

[1] All thanks to Michal Andrle.

It is assumed that log potential output is a random walk with a stochastic drift G_t that itself follows a random walk:

$$\bar{Y}_t = \bar{Y}_{t-1} + G_t + \varepsilon_t^{\bar{Y}}$$

$$G_t = G_{t-1} + \varepsilon_t^{G}$$

where $\varepsilon_t^{\bar{Y}}$ and ε_t^{G} are shocks that have permanent effects on the level of potential output and its growth, respectively.

The annual real policy interest rate r_t is defined to be the difference between the nominal policy interest rate R_t and one-period-ahead (annualized) inflation expectations $E_t\pi_{t+1}$:

$$r_t = R_t - E_t\pi_{t+1}$$

where inflation π_t is annualized CPI inflation. The foreign interest rate r_t^f is similarly defined:

$$r_t^f = R_t^f - E_t\pi_{t+1}^f$$

where R_t^f is the foreign nominal interest rate and π_t^f is annualized foreign CPI inflation.

The log real exchange rate z_t evolves according to relative purchasing power parity:

$$\Delta z_t = \Delta s_t + \frac{1}{4}(\pi_t^f - \pi_t)$$

where s_t is the log nominal exchange rate.

The natural real policy interest rate r_t^*, the (log) trend of the real exchange rate z_t^*, and the inflation target π_t^* are assumed to follow stochastic processes:

$$r_t^* = \delta r_{t-1}^* + (1-\delta)(r_t^{f*} + c_t + 4\Delta E_t z_{t+1}^*) + \varepsilon_t^{r^*}$$

$$z_t^* = z_{t-1}^* + \varepsilon_t^{z^*}$$

$$\pi_t^* = \pi_{t-1}^* + \varepsilon_t^{\pi^*}$$

where the natural policy interest rate is a weighted average of its own lag and the trend policy interest rate implied by real Uncovered Interest Parity (UIP). r_t^{f*} is the foreign natural real interest rate and c_t is a country risk premium, where these trends follow random walk processes:

$$r_t^{f*} = r_{t-1}^{f*} + \varepsilon_t^{f*}$$

$$c_t = c_{t-1} + \varepsilon_t^{c}$$

The expectation for one-year-ahead annual inflation is:

$$E_t\pi_{t+4}^4 = \frac{1}{4}(E_t\pi_{t+1} + E_t\pi_{t+2} + E_t\pi_{t+3} + E_t\pi_{t+4})$$

Behavioral Equations

The output gap evolves according to a typical IS-type curve:

$$y_t = (1-\alpha_1)E_t y_{t+1} + \alpha_1 y_{t-1} - \alpha_2(r_t - r_t^*) + \alpha_3(z_t - z_t^*) + \varepsilon_t^y$$

where the output gap is positively related to its own expectation and its lag, negatively related to the real interest rate deviation from trend, and positively related to the real effective exchange rate deviation from trend (a positive real effective exchange rate gap reflects a depreciated currency relative to trend and stronger external demand). ε_t^y is a demand shock.

Similarly, inflation evolves according to a typical open-economy Phillips curve:

$$\pi_t = (1-\beta_1)E_t\pi_{t+1} + \beta_1\pi_{t-1} + \beta_2 y_t + \beta_3\Delta(z_t - z_t^*) + \beta_4(\pi_t^c - \pi_t^{c*} - (\pi_t - \pi_t^*)) + \varepsilon_t^\pi$$

where inflation is positively related to its own expectation and its lag, the output gap, the change in the real effective exchange rate gap, and annualized inflation in the domestic price of global commodities π_t^c relative to domestic inflation (where both inflation rates are expressed in deviations from trend). ε_t^π is a cost-push shock.

The nominal exchange rate evolves in line with UIP:

$$R_t = \Delta E_t s_{t+1} + R_t^f + c_t + \varepsilon_t^s$$

where R_t^f is the foreign nominal interest rate and ε_t^s is a shock representing temporary deviations from UIP.

The monetary policy rule is determined by either a standard inflation-targeting (IT) rule suitable for countries with inflation targets and flexible exchange rates and/or the nominal interest rate implied by UIP (likely suitable

for countries with pegged or managed exchange rates).

In the IT rule, the policy rate is a function of its own lag (smoothing), the central bank's response to movements of the output gap, and the deviation of the expected annual inflation rate one-year ahead from its target:

$$R_t^{IT} = (1-\gamma_1)\left(r_t^* + E_t\pi_{t+4}^4 + \gamma_2\left(E_t\pi_{t+4}^4 - \pi_t^*\right) + \gamma_3 y_t\right) + \gamma_1 R_{t-1}$$

For countries with pegged or managed exchange rates, the policy rate is assumed to be determined by UIP:

$$R_t^{UIP} = \Delta E_t s_{t+1} + R_t^f + c_t$$

To allow for the possibility that UIP fails to hold in the short term due to capital controls or other financial frictions, the policy rule for countries that do not target inflation is determined by estimating a weighting parameter ϕ in the hybrid rule below:

$$R_t = (1-\phi)R_t^{IT} + \phi\, R_t^{UIP} + \varepsilon_t^R$$

where ε_t^R is a monetary policy shock.

For simplicity, foreign inflation, global-commodity-price inflation $\pi^{f,c}$, and the foreign interest rate gaps are assumed to be zero-mean stationary processes:

$$\left(\pi_t^f - \pi^{f*}\right) = \tau\left(\pi_{t-1}^f - \pi^{f*}\right) + \varepsilon_t^{\pi f}$$

$$\left(\pi_t^{f,c} - \pi^{f,c}\right) = \phi\left(\pi_{t-1}^{f,c} - \pi^{f,c}\right) + \varepsilon_t^{\pi f,c}$$

$$\left(r_t^f - r_t^{f*}\right) = \rho\left(r_{t-1}^f - r_{t-1}^{f*}\right) + \varepsilon_t^{rf}$$

where the global inflation target is constant and equal to U.S. inflation target ($\pi^{f*} = 2$), and inflation in global commodity prices is assumed to have a zero mean ($\pi^{f,c} = 0$), close to its historical average.

Finally, inflation in the domestic price of global commodities is:

$$\pi_t^c = \pi_t^{f,c} + 4\Delta s_t$$

and its trend is:

$$\pi_t^{c*} = \pi^{f,c} + 4\Delta z_t^* - \pi_t^{f,*} + \pi_t^*$$

Estimation

The parameters and trends in the model above are estimated using quarterly data from 2000Q1 to 2022Q4 with the Kalman filter and Bayesian methods (estimation details available upon request). The observable variables used for each country are real GDP, CPI inflation, the policy interest rate, and the inflation target, where the inflation target is assumed to be the real-time 5-year-ahead inflation projection from WEO databases (see above for how this is derived). The foreign observable variables are US CPI inflation, the Fed funds rate, the US natural real policy interest rate (based on the most recent estimates from Holston, Laubach, and Williams 2017), and IMF estimates of global commodity price inflation. The observed real exchange rate is each country's bilateral exchange rate against the US dollar. Quarterly growth and inflation data are missing for some (or all) of the sample period for some countries. These missing data are replaced with quarterly interpolated data from the latest WEO database (see above for the interpolation procedure).

Results

Estimates of the natural real policy rate and 95 percent confidence intervals are displayed below (Figure A2.1), along with estimates for natural nominal interest rates (real natural rate estimates plus inflation target estimates) (Figure A2.2) and output gaps (Figure A2.3).

Figure A2.1 Real Rates

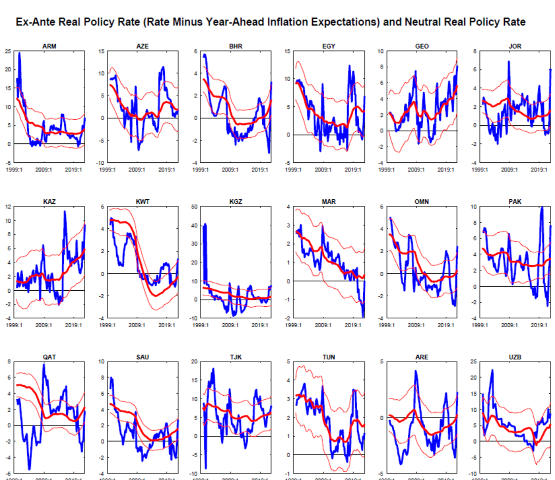


Figure A2.2 Nominal Rates

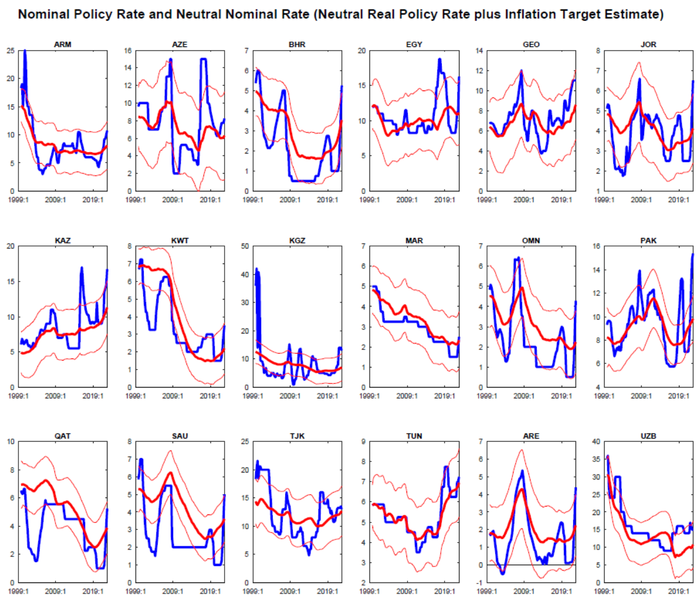
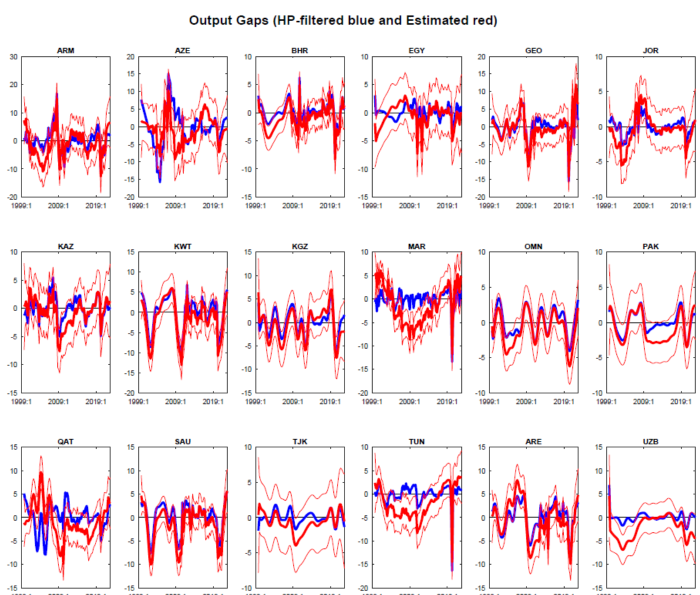


Figure A2.3 Output Gaps



Estimates from TVP-VAR

To complement the structural model, a time-varying parameters VAR model with stochastic volatility is used to estimate natural rates country-by-country following the methodology of Lubik and Matthes (2015). This approach is entirely data-driven. The estimated model is a VAR(1) with four endogenous variables: GDP growth, inflation, the real interest rate, and the real exchange rate. Estimation uses Bayesian techniques and Gibbs sampling. Finally, the natural rate of interest is defined as the five-year ahead forecast from the VAR.

Annex 3. Results from the Estimation of Monetary Policy Rules

Monetary and Exchange Rate Frameworks in ME&CA

About 50 percent of countries in ME&CA maintain de facto an exchange rate anchor. Only four countries in CCA (Armenia, Georgia, Kazakhstan, Uzbekistan) explicitly target inflation within their monetary framework—only three also have a free-floating exchange rate. Some other countries, particularly low-income countries, conduct monetary policy using monetary aggregates as their main targets (Afghanistan, Algeria, Tajikistan, and Yemen; however, we do not have output and price data at quarterly frequencies for these countries). The remaining ME&CA countries have other monetary frameworks, often paired with flexible exchange rate anchors (Table A3.1). Monetary and exchange rate frameworks have evolved over time, with some countries in the region transitioning toward more exchange rate flexibility and, in some cases, inflation targeting (Egypt).

Table A3.1 Monetary and Exchange Rate Frameworks in ME&CA

	Monetary framework						
	Exchange rate anchor				Monetary aggregate targ	Inflation Targeting framewo	Other
Exchange rate arrangement	**USD**	**EUR**	**Composite**	**Other**			
Currency board	Djibouti						
Conventional peg	**Iraq** **Jordan** **Oman** **Qatar** **Bahrain** **Saudi Arabia** Iran Turkmenistan **UAE**		Libya				
Stabilized arrangement	**Lebanon**				**Algeria** **Tajikistan**		Azerbaijan **Egypt** Sudan
Crawl-like arrangement					Afghanistan	**Uzbekistan**	**Mauritania** **Tunisia**
Pegged exchange rate within horizontal bands			**Morocco**				
Other managed arrangement				**Kuwait** Syria			
Floating					Yemen	**Georgia** **Armenia** **Kazakhstan**	Pakistan
Free floating							Somalia

Source: AREAER 2021.
Notes: All data refers to 2020. Countries for which enough quarterly observations are available for the empirical exercise in this annex are shown in bold.

Taylor Rules

The policy rules commonly referred to as Taylor rules are simple reactive rules that adjust the policy interest rate instrument in response to developments in both inflation and economic activity. By linking interest rate decisions directly to inflation and economic activity, Taylor rules offer a convenient tool for studying monetary policy while abstracting from a detailed analysis of the demand and supply of money (Clarida, Gali, and Gertler 1999). This allowed the development of simpler models and the replacement of the LM curve with a Taylor rule in treatments of the Hicksian IS-LM apparatus. Subsequent research (see Orphanides 2003) suggested that a generalized form of Taylor's classic rule could provide a useful common basis both for econometric policy evaluation across diverse families of models and for historical monetary policy analysis over a broad range of experience:

$$i_t^{TR} = \rho i_{t-1} + (1-\rho)\left(i^* + \varphi_\pi(E_t[\pi_{t+k}] - \pi^*) + \varphi_y \tilde{y}_t\right) \quad (1)$$

This generalized forward-looking Taylor rule allows us to model the policy response to the level of the output gap as a percentage of potential output $(\tilde{y}_t)$, the deviation of the expected inflation rate from its target, and the long-run equilibrium rate i^*. The introduction of an inertial behavior in setting interest rates ($\rho > 0$) is relevant for possible smoothing of interest rate changes.

The estimation of a Taylor rule like that represented in equation (1) requires the characterization of the natural level of interest rates, the inflation target, and the potential output for the estimation of the output gap. Considering equation (1) in differences and approximating the change in output gap with the growth rate, we have:

$$\Delta i_t^{TR} = \rho \Delta i_{t-1} + (1-\rho)\big(\varphi_\pi (E_t[\Delta \pi_{t+k}]) + \varphi_y g_\pi\big) \quad (2)$$

Equation (3) is easier to estimate than its corresponding equation in levels as it does not contain unobservable and hard-to-measure variables such as the output gap and the natural level of interest rates.

Uncovered Interest Rate Parity (UIP) Rules

Although there is no textbook formula for monetary policy reaction functions under an exchange rate anchor, under capital mobility and perfect substitutability of domestic and foreign assets, no-arbitrage condition requires the uncover interest party (UIP) condition to hold. This relationship links interest rates in the domestic and foreign country as follow:

$$(1 + i^{UIP}) = \frac{E_t(S_{t+k})}{S_t}(1 + i^f) \quad (3)$$

Where $E_t(S_{t+k})$ is the expected future spot exchange rate at time t+k, S_t is the spot exchange rate and i^d and i^f are the domestic and foreign interest rate. Taking logs, equation (3) can be approximated as:

$$i^{UIP} \approx \frac{\Delta E_t(S_{t+k})}{S_t} + i^f \quad (4)$$

Maintaining an exchange rate peg implies that $\frac{\Delta E_t(S_{t+k})}{S_t} = 0$, which yields the familiar pegger condition stating that the home interest rate equals the foreign interest. If home and foreign assets have different risk profile, condition (4) can be augmented by a risk premium. In first differences the UIP for traditional peggers implies:

$$\Delta i^{UIP} = \Delta i^f \quad (5)$$

Most ME&CA countries with controlled exchange rate regimes use the US dollar as an anchor (except for Morocco[2] and Libya). In this case, changes in domestic interest rates should be proportional to the corresponding change in the interest rates of the corresponding basket.

Estimating Monetary Policy Rules for ME&CA

The macroeconomics literature frequently summarizes a central bank's reaction function with an interest rate rule, such as the ones introduced by Taylor (1993, 1999). Such policy rules have been used to describe how the monetary authority adjusts its policy instrument (typically a short-term interest rate) in response to deviations of inflation or economic conditions (output or unemployment, for example) from their objectives. Monetary policy rules, such as the one proposed by Taylor, are relevant in countries where monetary policy frameworks are set to respond to inflation or real economic

[2] Morocco targets a currency basket that comprises the US dollar (60 percent of weight) and the Euro (40 percent).

developments. On the other hand, in countries adopting traditional pegs, policy interest rates are required to adjust following changes in interest rates on foreign assets.

A generic interest rate rule in first differences that could be relevant for both conventional peggers and other exchange rate regimes can take the following form:

$$\Delta i_t = \rho \Delta i_{t-1} + (1-\rho)(\theta \Delta i_t{}^{TR} + (1-\theta)\Delta i_t{}^{UIP}) \quad (5)$$

where i^{TR} is the interest rate implied by the Taylor rule and i^{UIP} is the interest rate implied by the UIP condition. Considering an equation in first differences allows removing estimates for the output gap and the natural level of interest rates from the Taylor-rule component of the equation. In countries with free floating exchange rates θ will be 1, in countries with conventional pegs θ will be zero, and for all other exchange rate regimes, θ will be between 0 and 1. The a priori choice of an appropriate model for describing policy interest rates for countries in ME&CA is however not trivial as most countries in the region have in place some sort of controlled exchange rate arrangement in place.

For each country in ME&CA for which relevant quarterly series are available,[3] we estimate a generic model for the policy interest rates, comprising a Taylor's rule component, relevant for countries with inflation targeting frameworks and a relatively flexible exchange rate policy, and an uncovered interest rate parity (UIP) component, relevant for conventional peggers. The objective is to identify simple reactive interest rate rules that would deliver a satisfactory representation of past monetary policy reactions for ME&CA countries. To do so for each country we estimate a number of competing models that are then compared using information reported in Table A3.1. To choose the best model for each country starting from the generic representation in (5), we use a Bayesian approach based on computing and comparing model posterior probabilities given observed data.[4] The optimal models selected on the basis of posterior probabilities for each country are shown in Table A3.2.[5]

Table A3.2 Monetary Policy Rules Maximizing Posterior Probabilities

Framework	Country	Rule components			Model fitting (R-squared) when using different proxies for inflation expectations (the model chosen for estimation is the one with highest fit)			
		Inertia	Taylor Rule	UIP	Models without inflation	Adaptive expectations	Perfect foresight	4-quarter-ahead IMF forecast
Infaltion Target	Armenia	x	x			**0.40**	0.30	0.21
	Georgia	x	x			0.38	**0.41**	0.30
	Kazakhstan	x	x			0.06	**0.26**	0.05
Exchange rate anchor	Iraq	x		x	**0.37**			
	Jordan	x		x	**0.28**			
	Oman			x	**0.58**			
	Qatar			x	**0.24**			
	Bahrain	x		x	**0.66**			
	Saudi Arabia	x		x	**0.50**			
	Marocco		x	x		0.50	0.5	**0.51**
	Kuwait	x		x	**0.45**			
Other Framework	Egypt		x	x		0.37	0.34	**0.63**
	Tunisia		x	x		**0.25**	0.24	0.24

Notes: For each country, the column under "rule component" identifies the specification that appears to best fit the data. Given this specification, the functional form for inflation expectations is chosen on the basis of the highest R-square (figures in bold in the right-hand side of the table above).

[3] Armenia, Bahrain, Egypt, Georgia, Iraq, Jordan, Kazakhstan, Kuwait, Morocco, Oman, Qatar, Saudi Arabia, and Tunisia.

[4] We estimate four models for each country. For countries with a conventional peg, these are the UIP rule and the UIP rule nested with a Taylor rule, for both models, with and without inertia. For countries with other exchange regime framework these are a Taylor rule and a Taylor rule nested with a UIP rule, in both cases with and without inertia. Each model is estimated in isolation in a Bayesian framework. For each model, posterior probabilities are then computed and compared across models. Prior probabilities of each model are given using the information in Table A3.1. For countries adopting a conventional peg exchange regime framework (Bahrain, Iraq, Jordan, Morocco, Oman, Qatar, Saudi Arabia), the probability assigned to a simple UIP rule is double that assigned to other models. For countries with a flexible exchange rate and inflation targeting (Armenia, Georgia, Kazakhstan), the probability assigned to a simple Taylor-type monetary policy rule is double that assigned to other models. The best model is then chosen on the basis of the posterior likelihood of considered models given observed data.

[5] After the identification of the model best representing central banks' reaction functions, for equations including inflation, the choice of an adequate proxy for inflation expectations is made on the basis of the coefficient of determination (R-squared) for each single model, choosing among three different forecasting frameworks: (1) random walk (adaptive expectations), (2) perfect foresight; and (3) using interpolated 1-year-ahead IMF inflation forecasts.

Estimating External Benchmarks

External monetary policy reaction benchmarks are estimated in a panel setting for a subset of five Latin American countries that historically have been considered relatively successful in controlling inflation.[6] Estimations are performed using equation (3) adapted in a panel setting as a benchmark for ME&CA inflation targeters and using the corresponding panel model of equation (5) for the ME&CA countries with other monetary policy framework. Interest rate benchmarks are then constructed by projecting each individual ME&CA country's rule regressors (inflation, growth, and so on) using coefficients estimated for the set of comparison countries.

[6] Such an exercise is subject to several caveats that we should consider when interpreting the results. First, short-term rates may be only one of the instruments used by central banks to tighten monetary conditions. Thus, changes in policy rates may represent only a partial representation of the actual tightening. Second, benchmarking actual tightening with an estimated monetary policy rule does not necessarily indicate whether the recent actions of the monetary policy authority can be interpreted as adequate. To the extent the model fits the data well, estimated monetary policy rules simply describe central banks' past responses to prices and economic dynamics. Finally, any cross-country comparison may be faulted by the fact that each country has specificities that require a different response to inflation and output gap, even for the achievement of a similar target of price stability.

Annex 4. A Financial Conditions Index for ME&CA

The financial conditions index (FCI) is constructed by extracting the common source of variation for a set of financial indicators, as represented by the principal component (PC), computed using monthly data. PCs are commonly used in explanatory analysis to reduce the dimensionality of many variables while preserving data variation. PCs represent the eigenvector of the data variance-covariance matrix. Therefore, from a computational standpoint, they can be extracted via the eigen decomposition of the correlation matrix or a singular value decomposition of the data matrix. The first principal component can equivalently be defined as a direction that maximizes the variance of the projected data. We interpret this first principal component as a proxy for financial conditions. The first principal component v_1 can be derived as:

$$v_1 = argmax\left(\frac{v^T X^T X v}{v^T v}\right)$$

Where X is the (column-wise zero empirical mean) indicator matrix. The mathematical derivation comes from a standard result for a positive semidefinite matrix such as $X^T X$ so that the quotient's maximum possible value is the largest eigenvalue of the matrix, having the corresponding eigenvector in *v*.

The full set of indicators used for the analysis are listed in Table A4.1.

Table A4.1. FCI Variables

Interest Rates		
polrate	Policy rate	Level, percent
st_rate	Short-term interest rate	Level, percent
fitb	Government treasury bills rate	Level, percent
figb	Government treasury bonds rate	Level, percent
filr	Lending rate	Level, percent
fidr	Deposit rate	Level, percent
Monetary Aggregates		
mon_base	Monetary base, % of GDP	YoY percent change
br_mon	Broad money, % of GDP	YoY percent change
Domestic Risk Premia		
cds	CDS spread (5Y, USD)	Level, basis points
Credit		
psc	Private sector credit, percent of GDP	YoY percent change
csc	Corporate sector credit, percent of GDP	YoY percent change
hsc	Household sector credit, percent of GDP	YoY percent change
Stock and Bond Markets		
eq_pr	Equity index	MoM percent change
eq_vol	Equity volume	MoM percent change
eq_pb	Equity price to book ratio	Level, ratio
embig	EMBIG spread	Level, basis points
cembi	CEMBI spread	Level, basis points
Exchange Rates		
neer	NEER	MoM percent change
xrate	Exchange rate, NC per USD, avg	MoM percent change

External Factors		
msci_em	MSCI EM equity index	MoM percent change
msci_em_pb	MSCI EM, price-to-book ratio	Level, ratio
vix	CBOE Market Volatility Index VIX	MoM percent change
oil_pr	Oil price	MoM percent change
ffr	Federal Funds Rate	Level, percent

Table A4.2 shows the corresponding factor loadings for each country. These loadings reveal the signs and magnitudes of variables included in the index. An increase in the FCI signals financial tightening, while a decrease signals easing. A positive sign for factor loadings indicates a positive correlation with the FCI. Indicators whose factor loading is not consistent with the following priors are dropped: an increase in interest rates and an increase in risk premia are expected to tighten financial conditions (positive factor loading); an increase in the monetary base, an increase in credit and domestic stock and bond markets indexes are expected to loosen financial conditions (negative sign).

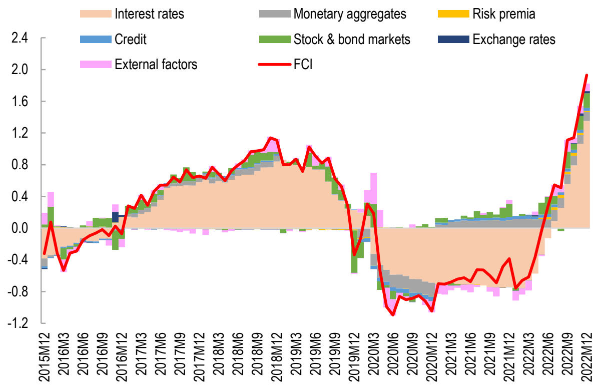
Table A4.2. FCI Variables Loadings

Variable	ARM	EGY	GEO	JOR	KAZ	KGZ	KWT	MAR	OMN	PAK	QAT	SAU	TUN	UZB
Variance captured by PC1	31.13	39.56	34.15	36.03	38.00	27.52	33.62	39.95	30.73	42.16	33.24	29.86	30.97	33.78
VARIABLES LOADINGS IN PC1														
Interest Rates														
polrate	0.470	0.482	0.345	0.452	0.537	0.382	0.446	0.546	0.451	0.348	0.418	0.578	0.486	0.492
st_rate	0.396	0.464	0.324	0.434	0.506	0.407	0.420	0.542	0.583	0.348	0.521	0.622	0.495	0.476
fitb	…	…	0.290	…	…	…	…	…	…	…	…	…	…	…
figb	0.400	…	…	…	…	0.365	…	…	…	0.346	…	…	…	…
filr	0.292	0.448	0.188	0.365	…	0.261	0.406	…	…	0.345	0.555	…	…	0.499
fidr	0.349	0.491	0.311	0.306	…	0.093	0.399	0.519	0.455	0.345	0.485	…	…	0.267
Monetary Aggregates														
mon_base	-0.209	…	-0.352	-0.373	…	-0.407	-0.162	-0.259	…	-0.252	…	-0.194	…	-0.238
br_mon	-0.233	…	-0.361	-0.375	…	-0.396	-0.217	…	…	-0.265	…	…	…	-0.182
Domestic Risk Premia														
cds	…	…	…	…	0.550	…	…	0.232	…	0.218	…	…	0.360	…
Credit														
psc	…	…	…	-0.201	…	…	…	…	-0.268	…	…	…	-0.354	…
csc	-0.200	…	-0.309	…	…	-0.036	-0.093	…	…	-0.072	-0.084	…	…	…
hsc	-0.196	…	-0.343	…	-0.260	-0.327	-0.179	…	…	-0.194	-0.057	…	…	…
Stock & Bond Markets														
eq_pr	…	…	…	-0.150	…	…	…	…	…	-0.092	…	-0.308	-0.100	…
eq_vol	…	…	…	-0.085	…	…	…	…	…	-0.090	…	-0.171	-0.138	…
eq_pb	…	…	…	…	-0.259	…	…	…	…	-0.298	…	…	…	…
embig	…	…	…	…	…	…	-0.290	…	-0.305	…	…	-0.237	…	…
cembi	…	-0.220	…	…	…	…	-0.317	…	-0.281	…	…	…	…	…
Exchange Rates														
neer	0.126	…	0.241	…	…	0.112	…	…	…	…	…	…	0.103	0.050
xrate	…	0.070	…	…	0.115	…	…	…	…	0.115	…	…	…	…
External Factors														
msci_em	-0.135	-0.017	-0.043	-0.065	…	-0.179	…	-0.030	…	-0.087	…	…	-0.125	-0.021
msci_em_pb	-0.209	-0.212	0.164	-0.162	…	-0.058	…	0.129	…	-0.015	…	…	-0.178	0.199
vix	-0.014	0.015	-0.019	-0.003	-0.058	0.027	0.040	-0.008	0.063	0.050	0.004	…	0.083	0.052
oil_pr	…	…	…	…	-0.043	…	-0.002	…	-0.043	…	-0.011	-0.248	…	…
ffr	…	0.105	0.069	…	…	…	…	…	…	0.218	…	…	0.412	0.275

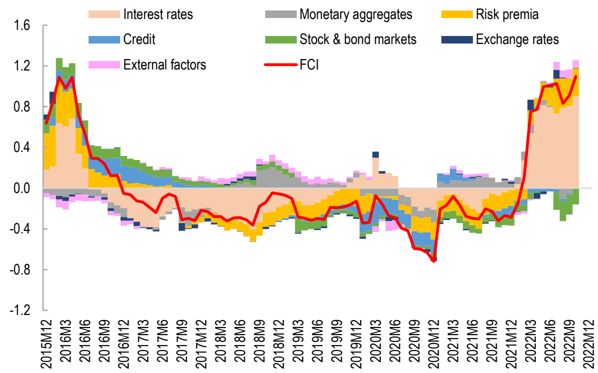
FCI Results

The country sample includes 14 countries (Armenia, Egypt, Georgia, Jordan, Kazakhstan, the Kyrgyz Republic, Kuwait, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, Tunisia, and Uzbekistan). For each country we use all available indicators from the list below. The time horizon is defined as the one identified by the indicator with the shortest time dimension. The regional FCIs are weighted by purchasing power parity GDP.

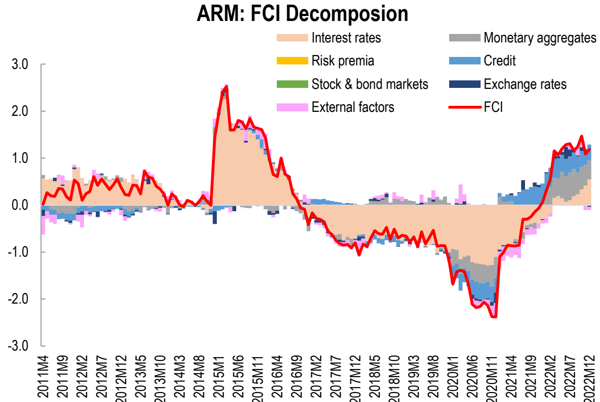
MENA: FCI Decomposion



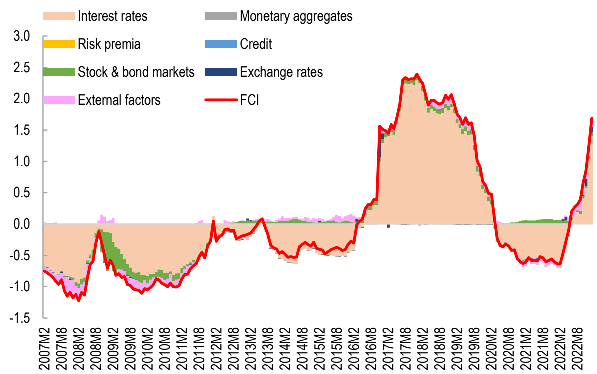
CCA: FCI Decomposion



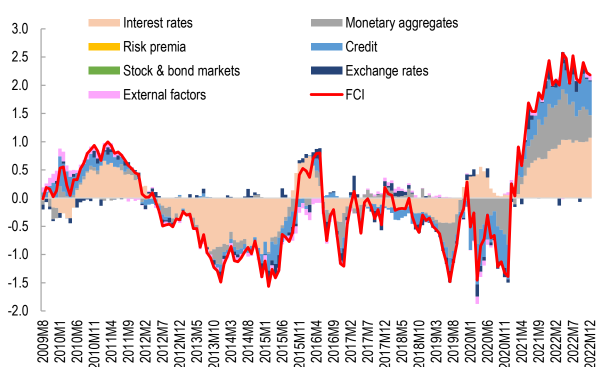
ARM: FCI Decomposion



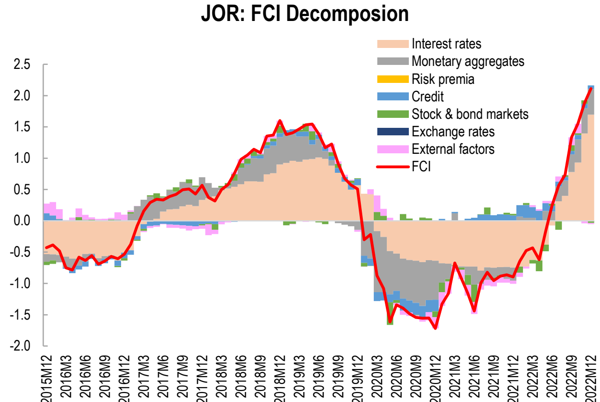
EGY: FCI Decomposion



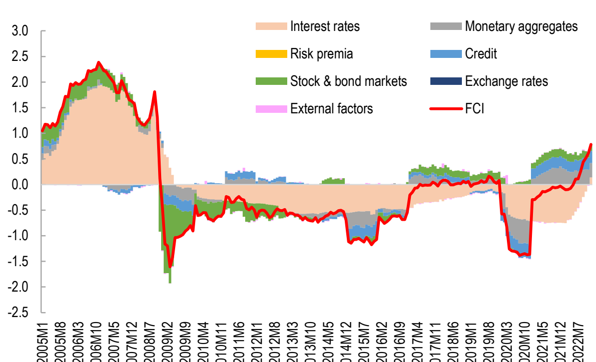
GEO: FCI Decomposion



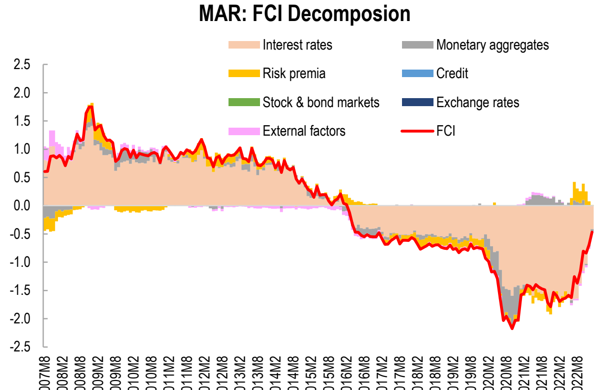
JOR: FCI Decomposion



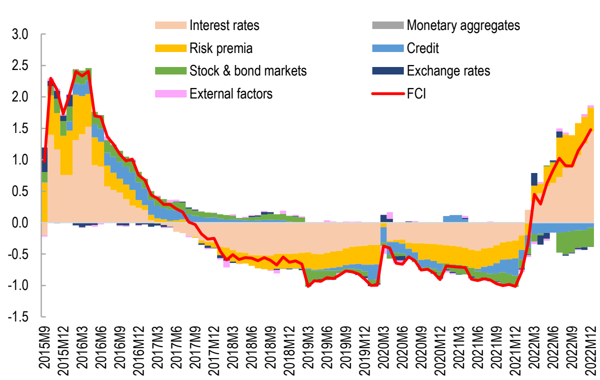
KWT: FCI Decomposion



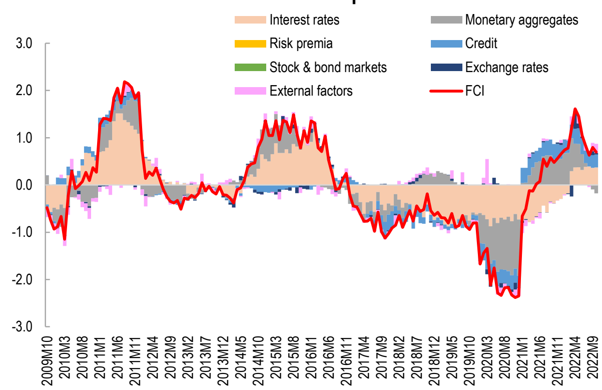
MAR: FCI Decomposion



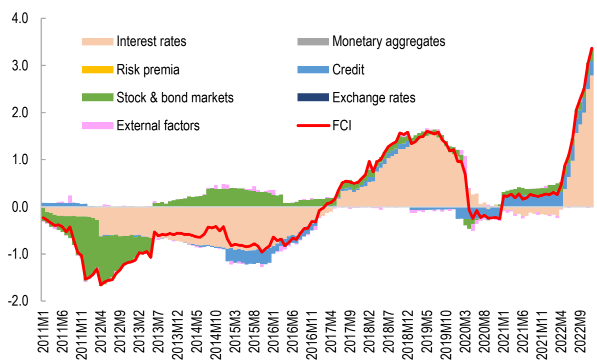
KAZ: FCI Decomposion



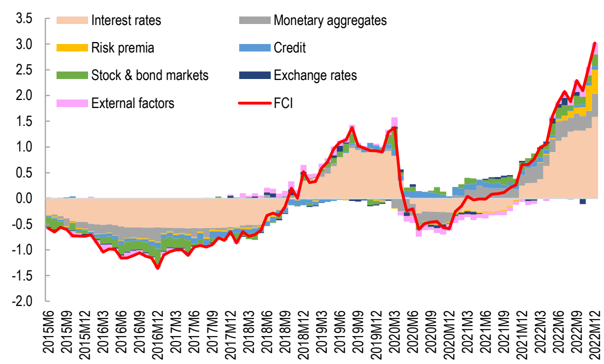
KGZ: FCI Decomposion



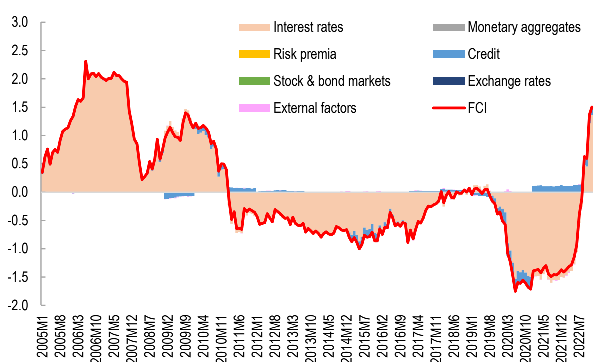
OMN: FCI Decomposion



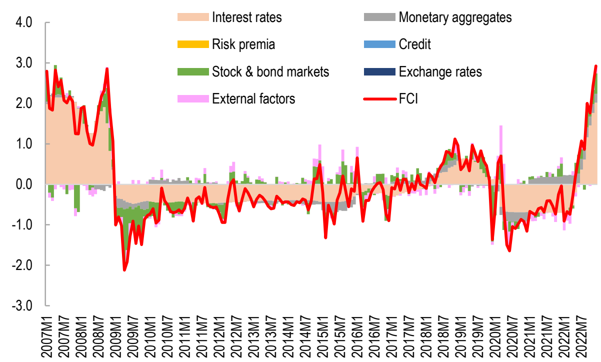
PAK: FCI Decomposion



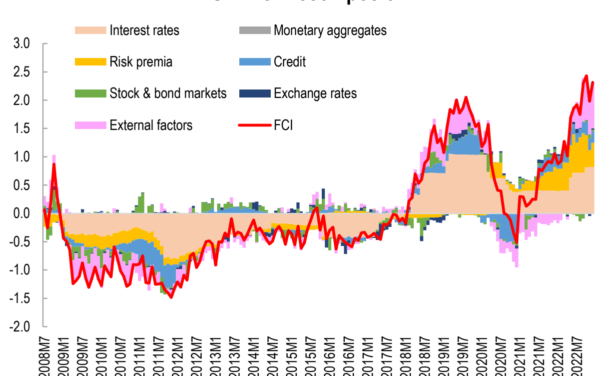
QAT: FCI Decomposion



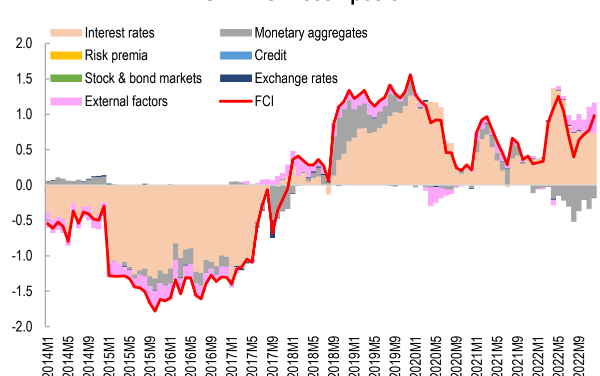
SAU: FCI Decomposion



TUN: FCI Decomposion



UZB: FCI Decomposion



Annex 5. Assessing the Role of the Exchange Rate Channel in Monetary Transmission in Selected ME&CA Countries: Evidence from Local Projections

This empirical analysis assesses the transmission of monetary policy to economic activity and prices in a sample of ME&CA countries using Jordà's (2005) local projection method. In particular, we attempt to uncover any significant role that the exchange rate channel may be playing in monetary policy transmission in the region. The sample selection is, therefore, primarily dictated by the type of exchange rate regime adopted by the country. Specifically, we focus on countries with either a floating exchange rate or a managed float regime. Data availability also limits our sample to seven countries—Armenia, Azerbaijan, Georgia, Kazakhstan (all from the CCA region), Egypt, Tunisia (MENA countries), and Pakistan.

We use the monetary policy shocks identified in Annex 2 and quarterly data interpolated from annual data (also, see annex 2) to estimate the responses of output and inflation to monetary policy using Jordà's local projections method. The local projections method estimates the response of macroeconomic variables to properly identified policy shocks. We follow Brandao-Marques and others (2020) and specify the following regression model for output and inflation. The model is estimated separately for each country in our sample.

$$\Delta y_{t+h} = \gamma^h \hat{\varepsilon}_t + \delta^h \Delta neer_t * \hat{\varepsilon}_t + \sum_{j=1}^{2} \beta_{1j}^h Z_{t-j} + \sum_{j=1}^{2} \beta_{2j}^h i_{t-j} + x_{it}\theta^h + \omega_t^h \qquad (1)$$

where $\hat{\varepsilon}$ is the estimated country-specific policy shock, the vector Z contains contemporaneous and lagged values for Δy, π, and NEER, which are the quarter-over-quarter real GDP growth, quarter-over-quarter inflation, and the log of the nominal effective exchange rate, respectively, and i is the central bank policy rate. The vector x comprises global and country-specific controls, including the CBOE volatility index (VIX), a commodity price index, the first principle component of shadow policy rates for the United States, euro area, and Japan, and country-level monthly temperature and precipitation anomalies. The above regression model is estimated separately for each horizon (h) up to 12 horizons. We estimate a similar equation for the quarter-over-quarter inflation rate to derive the impulse response function for inflation.

To reflect that all countries in our sample have some degree of flexibility in their exchange rates, we also interact the monetary policy shock with the contemporaneous change in the exchange rate. This interaction allows us to account for the exchange rate channel in the transmission of monetary policy to output and inflation. In (1), the coefficient associated with the monetary policy shock (γ^h) is the response of output (or inflation) when the exchange rate channel is shut down, and ($\gamma^h + \sigma\delta^h$) is the total output (or inflation) response when we also consider the role that exchange rates may potentially play in amplifying the effect of monetary policy shocks. For the latter, we assume that a one standard-deviation change in the NEER (σ) occurs simultaneously with the policy/interest rate shock.

Impulse response functions of inflation suggest that the exchange rate channel plays an amplifying role in the transmission of monetary policy to inflation in several countries of the region, in particular Armenia, Azerbaijan, Georgia, Kazakhstan, Pakistan, and Tunisia (Table A5.1). In these countries, the decline in inflation following a contractionary 100 basis point shock to monetary policy is statistically significant and larger when the exchange rate channel is at work than when it is not. In Egypt, we observe a puzzling inflation response. The peak inflation response is also typically reached sooner when the exchange rate channel is at work than when it is not, suggesting that besides amplifying the magnitude of the response of inflation to monetary policy tightening, the exchange rate channel also plays a role in shortening transmission lags.[7]

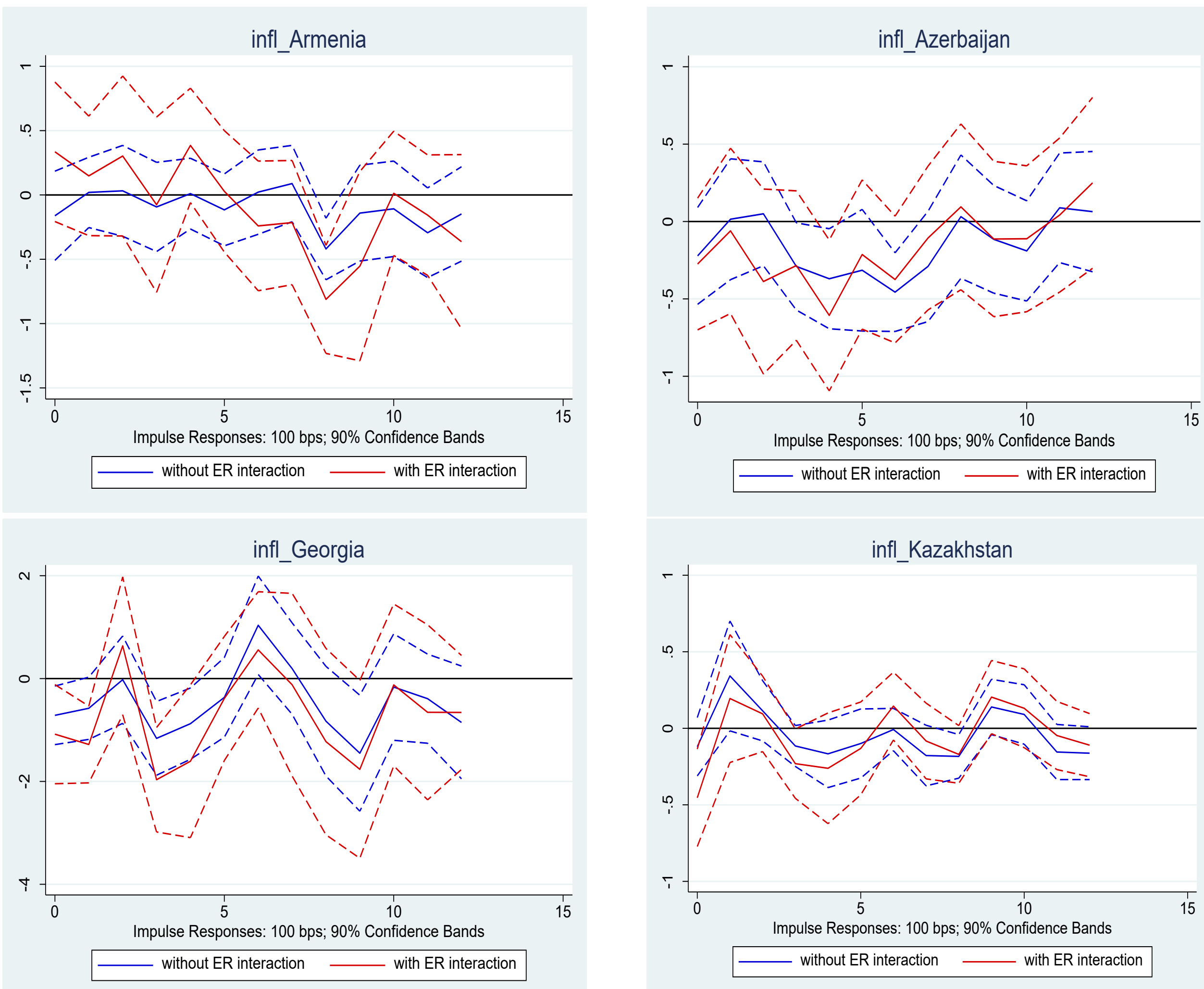
[7] It is, however, worth caveating these results and their interpretation. Impulse response functions look erratic for some countries, potentially due to the change in the exchange rate regime (pivoting between fixed, crawl, and floating) that some countries underwent over the sample period, which could be a confounding factor in the estimations.

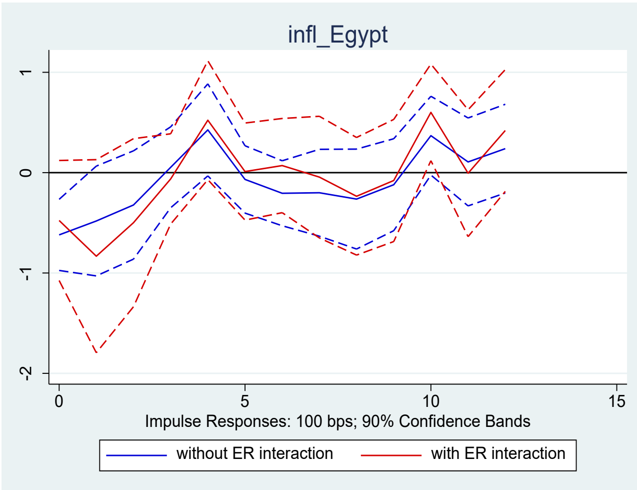
Table A5.1. Peak Impulse Responses of Inflation to a 100-basis point Contractionary Monetary Policy Shock: Magnitude and Lags

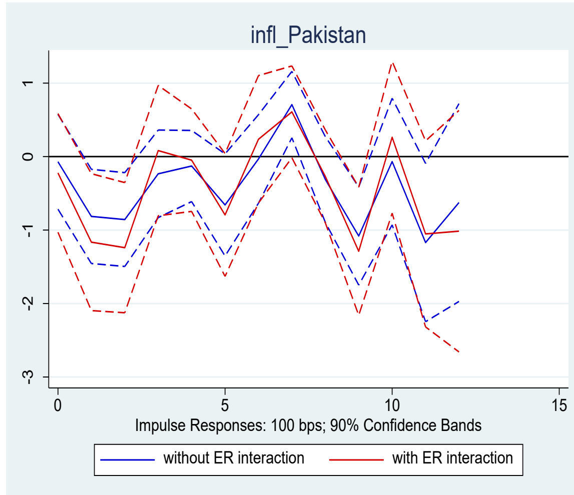
	Peak Inflation Response (in percentage points)		**Peak Quarter:** (quarters)	
Country	**Without ER channel**	**With ER channel**	**Without ER channel**	**With ER channel**
ARM	-0.4198826	-0.8116792	8	8
AZE	-0.4562494	-0.6066163	6	4
GEO	-1.451177	-1.966509	9	3
KAZ	-0.1832229	-0.2308704	8	3
PAK	-1.170059	-1.288628	11	9
TUN	-0.4990366	-0.623455	1	1
MEDIAN	**-0.477643**	**-0.7175671**	**8**	**3.5**

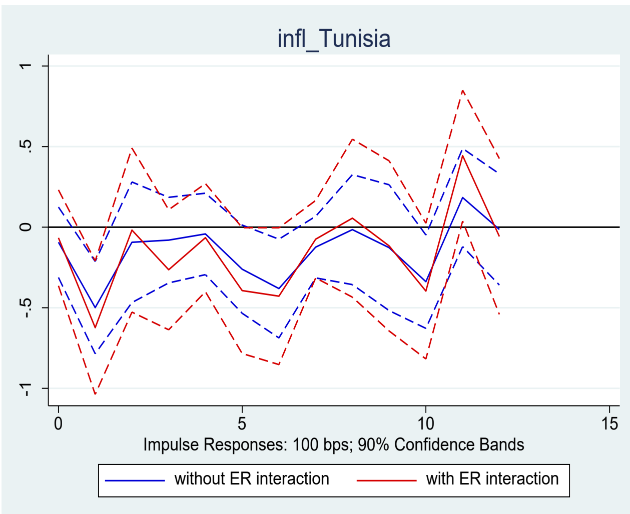
Note: This table reports the peak negative response of inflation and the quarter in which it occurs when the exchange rate channel is at work and when it is not. Statistics reported in this table are also reported in Figure 2.9 of Chapter 2.

Figure A5.1 Impulse Response Functions of Inflation to a 100-basis point Contractionary Monetary Policy Shock




infl_Egypt
1
0
-1
-2
0
5
10
15
Impulse Responses: 100 bps; 90% Confidence Bands
without ER interaction
with ER interaction


infl_Pakistan
1
0
-1
-2
-3
0
5
10
15
Impulse Responses: 100 bps; 90% Confidence Bands
without ER interaction
with ER interaction


infl_Tunisia
1
.5
0
-.5
-1
0
5
10
15
Impulse Responses: 100 bps; 90% Confidence Bands
without ER interaction
with ER interaction

Annex 6. Monetary Policy Transmission Mechanism through the Banking System across ME&CA: Effectiveness of Instruments and Lags in Transmission

Sample and Data

The data consists of quarterly bank balance sheet and income statement data for 2010–22. We remove LICs, FCS, and countries with poor data coverage. The final sample consists of 234 unique banks across 15 countries in the region. For the main analysis, we group countries into conventional peggers, managed peggers, and floaters based on the 2021 AREAER classification. There are eight peggers: AZE, BHR, JOR, KWT, OMN, QAT, SAU, UAE. EGY, MAR and TUN are classified as managed peggers.[8] The set of floaters consists of four economies: ARM, GEO, KAZ, PAK.

We consider three main outcome variables: banks' asset rate, liability rate, and real credit growth. The asset rate is defined as gross interest income divided by total earning assets (earning assets are largely loans and securities). The liability rate is defined as total interest expenses divided by total funding (funding consists primarily of deposits but also includes longer-term funding). Real credit growth is the log difference in real credit, where real credit is measured as gross loans divided by the inflation index.

Methodology

We estimate local projections at the quarterly level for 0 up to 12 quarters ahead.

Baseline

$$\Delta y_{i,t+h} = \alpha_i + \alpha_q + \beta \Delta IR_t + \gamma X_{it} + \delta W_t + \varepsilon_{it}$$

α_i indexes bank fixed effects, α_q are quarter fixed effects that remove seasonality. X_{it} are a set of bank-level controls. In the baseline, we control for size (log total assets), liquid asset holdings and leverage. Robustness checks with further controls such as NPL ratios or the ratio of securities holdings to total assets have also been conducted. W_t are macro controls. For peggers, we include GDP growth, inflation, VIX, and the oil price. For floaters, we additionally control for the change in the NEER.

As the dependent variable, we use the $\Delta y_{i,t+h} = y_{i,t+h} - y_{i,t}$ Thus, the coefficient β at horizon h captures the cumulative impulse response of the dependent variable at horizon h. For the sake of legibility, we did not include the superscript h for regressions coefficient in the above equation.

Finally, the main right-hand side variable of interest is ΔIR_t , the change in the interest rate. For the peggers, our baseline results use the first difference of the change in the Wu-Xia (2016) shadow rate. For the managed peggers and floaters, we follow the approach of Romer and Romer (2004) and its adaptation to emerging market economies by Brandao-Marques and others (2020) and follow a two-step procedure. In the first step, we regress changes in the policy rate on contemporaneous and lagged values of GDP, inflation, and the NEER, as well as projections for GDP and inflation, country by country. The monetary policy shock are the residuals from this first-stage regression and thus captures the unanticipated component of domestic monetary policy.

Double Interaction

$$\Delta y_{i,t+h} = \alpha_i + \alpha_q + \beta_1 \Delta IR_t Z_{it} + \beta_2 \Delta IR_t + \beta_3 Z_{it} + \gamma X_{it} + \delta W_t + \varepsilon_{it}$$

To further test for the determinants of interest rate and credit pass-through into ME&CA economies, we estimate regressions with a double interaction term $\Delta IR_t Z_{it}$. Z_{it} are either macro characteristics, for example, the oil price, or

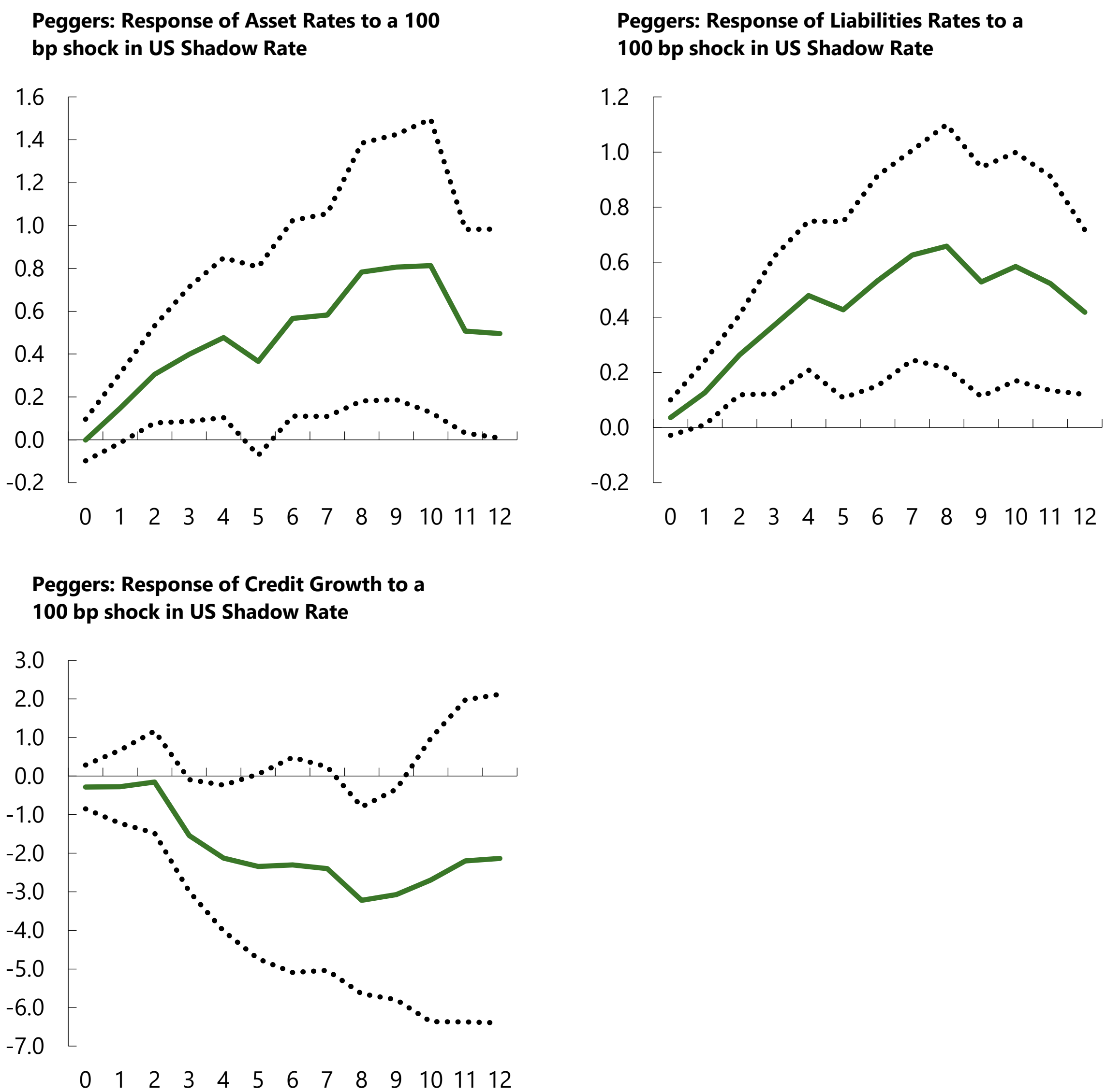
[8] Egypt has since then de jure adopted a floating exchange rate arrangement.

bank-level characteristics such as market share or a dummy for government ownership. All other variables are the same as for the baseline regressions.

Impulse Responses for Peggers

In the following, all figures display coefficient estimates with their respective 95 percent confidence bands.

Figure A6.1 Monetary Policy Pass-through in Peggers

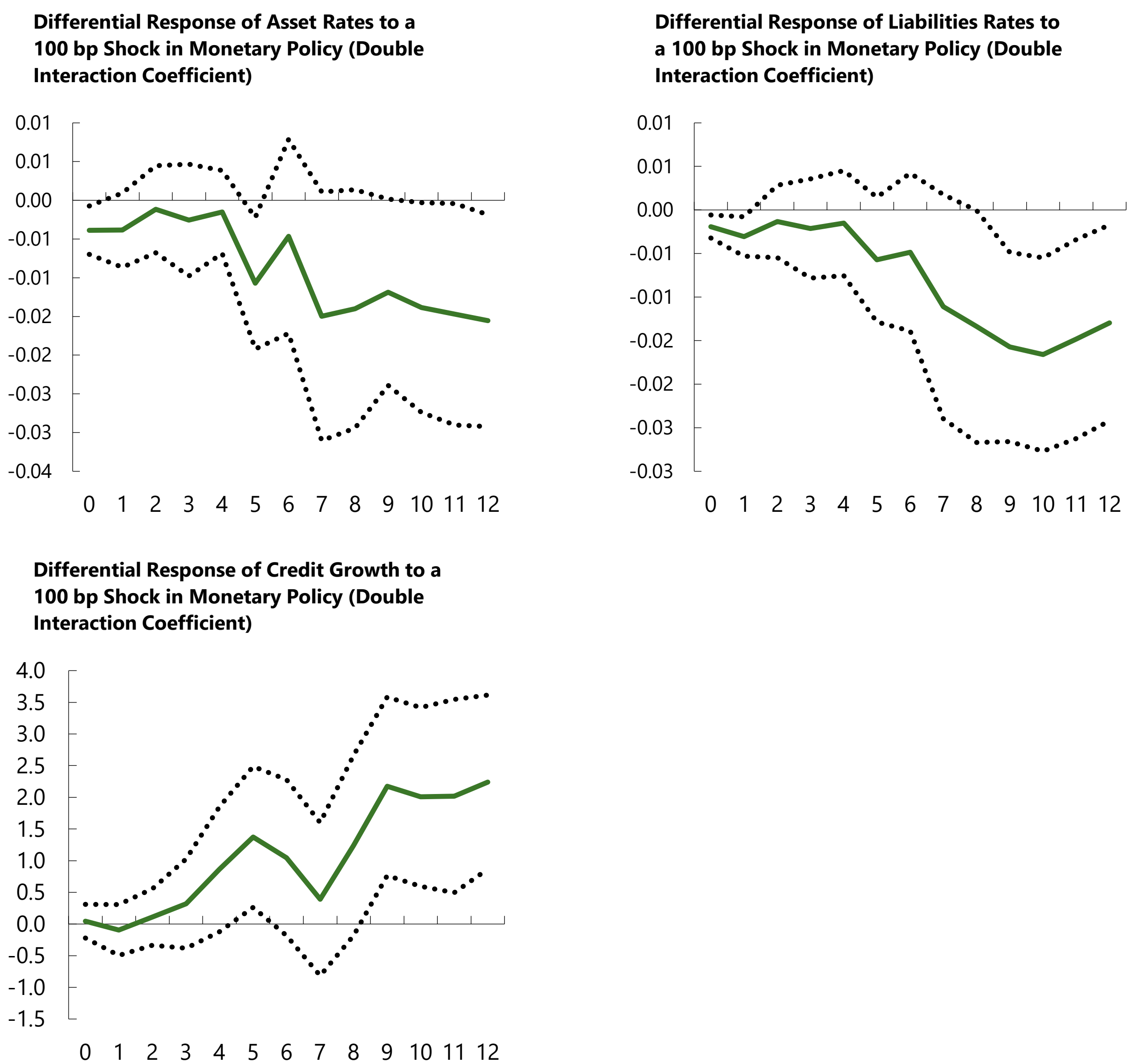


Double Interaction Coefficients for Oil Exporters – Oil Price

The following plots show the coefficient on the interaction of the interest rate shock with the oil price for oil exporters with a pegged exchange rate. The interpretation is the following. In the pricing regressions, a negative coefficient implies that at a higher level of the oil price, pass-through into asset and liability rates is lower. Concretely, we show the response to a 100-bps monetary shock for a $10 difference in the oil price. The estimated coefficients imply both for the asset and for the liability rate that a 100-bps tightening has a 15-bps weaker pass-through into asset and deposit rates when the oil price is $10 higher.

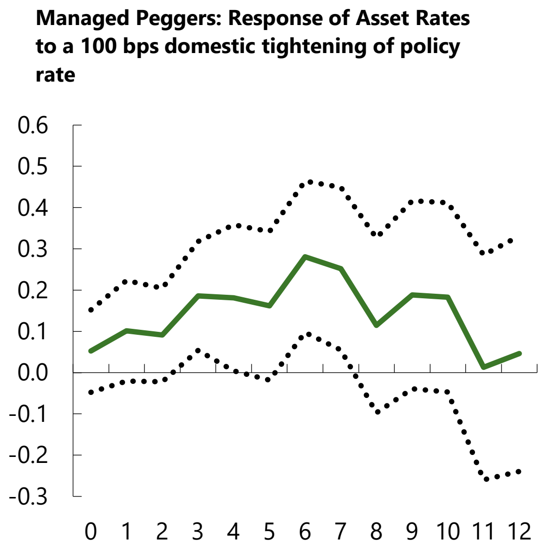
For credit growth, a $10 higher oil price implies about 1 percent higher credit growth in the short run (4–6 quarters) and 2 percent higher credit growth in the long run (10–12 quarters). Since the baseline estimate for credit growth in response to monetary shocks is a credit contraction, this implies that the contraction is less severe when the oil price is higher. These results show that the spillovers from US monetary policy into domestic financial conditions are attenuated for higher oil prices. Asset and liability rates rise less when the oil price is higher and credit growth contracts less.

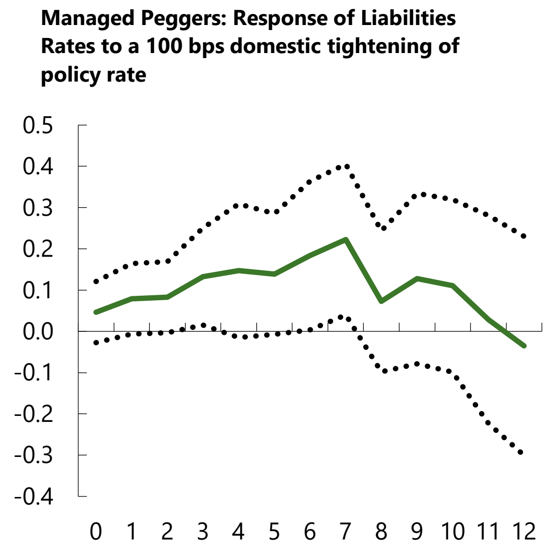
Figure A6.2 Interaction of Monetary Policy Pass-through in OE Peggers with Oil Price

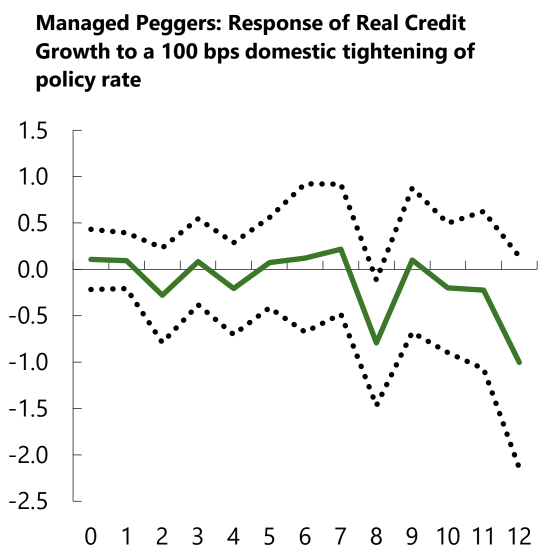


Full Impulse Responses for Managed Peggers

Figure A6.3 Monetary Policy Pass-through in Managed Peggers

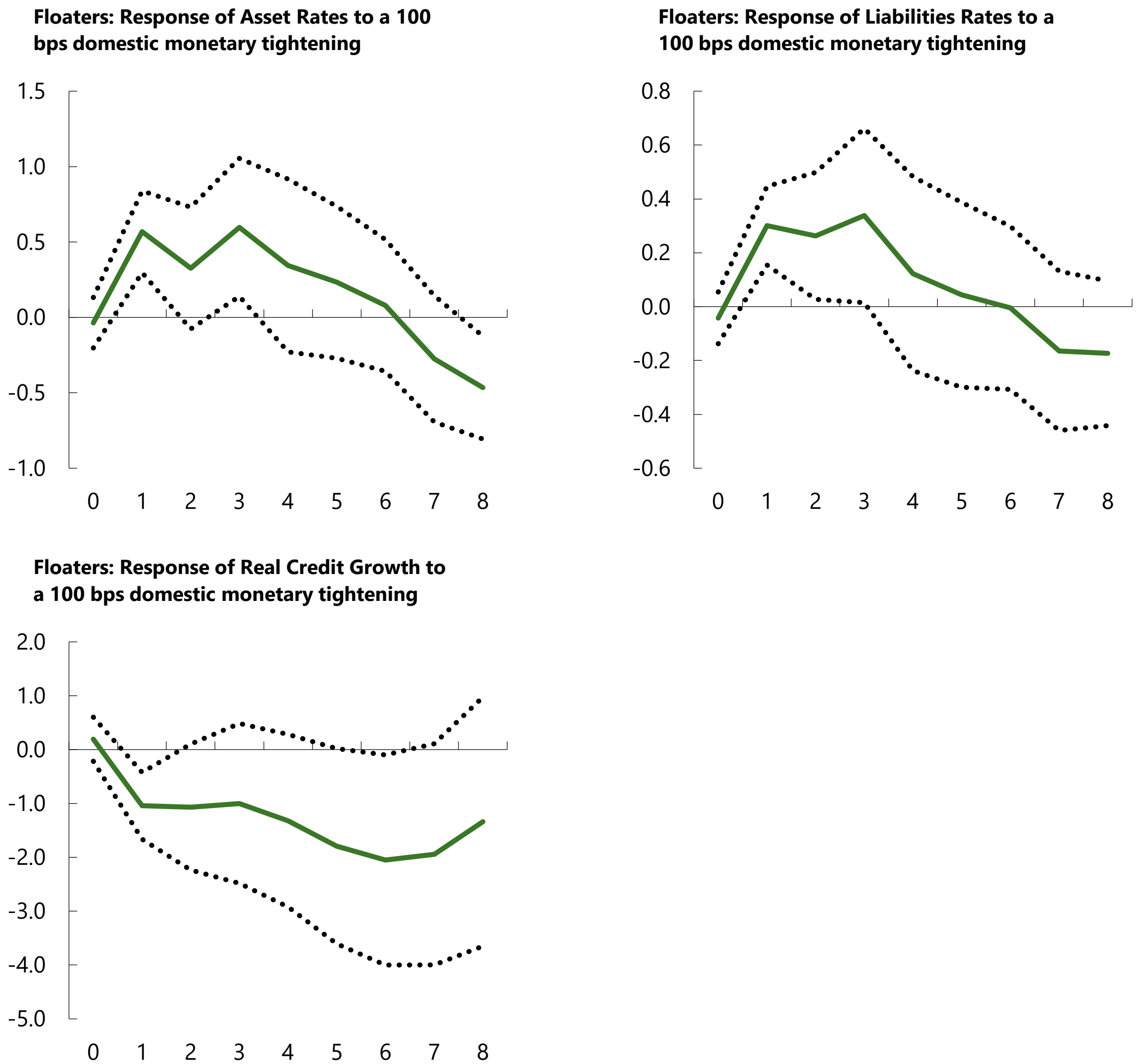






Full Impulse Responses for Floaters

Figure A6.4 Monetary Policy Pass-through in Floaters



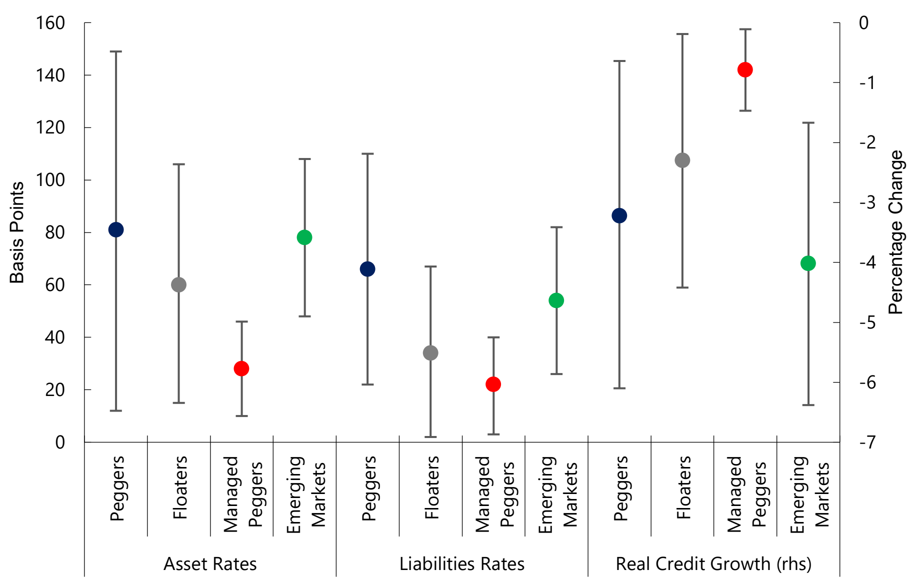
Comparing MECA countries to other emerging markets

To benchmark the results for ME&CA countries against other regions, we compare monetary policy pass-through in ME&CA countries to other emerging markets that are broadly comparable in their income levels. We retain a sample of 20 emerging markets for which we can gather bank-level data as well as a sufficient time series of macroeconomic variables. The sample consists of Brazil, Chile, Colombia, Czech Republic, the Dominican Republic, Guatemala, Indonesia, Mexico, Malaysia, Nigeria, Peru, The Philippines, Poland, Paraguay, Serbia, Thailand, Turkey, Uruguay, and South Africa.

As all these emerging markets are exchange rate floaters, we use the two-step methodology to estimate the pass-through of monetary policy in these economies.

Figure A6.5 Monetary Policy Pass-through Maximum Impulse Responses across Regions

1. Maximum Impulse Responses to a 100 bp Monetary Policy Shock



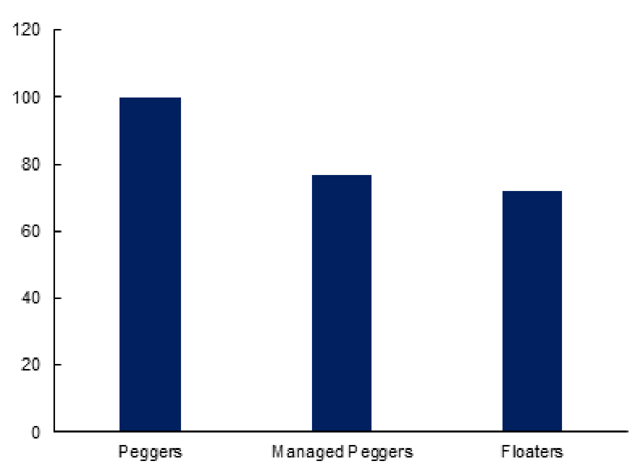
Pass-through in other emerging markets is generally comparable to the pass-through of ME&CA exchange rate peggers and stronger than in ME&CA managed peggers or floaters. In the sample of 20 emerging markets, asset rates rise by 78 bps at the peak and liability rates rise by 54 bps in response to a 100-bps monetary policy tightening. Real credit growth contracts by 4.2 percentage points at the peak.

The strength of monetary pass-through across country groups correlates with their level of financial development (see next section).

The Role of State-Owned Banks and Financial Development in Bank-Level Transmission

Figure A6.6 Financial Development for ME&CA countries

Expressed relative to non-MECA EMs (Index = 100 for non-MECA EMs)

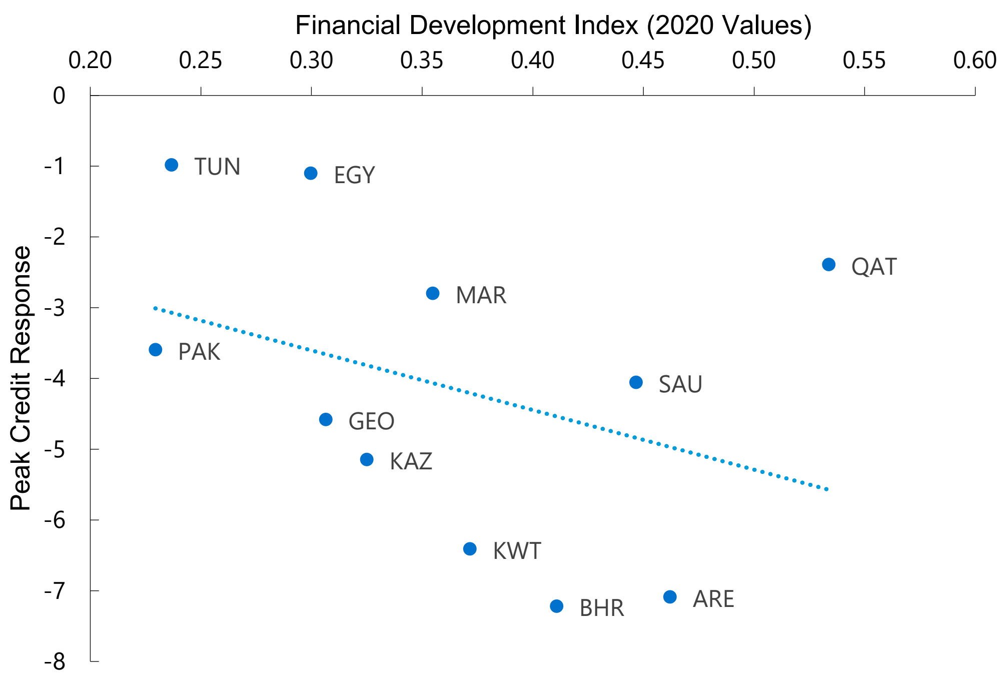


Source: IMF Financial Development Index, IMF staff calculations.
Note: The FDI measures development of financial markets and financial institutions. Index is normalized to 100 for non-MECA EMs and figures for EMCA countries are expressed relative to EM average.

Figure A6.6 shows the levels of financial development across subregions of ME&CA, normalized relative to the average financial development of non-ME&CA emerging markets. ME&CA peggers have similar levels of financial development as non-ME&CA emerging markets. Managed peggers and floaters are less financially developed. Hence, regional levels of financial development correlate with the strength of monetary policy pass-through.

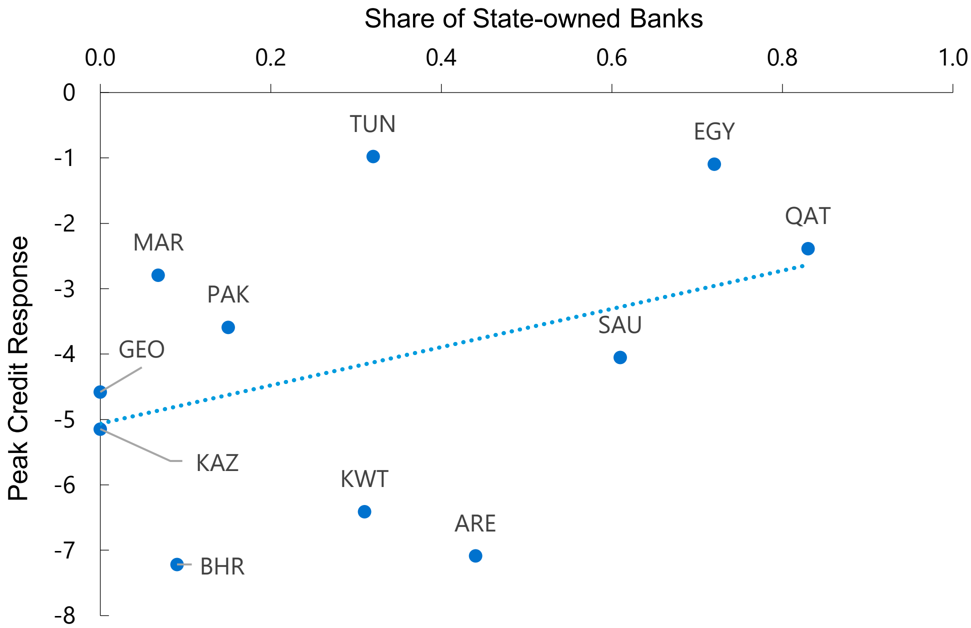
Finally, we show that at the country level within ME&CA, the level of financial development correlates positively with the strength of monetary pass-through. Specifically, we estimate the baseline local projections separately, country by country. Figures A6.7 and A6.8 show the peak estimated impact on real credit growth in response to a 100-bps monetary tightening for each country. Figure A6.8 shows that a stronger footprint of state-owned banks is associated with a lower degree of monetary policy transmission into real credit growth.

Figure A6.7 Strength of Monetary Policy Pass-through and Level of Financial Development



Sources: Fitch Connect; IMF Financial Development Index; IMF staff calculations.
Note: Figure reports peak response measured in percent of real credit growth in response to a 100-bps monetary policy tightening and Financial Development Index as of 2020.

Figure A6.8 Strength of Monetary Policy Pass-through and Share of State-Owned Banks



Sources: Fitch Connect; IMF staff calculations.
Note: Figure reports peak response measured in percent of real credit growth in response to a 100-bps monetary policy tightening and country-level share of banking assets at state-owned banks as of 2021. State-owned banks are defined as banks with at least 30 percent of ownership by the state.

Annex 7. Monetary Policy Transmission Mechanism: the Role of the Exchange Rate

Overview

This analysis assesses the role that the exchange rate plays in amplifying the effect of monetary policy on inflation. We estimate small open economy SVAR models with sign and zero restrictions (Arias and others 2018) for countries in ME&CA with flexible or managed exchange rate regimes. By identifying both monetary policy and 'non-fundamental' exchange rate shocks, we can produce counterfactual analysis, similar to Wong (2015), isolating the effect of monetary policy on inflation absent a response in the exchange rate. We find that, on average, responses of the exchange rate to monetary policy shocks account for roughly 40 percent of the peak impact of monetary policy shocks on inflation.

Methodology

The baseline VAR we estimate is a five variable open economy model with international commodity prices, the nominal effective exchange rate (NEER), GDP, inflation, and the policy rate. Commodity prices are treated as an exogenous block, which cannot be impacted by fluctuations in the domestic economy. The model is estimated using Bayesian methods with stochastic volatility (following Cogley and Sargent 2005) to account for periods of high volatility, in particular, the pandemic.

Identification:

Sign restrictions have been a common approach for identifying monetary policy shocks since Faust (1998) and Uhlig (1997, 2005). We combine sign restrictions with zero restrictions to identify a monetary policy shock; a positive monetary policy shock is assumed to have an immediate positive impact on the exchange rate, but no contemporaneous effect on GDP and inflation. This is implemented using the methodology of Arias and others (2018).

The second important shock we identify is a 'non-fundamental' exchange rate shock. Our desire is to isolate the impact of the exchange rate on macroeconomic variables. Doing so requires isolating movements in the exchange rate, which are, in turn, independent of movements in macroeconomic fundamentals. It has been well established that such movements exist; the nominal exchange rate is not robustly correlated with macroeconomic fundamentals—the 'Meese-Rogoff puzzle' (Meese and Rogoff (1983), Engel and West (2005)). We identify a 'non-fundamental' shock as a movement in the exchange rate which has no contemporaneous effect on GDP, inflation, or the policy rate. This shock can potentially be thought of as a financial shock in line with the work of Itskhoki and Mukhin (2021) and Gabaix and Maggiori (2015), among others.

One concern is that this exchange rate shock might capture news shocks and so may be actually capturing expected changes in macroeconomic fundamentals. Nothing in our identification strategy rules this out. However, in practice, for most countries in our sample, we estimate that this shock results in opposite movements of GDP and the exchange rate which contrasts with what we would expect from a news shock (where the expectation of future growth would result in a contemporaneous appreciation).

Finally, Wolf (2022) recommends the imposition of other shocks in the model to improve the identification of our key shocks of interest by reducing 'shock masquerading'. Accordingly standard supply, demand and commodity price shocks are added to the model. The full set of identifying assumptions are shown in Table A7.1.

Table A7.1 Identifying Assumptions

Variable	Monetary Policy shock	'Non-fundamental' exchange rate shock	Supply Shock	Demand Shock	Commodity price shock
Commodity prices	0	0	0	0	+
NEER	+	+	+	+	
GDP	0	0	+	+	
Inflation	0	0	-	+	+
Policy Rate	+	0	-	+	

Sample and Data

We use quarterly data dating as far back as possible for each country in ME&CA that currently has a floating or managed exchange rate regime. We drop countries where we do not have at least 10 years of data. Commodity prices, the NEER, and inflation are measured in year-on-year percentage changes, while GDP is measured in log-level deviations from trend, which in turn is calculated using an HP filter. Policy rates are measured in level terms. In total we have estimates for the four floating regimes (Armenia, Georgia, Kazakhstan, and Pakistan) and five with managed pegs (Egypt, the Kyrgyz Republic, Morocco, Tajikistan, and Tunisia).

Results

Table A7.2 summarizes the effect of a 100-bps monetary policy shock across the 9 countries in our sample, reporting the peak impact on year-on-year inflation and the timing of this in terms of lags. We also report whether we identify a 'price puzzle' where an increase in interest rates appears to raise inflation (Eichenbaum 1992). In these instances, we believe the data are insufficient to identify monetary policy shocks—for example due to short sample periods or the lack of reliable data on inflation expectations for the countries in question.

In 7 out of 9 countries in our sample we estimate that a contractionary monetary policy shock reduces inflation. Except for Morocco, the estimates for which seem implausibly large, the magnitudes are in line with results from the literature, with a 1-pp increase in interest rates resulting in a peak decline in year-on-year inflation of between roughly 0.3 and 0.6 pp. Peak impacts are between 4 and 13 quarters, with an average of just over 8 quarters.

Finally, we report counterfactual peak impacts of monetary policy on inflation where the exchange rate doesn't respond. To construct this counterfactual, we generate a sequence of non-fundamental exchange rate shocks just large enough to mute the exchange rate response to our 100bps monetary policy shock. This approach is similar to that of Wong (2015). For all countries except for the Kyrgyz Republic, eliminating the exchange rate effect of the transmission mechanism reduces the peak impact on inflation from monetary policy. On average, across our sample of countries, eliminating the exchange rate channel reduces the peak impact of monetary policy on inflation by 40 percent.

Table A7.2 Summary of Results

Country	Price puzzle	Peak impact on inflation	Lags until peak (quarters)	Counterfactual peak impact with no exchange rate effect
Armenia	No	-0.3pp	9	+0.1pp
Georgia	No	-0.5pp	6	-0.3pp
Kazakhstan	Yes	N/A	N/A	N/A
Pakistan	No	-0.5pp	11	-0.1pp
Egypt	No	-0.6pp	5	-0.5pp
Kyrgyz Republic	No	-0.4pp	4	-0.5pp
Morocco	No	-4.4pp*	9	-2.8pp
Tajikistan	Yes	N/A	N/A	N/A
Tunisia	No	-0.5pp	13	-0.2pp

1. We view this estimate to be implausible (similar to countries displaying a price puzzle) but are reporting it for completeness.

References

Arias, J.E., J.F. Rubio-Ramírez, and D.F. Waggoner. 2018. "Inference Based on Structural Vector Autoregressions Identified with Sign and Zero Restrictions: Theory and Applications." *Econometrica* 86: 685–720.

Brandao-Marques L., G. Gelos, T. Harjes, R. Sahay, and Y. Xue. 2020. "Monetary Policy Transmission in Emerging Markets and Developing Economies." IMF Working Paper 20/35, International Monetary Fund, Washington, DC.

Clarida, R., Gali, J., and Gertler, M. 1999. "The science of monetary policy: a new Keynesian perspective". *Journal of economic literature*, 37(4):1661-1707.Cogley, T., and T.J. Sargent. 2005. "Drift and Volatilities: Monetary Policies and Outcomes in the Post WWII U.S." *Review of Economic Dynamics,* 8 (2): 262–302.

Eichenbaum, M. 1992. "Comment on Interpreting the Macroeconomic Time Series Facts: The Effects of Monetary Policy. *European Economic Review* 35 (5): 1001–11.

Engel, C., and K.D. West. 2005. "Exchange Rates and Fundamentals." *Journal of Political Economy* 113 (3): 485–517.

Faust,J. 1998. "The Robustness of Identified VAR Conclusions about Money." *Carnegie-Rochester Conference Series on Public Policy* 49: 207–44.

Gabaix X, and M. Maggiori. 2015. "International Liquidity and Exchange Rate Dynamics." *Quarterly Journal of Economics* 130 (3):1369–1420.

Holston, K., T. Laubach, and John C. Williams. "Measuring the Natural Rate of Interest: International Trends and Determinants." *Journal of International Economics* 108 (2017): S59–75.

Itskhoki, O, and O. Mukhin. 2021. "Exchange Rate Disconnect in General Equilibrium." *Journal of Political Economy* 129 (8): 2183–2232.

Jordà, Ò.. (2005). "Estimation and Inference of Impulse Responses by Local Projections." *American Economic Review* 95 (1): 161–82.

Lubik, T. A., and C. Matthes. 2015. "Calculating the Natural Rate of Interest: A Comparison of Two Alternative Approaches." *Richmond Fed Economic Brief* Oct.

Meese, R., and K. Rogoff. 1983. "Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample?" *Journal of International Economics* 14: 3–24.

Orphanides, A. 2003. "Historical Monetary Policy Analysis and the Taylor Rule." *Journal of Monetary Economics* 50 (5): 983–1022.

Taylor, J. B. 1999. "A historical analysis of monetary policy rules." In *Monetary policy rules*. University of Chicago Press, Chicago.

Taylor, J. B. 1993. "Discretion versus policy rules in practice". In Carnegie-Rochester conference series on public policy, (39): 195–214. North-Holland.

Uhlig, H. 2005. "What are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure." *Journal of Monetary Economics* 52 (2): 381–419.

Uhlig, H. 1997. “What are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure.” Tilburg University Manuscript.

Wolf, C. 2022. “What Can We Learn from Sign-Restricted VARs?” *AEA Papers and Proceedings* 112: 471–75.

Wong, B. 2015. “Do Inflation Expectations Propagate the Inflationary Impact of Real Oil Price Shocks? Evidence from the Michigan Survey.” *Journal of Money, Credit and Banking* 47: 1673–89.

Wu, J. C, and F D. Xia. 2016. “Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound.” *Journal of Money, Credit and Banking* 48 (2–3): 253–91.