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Morocco's Monetary Policy Transmission in the Wake of the COVID-19 Pandemic

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Abstract

This paper finds that the neutral interest rate has been on a downward trajectory in Morocco since the global financial crisis and may have fallen in the wake of the pandemic. In that context, monetary policy transmission to output and prices appears relatively muted given limited exchange rate flexibility until recently. Also, monetary policy transmission to some market rates has somewhat weakened in the wake of the pandemic. A lower natural rate and low policy rates raise the question of whether further rate reductions would impair the banking system. We find that the sensitivity of cash demand to deposit rates is low, implying limited risks that banks would lose funding with further reductions. A reliance on checking and savings accounts for funding may impair monetary pass-through, however. If monetary policy reaches its effective lower bound, limited and credible recourse to an asset purchase program could usefully complement conventional measures and strengthen monetary policy transmission under an inflation-targeting regime with a flexible exchange rate.

JEL Classification Numbers: E4, E5

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Contents

GLOSSARY

AE	Advanced Economy
APP	Asset Purchase Program
BAM	Bank al-Maghrib
BPS	Basis Points
CPI	Consumer Price Index
ECB	European Central Bank
ELB	Effective Lower Bound
EME	Emerging Market Economy
ER	Exchange Rate
GDP	Gross Domestic Product
GFC	Golbal Financial Crisis
IMF	International Monetary Fund
IT	Inflation Targeting
NEER	Nominal Effective Exchange Rate
QE	Quantitative Easing
R*	Real Neutral Interest Rate
SME	Small and Medium Size Enterprise
TLB	Technical Lower Bound
UIP	Uncovered Interest Rate Parity

INTRODUCTION

Morocco's central Bank (Bank al-Maghrib -BAM) promptly reacted to the pandemic crisis by easing monetary policy through a series of measures. It reduced its policy rate by 75 bps (to 1.5 percent) from March to September 2020 and brought reserve requirements to zero. The widening of the fluctuation band around the exchange rate peg in March 2020 also eased monetary conditions as it allowed a significant depreciation of the dirham at the beginning of the health crisis. The need to directly aid firms under financing constraints and to respond to growing demand for liquidity in the banking system (both in domestic and foreign currency) also called for an expansion of the liquidity provisions to the banking sector, through more refinancing operations (including for the funding of targeted lending programs to small and medium enterprises (SMEs)), a broadening of the range of collateral accepted for repos, and the provision of foreign exchange swaps. As a result, BAM's balance sheet grew by more than 25 percent from February to end-2020, an increase of about 8 percent of GDP.

These measures have greatly mitigated the impact of the COVID-19 pandemic on the Moroccan economy. Going forward, the exceptional uncertainty that surrounds the recovery and the post COVID-19 new normal suggests that BAM may need to continue expanding its balance sheet to fulfill the price stability mandate and support the flow of credit to the economy. However, Morocco's exchange rate anchor may provide little scope for expanding the money supply, and historically low policy rates suggest that the room for further conventional easing in the current moentary policy framework may have narrowed.

Of course this is not just a problem for Morocco, as many emerging market economies' (EMEs) central banks have responded to the COVID-19 crisis with aggressive cuts in their policy rates. With interest rates approaching historically low levels, many of these economies also begun to adopt unconventional monetary policy measures in the course of 2020 (IMF, 2020). While some have used quantitative easing (QE) to inject more liquidity and reduce market stress, most have put in place asset purchase programs (APPs) to flatten the yield curve, compress spreads, and ultimately stimulate the economy. These APPs were mostly targeted at government bonds in the secondary market (for example in Croatia, Indonesia, the Philippines, Poland and South Africa), but remained small relative to those implemented in advanced economies (AEs) (IMF, 2020; IFF, 2020).

Against this background, this paper addresses a few key questions: what is space for further conventional monetary policy easing in Morocco? How strong is the pass through of the interest rate to output and prices in Morocco? Has monetary policy transmission to market rates weakened since the pandemic, and what factors may constrain monetary policy decisions in Morocco? Could Morocco follow other EMEs in using QE as a policy tool to ease monetary conditions if policy rates reach their lower bound?

To answer these questions, the paper first estimates the neutral interest rate in Morocco, which is essential in order to properly gauge the monetary policy stance and the need for further monetary policy easing. Second, it analyzes monetary policy transmission in Morocco, by i) estimating the channels through which changes in interest rates are transmitted to the real economy in a Taylor-rule regression setting, as well as the impulse response to monetary policy shocks using local projections method, (ii) gauging the

transmission of recent policy rate cuts to the sovereign yield curve, to deposit rates, and to lending rates, and (iii) assessing factors that may hinder transmission if the central bank further cuts the policy rate in a context of already low rates. Finally, the paper discusses the potential for implementing an APP in Morocco, and uses a semi-structural model of Moroccan economy (as in Bulir et al., 2021) to simulate its macroeconomic impact.

First, this paper finds that the real neutral interest rate in Morocco has trended downward following the global financial crisis, before falling in the wake of the pandemic. Second, our results point to a somewhat relatively muted reaction function of Morocco's central bank to its inflation and GDP growth forecasts. Third, the impulse response of output to a monetary policy shock is limited in the short and medium term, while the impact on inflation proves weaker. Fourth, event studies show that transmission of policy rate cuts to market rates remains relatively strong, but has somewhat declined after the pandemic in a context of heightened uncertainty. Morocco has experienced a weaker pass-through to deposit rates, some lending rates, and long-term sovereign yields. Fifth, in a context of historically low policy rates, we find that the sensitivity of the demand for banknotes to deposit rates is limited in Morocco and does not seem to constrain significantly monetary policy. These results possibly indicate the limited role of the policy rate in driving bank deposits in a context of relatively low financial inclusion. But heavy reliance of bank funding on non-interest-bearing deposits and savings accounts in Morocco may weaken banks' capacity to pass-through lower policy rates.

Finally, our simulations shows that the impact of an APP in Morocco would be dampened by the need for BAM to defend the dirham fluctuation band. An APP would become a more effective monetary policy instrument under an inflation targeting (IT) framework. Illustrative simulations find that under an IT regime with a flexible exchange rate, limited and credible recourse to an APP would usefully complement conventional measures and strengthen monetary policy transmission. The recourse to an APP would need to be consistent with BAM continued, credible commitment to maintain long-term inflation expectations anchored, something that would be easier to communicate once the transition to an IT monetary policy regime is completed.

I. Assessing Morocco's Space for Conventional Monetary Policy

Assessing the room for conventional monetary policy easing in Morocco depends on three questions. First, we estimate the real neutral interest rate to gauge the stance of monetary policy. Second, we assess the reaction function of the central bank and the strength of the interest rate channel pass through to output and prices. Third, we analyze whether monetary policy transmission has weakened in the context of the pandemic, and what factors could impair the effectiveness of further monetary easing in an environment of low policy rates.

A. Estimating the Neutral Interest Rate in Morocco

The neutral rate of interest measures the opportunity cost of investment in an economy producing at its potential with non-accelerating inflation (Wicksell, 1936). Formally, the neutral interest rate arises as the flexible-price equilibrium interest rate (Woodford, 2003) and so is a function of permanent aggregate supply and demand shocks. The neutral interest

rate also arises in the representative monetary policy function of Taylor (1993) as the intercept and provides a benchmark for the stance of monetary policy; when the short-term real interest rate is above (below) the neutral rate, the monetary stance is said to be contractionary (expansionary).

Neutral interest rates have been on a downward trend globally after reaching all-time highs in the 1980s (Gourinchas and Rey, 2019). Various explanations have been put forth to characterize this decline. Demographic developments may have played a role by affecting saving and investment behaviors through life cycle choices and changes in population structure. Higher life expectancy may have pushed up savings and thus exerted downward pressure on interest rates, dominating an increase in the dependency ratio that would exert upward pressure (Carvalho et al., 2016; Gagnon et al., 2016; Fiorentini et al., 2018). Increasing wealth inequality may also have increased savings, given different propensities to save across wealth distributions (Summers, 2014; Rachel and Smith, 2015). A decline in the supply of safe assets since the global financial crisis (GFC) in addition to increased demand for such assets due to changes in risk aversion may have further depressed interest rates (Krishnamurthy and Vissing-Jorgensen, 2012; Caballero et al., 2016; Caballero et al., 2017; Del Negro et al., 2017). Evidence also suggests a synchronization in the global financial cycle with important implications for excess global savings that would depress the neutral interest rate (Pescatori and Turunen, 2015; Duarte and Rosa, 2015).

As the neutral interest rate is an unobserved variable, it is generally estimated through filtering techniques that can include fully structural models (Justiniano et al., 2013; Gerali and Neri, 2017), semi-structural models (Laubach and Williams, 2003, 2016; Holston et al., 2017; Lewis and Vazquez-Grande, 2018), or purely reduced-form models (Del Negro et al., 2018; Fiorentini et al., 2018).[2] Model-specific differences in the conceptualization of the neutral rate, as well as statistical uncertainty, pose challenges that are not entirely overcome with any single approach.

There is a growing literature on neutral interest rates in EMEs, and multiple approaches are typically employed to obtain a range of estimates capturing different elements (Magud and Tsounta, 2012; Perelli and Roache, 2014; Carillo et al., 2018 among others).[3] Carillo et al. (2018) find that capital inflows temporarily depress the natural rate in Mexico, while the global rate also plays a role. Perrelli and Roache (2014) find a similarly important role of global real interest rates in the case of Brazil, in addition to domestic factors including sovereign risk, supply of savings, and public debt. Magud and Tsounta (2012) survey 10 South American economies and find that lower foreign exchange and inflation risk are consistent with declining neutral interest rates. For Morocco, there is a growing literature estimating general equilibrium models to produce forecasts (e.g. El Othmani, 2018) and to assess the impact of transitioning to a floating foreign exchange regime (e.g. Benlamine

[2] For a recent survey of methods and estimates, see Brand et al. (2018).

[3] The approaches used typically involve at least one application of: an adjusted Taylor rule; local linear trend models; common stochastic trend models that occasionally proxy for country risk when data are available; semi-structural models as in Laubach and Williams (2003) that are occasionally augmented by the real exchange rate; simple, structural consumption models.

et al., 2018; Achour, 2019; Baksa et al., 2020), but estimates of the neutral interest rate remain very sparse. Moumni and Dasser (2014) estimate variants of the Taylor rule where the neutral interest rate is the intercept and find it to be between 1.14 and 2 percent over the sample 1995-2009, depending on the specification.

In this paper, we estimate three different models of the neutral interest rate for Morocco, that capture the role played by global components, risk premia, and output and inflation dynamics, in line with the literature on neutral interest rates in EMEs. First, we use the trend-cycle decomposition of Del Negro et al. (2018), which assumes that there are common trends driving interest rates, identified as the local and global neutral interest rates (Box 1). The distinction between the local and global interest rate trends differentiates between Moroccan idiosyncratic conditions and imported monetary conditions from the European Union and the United States (Miranda-Agrippino and Rey, 2020). Second, we use a small semi-structural model of the Moroccan economy similar to the one used (for the US) by Laubach and Williams (2003), that loses the global component but adds output and inflation dynamics into the estimation of the neutral interest rate. Following Lewis and Vazquez-Grande (2018) our specification also allows for transitory (cyclical) shocks to affect the neutral interest rate (Box 2). Finally, we use the semi-structural model for Morocco as Baksa et al. (2021), a significant expansion relative to Laubach and Williams (2003), as it incorporates exchange rate dynamics, monetary policy, and fiscal policy among other structural elements (Box 3). The increase in structure means that international financial developments are incorporated into the estimation of real interest rate trends, so that we can assess the role of country risk beyond the simple decomposition into common trends.

Box 1. Trend-Cycle Decomposition with Common Trends

We estimate a trend-cycle decomposition of short-term interest rates, long-term interest rates, and inflation across countries. Unobserved components models are useful for extracting the low-frequency component in short- and long-term interest rates that can be identified with the neutral interest rate. When adding a cross-country panel dimension, we can also differentiate between local and global trends, as in Del Negro et al. (2018). We include the US and the EU in our specification, in addition to Morocco, demonstrating to what extent monetary conditions are driven by trading partners as opposed to domestic factors.

The model is summarized by the following three equations:

$$R_{i,t} = \overline{r}_t^w + \overline{r}_t^i + \lambda_i^{\pi}\overline{\pi}_t^w + \overline{\pi}_t^i + \widetilde{\mathrm{R}_{\mathrm{i,t}}}$$

$$R_{i,t}^L = \overline{r}_t^w + \overline{r}_t^i + \overline{ts}_t^w + \overline{ts}_t^i + \lambda_i^{\pi}\overline{\pi}_t^w + \overline{\pi}_t^i + \widetilde{R_{i,t}^L}$$

$$\pi_{i,t} = \lambda_i^{\pi}\overline{\pi}_t^w + \overline{\pi}_t^w + \widetilde{\pi_{i,t}}$$

These equations decompose the short-term nominal rate $R_{i,t}$, the long-term nominal rate $R_{i,t}^L$, and inflation $\pi_{i,t}$ into their trend components $\overline{x}_t$ and cyclical components $\widetilde{x_t}$. Local trends are specified with an index i, whereas common trends are specified with a w superscript. For example, the nominal short-term rate is decomposed into a trend inflation component $\lambda_i^{\pi}\overline{\pi}_t^w + \overline{\pi}_t^i$ and a cyclical component $\widetilde{\mathrm{R}_{\mathrm{i,t}}}$, with the remainder $\overline{r}_t^w + \overline{r}_t^i$ estimating the real interest rate trend that corresponds to the neutral interest rate in country *i*. The global inflation

trend $\overline{\pi}_t^w$ transmits locally via an estimated parameter λ_i^{π}, whereas the global interest rate trend $\overline{r}_t^w$ enters additively to the local interest rate trend $\overline{r}_t^i$.

The model is estimated using Bayesian methods with uninformative priors at a monthly frequency over the sample 1997-2020.

Box 2. A Small Semi-Structural Model.

The semi-structural model estimated in the style of Laubach and Williams (2003) is centered around the relationship in neoclassical and New Keynesian models that the steady-state real interest rate is a function of growth and the rate of time preference. Output gap and inflation dynamics are captured through an IS relationship equation and a Phillips curve equation, each subject to transitory shocks. The neutral rate of interest is considered a low-frequency concept and is defined through the following equations:

$$r_t^* = g_t + z_t$$
$$g_t = \mu_g(1 - \rho_g) + \rho_g g_{t-1} + \varepsilon_{g,t}$$
$$z_t = \rho_z z_{t-1} + \varepsilon_{z,t}$$

Here, the neutral interest r_t^* rate is defined as the sum of the growth rate g_t and a non-growth component z_t. In the standard formulation of Laubach and Williams (2003), both g_t and z_t are assumed to follow an exogenous unit-root process ($\rho_g = \rho_z = 1$), so that the neutral interest rate is a function only of permanent shocks to supply and demand. Following Lewis and Vazquez-Grande (2018), we allow the growth and non-growth processes to be possibly stationary by estimating ρ_g and ρ_z rather than imposing unity, so that the neutral interest rate can also respond to transitory shocks if the data support this formulation.

The models are estimated using Bayesian methods with uninformative priors at a quarterly frequency over the sample 1997-2020. There is only weak evidence that ρ_z is different from 1.

Box 3. A Large Semi-Structural Model with Monetary and Fiscal Policy for Morocco.

In the model of Baksa et al. (2021), the real interest rate can be defined as:

$$r_t = i_t - \pi_t$$

And the real interest rate can be further decomposed into trend and gap (or cyclical) components, separated through a typical Kalman-filter based exercise:

$$r_t = \bar{r}_t + \hat{r}_t$$

Two blocks describe the cyclical behavior of the economies. First, the IS-curve and Phillips-curve give the short-run equilibrium position of aggregate demand (output gap) and aggregate supply (inflation). Aggregate demand and supply depend on the short-run position of the real interest rate gap and real exchange rate gap. Second, the exchange rate and monetary policy regime are modeled to reflect Morocco's transition toward an inflation targeting regime with a more flexible exchange rate. The nominal exchange rate in the current interim regime is determined by the weighted average of the currency basket and the uncovered interest parity implied rate; the latter captures the effect of the recently introduced (March 2020) horizontal fluctuation band (±5 percent). Due to the capital controls and the band around the peg, the

central bank has some flexibility in 'setting' the nominal policy rate, and thus affecting the short-run real interest rate gap.

However, medium-term monetary conditions are not fully independent, and the real interest rate trend ($\bar{r}_t$) follows the developments of international monetary conditions, with some lag. This can be described by the modified 'real-uncovered interest rate parity' (real-UIP) equation:

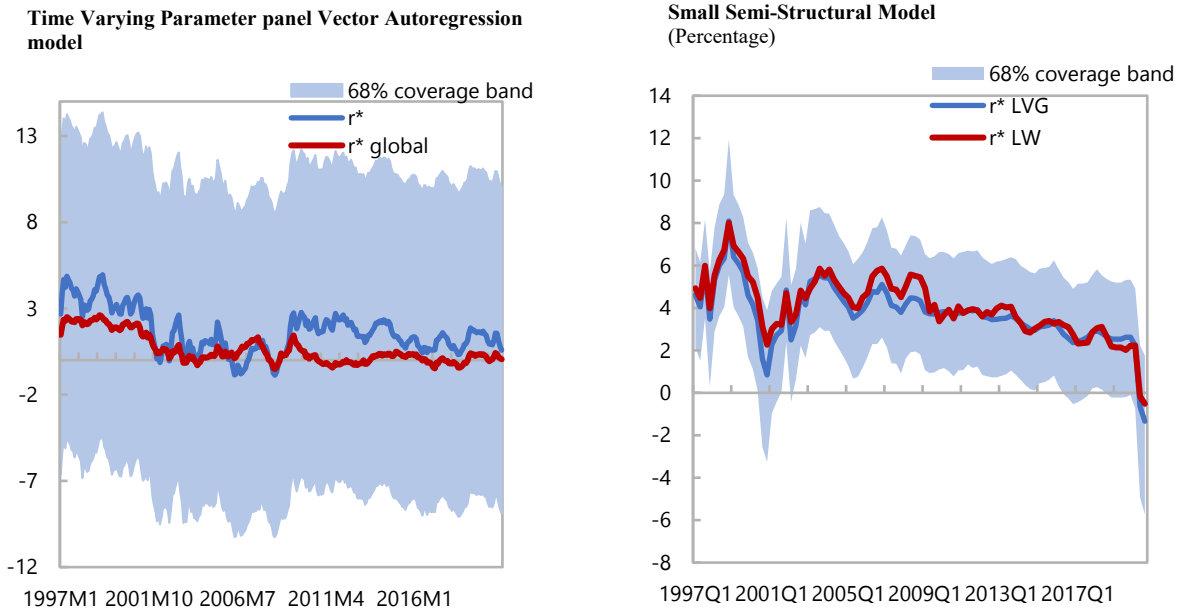
$$\bar{r}_t = \rho \cdot \bar{r}_{t-1} + (1-\rho) \cdot (\bar{r}_t^* + prem_t + \Delta\bar{z}_t) + \varepsilon_t^{\bar{r}}$$

where $\bar{r}_t$ is the neutral real interest rate; $\bar{r}_t^*$ is the exogenously given foreign (European Central Bank (ECB)) neutral real interest rate, $prem_t$ is the risk premium that absorbs all financial pressure hitting the Moroccan economy; $\Delta\bar{z}_t$ denotes the log difference of real exchange trend that is identified from the observed real effective exchange rate. This adjusted version of the real-UIP condition is consistent with Morocco's relatively closed financial account, with the parameter ρ affecting the speed at which domestic monetary conditions follow foreign monetary conditions, and the $\varepsilon_t^{\bar{r}}$ shock reflecting idiosyncratic, country-specific shocks.

This model has been calibrated to fit the stylized facts of the Moroccan economy at an annual frequency over the sample 2002-2020 (see Appendix I for more details).

Our estimates of the neutral interest rate for Morocco (Figure 1) remain within a narrow band over the two decades prior to the COVID-19 pandemic, while the range in estimates is explained by the specific elements of each model.

Figure 1. Results of the Trend-Cycle Decomposition and Small Semi-Structural Model

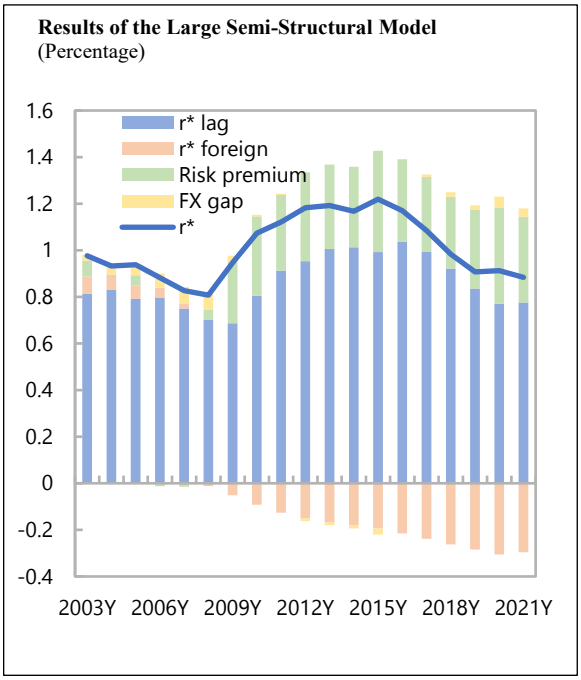


Source: IMF staff calculations.

The common trends approach shows evidence of some synchronization between global and local interest rates over the period 1997 to 2008, while the aftermath of the GFC resulted in a persistent gap between the neutral interest rate for Morocco and the global rate. After 2008, there is a decoupling between the global rate and the Moroccan rate, which can potentially be explained by an increase in the country risk premium. While there is large filter uncertainty, this model shows a persistent downward trend of the neutral rate for Morocco, fluctuating around 1.5 percent through the end of 2019.

The small semi-structural model shows weak evidence that transitory shocks to the non-growth component affect the neutral interest rate, and the path of the estimated neutral rate follows potential growth. This model also points to a downward trend in the neutral rate since the GFC, with estimates ranging between 0.9 and 4 percent over 2009-2019.

The large semi-structural model sheds some light on the findings from the two previous simpler filter models thanks to its richer structure, most notably the UIP condition The first component in the UIP is the foreign interest rate, proxied by the euro area real interest rate, which was positive before the GFC, and the foreign neutral real interest rate, which was slightly above zero. After the GFC, the euro area real short-term interest rate permanently moved to negative territory, as the nominal interest rate remained closed to the effective zero lower bound. The foreign neutral real interest rate also turned negative reaching -2 percent by end-2020. The second component in the UIP is the real exchange rate, which was relatively stable over the whole sample and did not significantly contribute to the evolution of the neutral interest rate in Morocco. The third and most volatile component is the risk premium. According to our estimation, it was nearly unchanged during the pre-GFC period, reflecting relatively stable foreign financing conditions. This pattern broke in 2009, and the increase in risk premium has offset the decline in the euro area interest rate since then. Overall, the estimated domestic neutral real interest rate was stable around 1 percent over 2003-2019, with the presence of capital controls mitigating the adjustment to the changing of the UIP components.



The impact of the pandemic crisis on neutral interest rates is still uncertain and our own empirical estimates for 2020 should be taken with caution, as the large COVID-19 shock likely violates the underlying filtering assumptions and may bias results downwards; this is particularly evident in the first two models employed, consisting of smaller models applied at higher frequency The large range of estimates, however, provides a likely coverage band for the neutral real interest rate and point to a decline in 2020. This is consistent with the possibility that the series of lockdowns may have generated a “Keynesian supply shock”, one that would trigger a demand-driven recession, depressing the neutral interest rate (Guerrieri,

2020). Jorda (2020) also finds that pandemics tends to have long-lasting effects on interest rates which tend to decline by nearly 1.5 percentage points about 20 years later. However, the expected sharp increase in government debt could exert an upward pressure on the neutral interest rate (Blanchard, 2020), in line with recent findings showing that fiscal policies raised real interest rates by several hundred basis points over the last generation (Rachel and Summers, 2019).

B. Gauging Monetary Policy Transmission in Morocco

In this section we discuss whether low interest rates may affect monetary policy transmission in Morocco. First, we assess the strength of transmission in a Taylor rule representation of monetary policy in Morocco and estimate the impulse response to monetary policy shocks from 2007-2020. Second, we look at whether the transmission of policy rate cuts to the sovereign yield curve and market rates has changed during the pandemic, using an event study approach. Third, we discuss two factors that may constrain monetary policy in a low rates environment: the influence of interest rate on the demand for cash that may lead banks to lose deposits and savings accounts, and the role of bank balance sheet and income stream that may reduce their willingness to pass through additional policy rate cuts.

Monetary Policy Transmission and Impulse Response to Monetary Shocks

We follow Brandao-Marques and al. (2020) and identify monetary policy shocks using a Taylor rule, in the spirit of Romer and Romer (2004). In this approach, deviations from the Taylor rule are intended to capture the non-systematic and unexpected part of monetary policy actions and are therefore identified with "policy shocks". In the Taylor-rule representation, we use the following main variables: (i) quarterly overall GDP; (ii) the overall consumer price index; (iii) the interbank money market rate, as it is closely aligned with BAM's seven-day open market operations which is used as the central bank policy rate; and (iv) the nominal effective exchange rate:

$$\Delta i_{it} = \alpha_{0i} + \alpha_{1i} E_t \Delta y_{it+12} + \alpha_{2i} E_t \pi_{it+12} + \sum_{j=1}^{2} \alpha_{3ij} \Delta y_{it-i} + \sum_{j=1}^{2} \alpha_{4ij} \Delta p_{it-j} + \sum_{j=1}^{2} \alpha_{5ij} \Delta neer_{it-j} + \sum_{j=1}^{2} \alpha_{6ij} i_{it-j} + \varepsilon_{it},$$

where $E_t \Delta y_{t+12}$ and $E_t \Delta p_{t+12}$ are BAM's 12-month-ahead forecasts of GDP growth and inflation. The variables *y, p, i*, and *neer* denote output (nominal GDP), prices, the interbank money market rate, and nominal effective exchange rate (in logs), respectively (see Appendix II for detailed information on data sources). Monetary policy shocks are captured by the residual ε. All variables are quarterly to match the frequency of BAM interest-setting Board meetings.[4] BAM started publishing quarterly GDP and inflation projections in 2007. GDP forecasts were only published for the next two quarters until 2016, while inflation forecasts covered the next 5-6 quarters. To obtain 12-month-ahead quarterly GDP growth forecasts

[4] While this approach allows aligning with BAM's monetary policy decision timeline, it tends to limit the number of observations and reduces the statistical significance of our results

from 2007-2016, we used BAM's annual GDP growth forecast to estimate the missing 2-3 quarters for each forecasting period. From 2016, BAM has developed a new forecasting and policy analysis system (FPAS) which includes a quarterly projection model calibrated with IMF technical assistance (Benlamine and others, 2018). This has allowed BAM to produce 24-month-ahead GDP and inflation forecasts for its monetary policy reports associated with each Board's meeting. While these forecasts are published as fan charts showing probability bands, in this paper we use BAM's baseline forecasts for 2016-2020.

As expected, the results show that changes in the interest rate are positively correlated with both inflation and GDP growth forecasts (see Table 1). The estimated coefficients are smaller than those estimated by Brandao Marques and al. (2020) for 40 emerging and developing economies though, pointing to a somewhat more muted reaction function of Morocco's central bank (consistent with the exchange rate peg). In addition, when setting its policy rate, BAM appears to have been on average relatively more focused on GDP growth forecast than inflation forecasts (as the estimated coefficients for GDP growth forecasts are larger and statistically more significant than those for inflation), given that inflation is stabilized by the peg to the currency basket. These results reflect the average observed Taylor rule over the entire sample and are thus perhaps not surprising since the transition to IT has been gradual and is not complete.

Once we have identified monetary policy shocks, we look at the responses of output growth and inflation to those shocks by using Jordà's (2005) local projections method. This approach differs from the extensive literature discussing monetary transmission using VARs. For example, in advanced economies, Christiano and others (1996 and 2005) assessed the transmission of Federal Reserve monetary policy shocks using VARs, and Bayoumi and Morsink (1999) used a VAR to examine the monetary transmission mechanism in Japan. In EMEs, Disyatat and Vongsinsirikul (2002) estimated a VAR to assess monetary transmission in Thailand, and Bennouna (2016) in Morocco.

The local projections method provides simple inference for impulse response coefficients and tend to be more robust to misspecification than vector autoregressions (VARs). Following Brandao-Marques et al. (2020), we estimate the following regressions for nominal GDP levels for each forecasting horizon *h* (a similar equation is used for estimating the impulse response function for CPI levels):

$$Y_{it+h} = \sum_{j=0}^{2} \gamma_j^h \varepsilon_{it-j} + \delta_0^h \Delta neer_{it} * \varepsilon_{it} + \sum_{j=0}^{2} \beta_{1j}^h Z_{it-j} + \sum_{j=1}^{2} \beta_{2j}^h i_{it-j+} \boldsymbol{x}_{it}\, \boldsymbol{\lambda}^h + \omega_{it}^h,$$

where ε is the estimated (and standardized) Morocco policy shock, the vector Z includes contemporaneous and lagged value for *y, π, neer*, and the vector **x** contains global and Morocco specific controls (including the VIX, a commodity price index, the first principal

component of the United States', EU's, and Japan's shadow policy rates,[5] and Morocco monthly temperature and rain precipitation).

To reflect the fact that the gradual transition to the IT regime has increased the flexibility around the peg, we also interact the interest rate shock with the contemporaneous change in the exchange rate. When the exchange rate channel is taken into account, $\gamma_0^h + \sigma\delta_0^h$ is the total contemporaneous response of output (and prices) to monetary policy shocks. We impose a recursiveness assumption and assume that Z is predetermined and has no contemporaneous effect on output and prices. We calculate standard errors using the Newey and West (1987) estimator where the bandwidth expands with the horizon *h* of the impulse response, given that these equations are predictive regressions and generate autocorrelation in the disturbances.

Table 1. Taylor Rule Regression

Variables	Results
CPI forecast	0.000127
	(0.000249)
GDP forecast	0.000385***
	(7.87e-05)
Interest rate (lagged once)	-0.0630
	(0.143)
Interest rate (lagged twice)	-0.0252
	(0.146)
Δlog CPI (lagged once)	0.0486
	(0.0359)
Δlog CPI (lagged twice)	-0.0379
	(0.0379)
Δlog GDP (lagged once)	-0.0156*
	(0.00782)
Δlog GDP (lagged twice)	-0.0193**
	(0.00796)
Δlog NEER	-0.0267
	(0.0218)
Δlog NEER (lagged once)	0.0307
	(0.0224)
Δlog NEER (lagged twice)	-0.0191
	(0.0226)
Constant	0.000912
	(0.00109)
Observations	53
R-squared	0.463

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: IMF staff estimates

Our results show that after a (one standard deviation) contractionary monetary policy shock (Figure 2), output marginally declines by about 0.01 percent after 10 quarters. The impact of the exchange rate channel appears also limited, as output falls only slightly more when considering the contemporaneous effect of the exchange rate (0.02 percent) after 9 quarters.

[5] Shadow policy rates are used to assess the stance of monetary policy when interest rates are near the zero-lower bound as currently in the US, EU and Japan.

This effect is statistically significant at the 1 percent significance level with the exchange rate interaction, but only at the 10 percent significance level without. Based on these results, a 100-basis point interest-rate hike would lower output by a maximum of about 0.18 percentage point with the exchange rate interaction and 0.14 without respectively (Table 2).

The impact on prices is more muted, with a one-standard-deviation contractionary monetary policy shock generating a 0.003 percent decline in prices after eight quarters, with a faster but similar limited effect when we account for the exchange rate channel (-0.004) after two quarters. The response is statistically significant at the 1 percent significant level when holding the exchange rate constant, and the 5 percent significance level with the exchange rate interaction. An equivalent 100-basis point rise in interest rate reduces prices by about 0.03 percentage point, and 0.04 percent with the contemporaneous effect of the exchange rate.

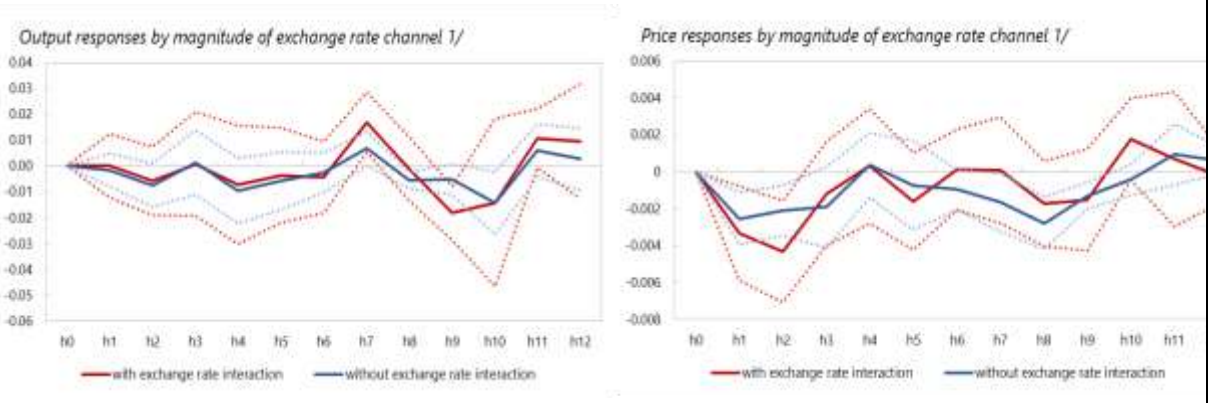
Table 2. Effect of Monetary Policy tightening on Output and Prices

	Peak effect		
	1 S.D. in percent	**100 bp-equivalent**	**Peak quarters**
	(1)	(2)	(3)
Output			
Without exchange rate channel	-0.014332 *	-0.138	10
	(0.0528)		
With exchange rate channel	-0.018215 ***	-0.175	9
	(0.0044)		
Prices			
Without exchange rate channel	-0.002774 ***	-0.027	8
	(0.0015)		
With exchange rate channel	-0.004316 **	-0.04144339	2
	(0.0116)		

Note: Heteroscedasticity and autocorrelation-robust p-values in parentheses. *, **, *** signify statistical significance at the 10, 5, and 1 percent level, respectively. S.D. stands for standard deviation.

Source: IMF staff calculations

Figure 2. Impulse Responses of Output and Prices to A Monetary Policy Shock



1/ In the x-axis, h1 corresponds to the first quarter following the monetary shock. The dotted lines represent the lower and upper limit of 90 percent significance confidence bands and the solid lines represent the point estimate. Standard errors are robust to heteroscedasticity and autocorrelation.

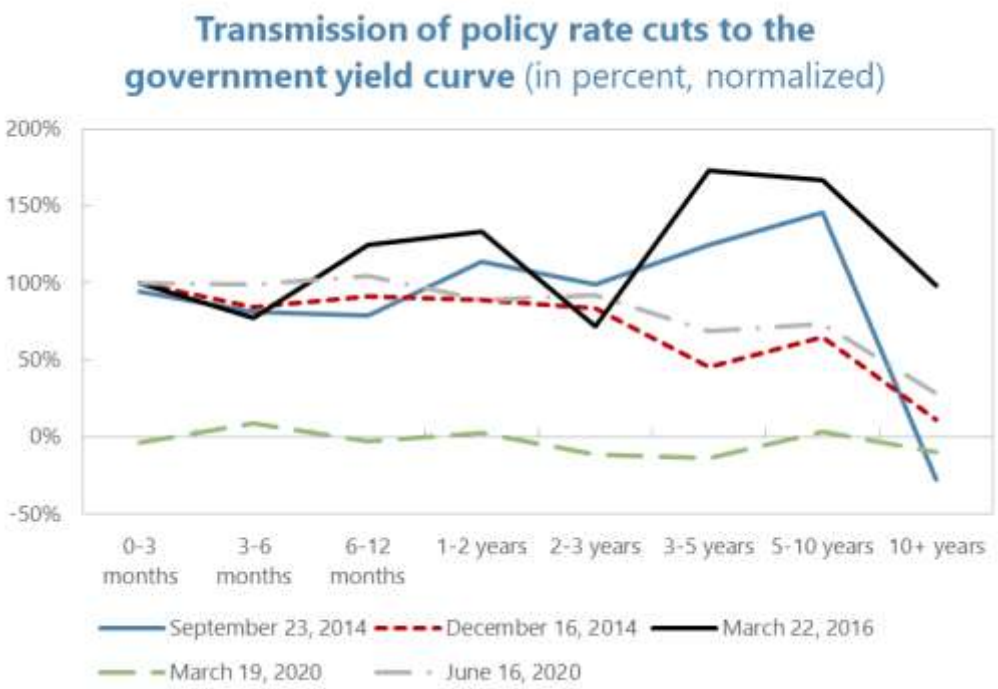
Source: IMF staff calculations

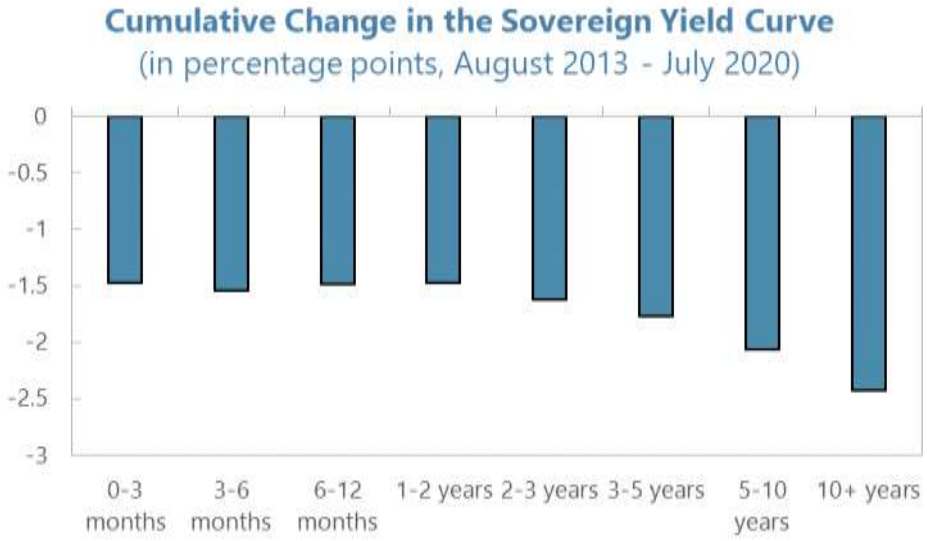
Overall, these results suggest that contractionary monetary shocks reduce output growth and inflation marginally in Morocco, including when we account for the behavior of the exchange rate. Our results likely reflect the absence of the amplification mechanism of the exchange rate, as the dirham has been pegged to a basket of currencies with increased flexibility only toward the end of the 2007-2020 period, and the fact that Morocco has not fully transitioned to an IT framework. These results are in line with Brandao Marques and al. (2020) which finds that tightening policy shocks reduce growth and inflation in EMEs only when the interaction with the exchange rate channel is taken into account, and their impact is significantly stronger in countries that have adopted an IT framework.

Has the transmission of policy rates of market rates weakened in Morocco?

In the wake of the pandemic, transmission to government bonds remained relatively strong at the short end of the yield curve. Government bonds are actively traded until the five-year maturity and considered sufficiently liquid until the 10-year maturity. The transmission of policy rates to the yield curve (measured one month before/after the monetary policy decision) has been historically strong, and the pass-through has remained significant also during the pandemic shock, except for the rate cut announced in March 19, 2020) (Figure 3). The rate cut announced in June 2020 affected the yield curve mainly until the 5-year maturity. The longer end of the curve may have reached a floor after experiencing a sizable decline over the past 7 years, which flattened the yield curve significantly.

Figure 3. Monetary Policy Transmission to the Government Yield Curve[6]



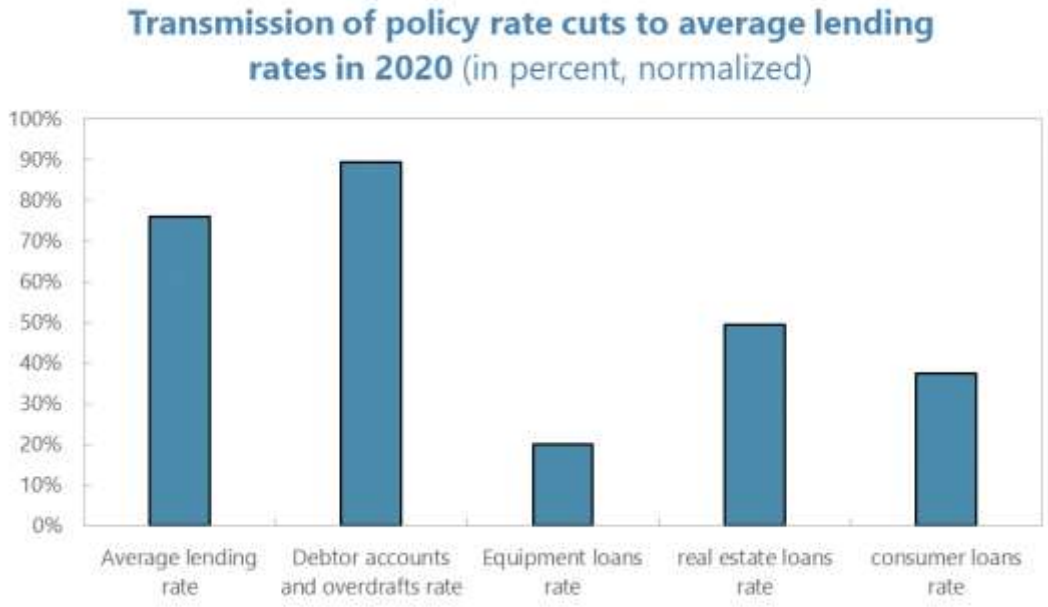


Source: Bank al-Maghrib, IMF staff calculations

[6] In this panel, the first chart presents the degree of pass-through (expressed in percentage points) to the sovereign term structure taking the difference in yields one month after the announcement relative to one month before) and divided by the number of basis points by which the policy rate has been cut. It comprises all 4 policy rate cuts announced from end-2012 to end-2020. The second panel presents the overall change in the sovereign term structure (in percentage points) from August 23, 2014 to July 17, 2020.

Transmission to lending rates appears stronger on average across different type of loans (Figure 4), but this partly reflects the direct link between the interest rate on funding-for-lending programs launched in the wake of the COVID-19 crisis (Damane Oygene and Damane Relance) and the policy rate, while other lending rates have not fallen significantly. This seems to be the opposite of what happened in the past, when the pass-through of policy rate cuts to short-term credit facilities was lower than to other type of loans, like mortgages (Bennouna, 2018). It is a testament to the effectiveness of the funding for lending scheme that were put in place in the wake of the pandemic to support short-term lending to firms.

Figure 4. Monetary Policy Transmission to Lending rates[7]



Source: Bank al-Maghrib, IMF staff calculations

Constraints to Monetary Policy in a Low Rate Environment

Banks may be reluctant to pass through additional rate cuts given the risks of losing funding, as depositors may shift to cash. Financial disintermediation can occur should the return of deposits with banks decrease below the opportunity cost of alternatives forms of holding liquidity for transactional purposes or storage of value. To avoid losing funding, bank should not pass to depositors any cut to the policy rate if this means to reduce the interest rate on deposits below a "technical lower bound" (TLB), which is the nominal interest rate at which the transmission mechanism breaks down completely (della Valle and al., 2018).

[7] This panel presents the degree of pass-through (expressed in percentage points) to lending rates of a 1 basis point reduction in the policy rate, as measured one month before/after the announcement. It comprises all 4 policy rate reductions announced from end-2012 to end-2020.

This paper estimates the interest elasticity of cash holdings in Morocco to approach this risk of financial disintermediation, as the TLB depends on the sensitivity of the demand for banknotes to the interest rate paid on banks' deposits (Della Valle, 2018).[8] We estimate the demand for banknotes in Morocco specifically, based on a vector error correction model. Following della Valle and al. (2018), the error correction model estimates the relationship between the public demand for banknotes (proxied by currency in circulation as a percentage of GDP) and variables proxying capital market development (real GDP per capita), financial depth (local currency -sight and term- deposits as a percentage of GDP), and the local (12- month) deposit rate. Foreign currency deposits also proxy foreign banknotes in circulation.

Overall, the correlation between the demand for banknotes and these financial variables appears relatively weak in the case of Morocco, in contrast with the panel and time series estimates presented in Della Valle and al. (2018). Our results show that the local currency deposit rate, which represents the opportunity cost of holding banknotes, is negatively correlated to the demand for banknotes only in the long run, but results are not statistically significant, and coefficients are relatively small (Table 3). As expected, capital market development is negatively correlated with the demand for banknotes both in the short and long terms. Financial depth is expected to increase the demand for banknotes but estimates for Morocco shows a positive correlation only in the long run. Finally, foreign currency deposits, which should reduce the demand of local banknotes for transactional purposes, has a diverging impact in the short and long run. In the long run, they are negatively correlated with the demand for banknotes as expected.

[8] In its 2021 Annual Report, BAM uses a similar approach to gauge the monetary policy lower bound.

Table 3. Estimates of the Demand of Banknotes in Morocco

	Morocco VECM	
VARIABLES	Co-integrating equation	Error correction equation
Demand deposit to GDP		-0.330***
		(0.115)
Log GDP per capita	-0.7806777	0.0735
	(0.2086114)	(0.240)
Local currency deposit to GDP	0.2373017	-0.227
	(0.3607086)	(0.214)
Foreign currency deposit to GDP	-3.011275	-1.799**
	(1.006809)	(0.723)
Local currency deposit rate	-0.0746137	0.000167
	(0.0581688)	(0.0520)
Constant	4.936004	0.0183***
		(0.00676)
Observations	70	
Time period	2002Q3 - 2019Q4	
AIC	-20.44371	
HQIC	-19.94611	
SBIC	-19.19097	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: IMF staff

The sensitivity of the demand for banknotes to deposit rates appears therefore limited in Morocco and does not seem to constrain significantly monetary policy. This weak relationship may reflect structural characteristics of the Moroccan economy. First, as sight deposits are not remunerated in Morocco, lower term-deposit rates are likely to lead to a shift from term deposits to sight deposits rather than to cash. Second, in a context of a fixed exchange rate from 2003-2016,[9] BAM had limited use of the interest rate channel, which have remained broadly stable, at around 3.5-4 percent. Third, the weak relationship between

[9] In March 2020, BAM broadened the dirham's fluctuation band to +/- 5 percent (from +/- 2.5 percent) as part of a gradual and orderly transition to a more flexible exchange rate regime.

the demand for banknotes and deposit rates may reflect low financial inclusion in Morocco, where large segments of the population have still low access to financial services.[10]

Central banks may also be unwilling to cut rates below a certain level for fear of adverse effects on financial intermediaries and credit dynamics. The interest rate below which these adverse effects could seriously impair or even reverse the pass-through of policy rates to lending and deposit rates is defined as the "reversal rate". It corresponds to the rate at which the positive effects of policy rate cuts on existing bank assets (with fixed interest payments) are offset by a decline in net interest margins on bank new business. Banks' lower net worth and tighter capital constraints mean the transmission of policy rate easing is impaired (Brunnermeier, 2017). Such rate depends on the composition of financial intermediaries' balance sheet and stream of income, and thus is affected by both micro- and macroprudential financial regulation.[11]

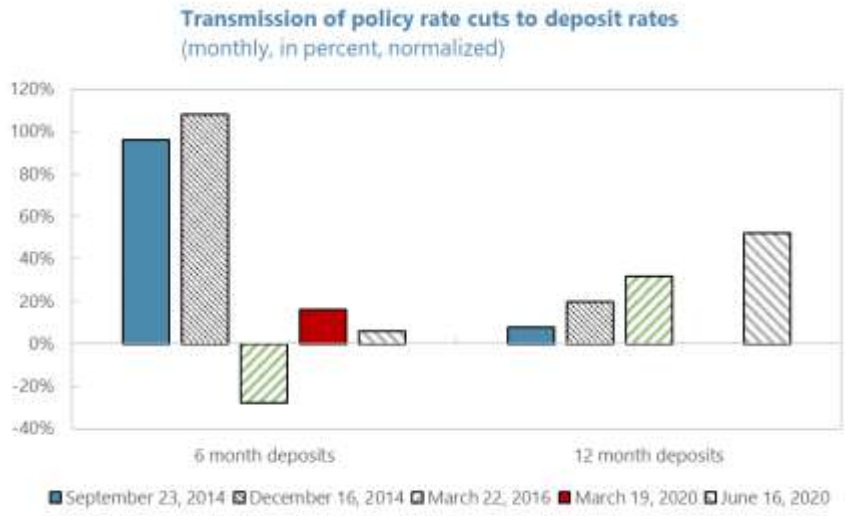
In Morocco, the banking system is heavily reliant on retail deposits for its funding, with the bulk constituted by sight deposits, which carry no interest. In 2019, deposits accounted for about two thirds of banks' funding. Banks already face increased difficulty passing through policy rate cuts to deposit rates, particularly to 6-month deposits rate (Figure 5).[12] And with the decline in deposit interest rates, banks experienced a change in the composition of deposits, with a shift from term deposits to sight deposits (Figure 6).

[10] The share of adults (aged 15+) with accounts in financial institutions is 29 percent, against 51 percent in peer countries.

[11] In Chile for example, the central bank estimates the lower bound at 0.5 percent which is the level below which money market funds would stop intermediate short-term investment instruments that help households and businesses meet their immediate cash-flow needs.

[12] The elimination of the reserve requirement reduced banks' cost of funding and provided them a temporary small additional margin which may have been partially passed through to depositors to limit the decline in short-term deposits.

Figure 5. Monetary Policy Transmission to Deposit Rates[13]



Source: Bank al-Maghrib, IMF staff calculations

Figure 6. Share of total bank liabilities
(in percent)

Source: Bank al-Maghrib

[13] This panel presents the degree of pass-through (expressed in percentage points) to deposit rates of a 1 basis point reduction in the policy rate, as measured one month before/after the announcement. It comprises all 4 policy rate reductions announced from end-2012 to end-2020.

With sight deposit reaching 40 percent of bank deposits the ability of banks to transmit policy rate cuts is limited. Moreover, low interest rates have caused a compression in Moroccan banks' net interest margins which have declined steadily since 2012, as the reduction in average lending rates was larger than the decline in the cost of deposits (Figure 7). In that context of lower profitability, Moroccan banks may become reluctant to pass-on lower policy rates to borrowers and depositors, thus weaking the transmission of monetary policy.

Figure 7. Interest Rate Margin on Retail Operations
(in percent)

Source: Bank al-Maghrib

II. Modeling the Impact of an Asset Purchase Program in Morocco

So far we have provided evidence on three arguments that all point to a challenging environment for expansionary monetary policy in Morocco: i) the neutral interest rate is likely to have fallen in Morocco over the last decade, as well as in many other AEs and EMEs; ii) the impact of monetary policy on economic activity seems relatively more muted in Morocco, even after controlling for the increased flexibility around the peg; and iii) the current extremely low level of interest rates may complicate the transmission of policy rates to market rates. Against the context of reduced room for conventional monetary policy, this section focuses on whether BAM could resort to unconventional monetary policy measures if it were to react to additional negative economic shocks in the future.

In particular, we ask whether BAM could flatten the sovereign yield curve (particularly at longer maturities) by purchasing governments bonds in secondary markets. Asset Purchase Programs (APPs) have proven effective in easing broad financial conditions in AEs, particularly in the US (Bernanke, 2020). And there is some evidence that they have proven effective in allowing a number of EMS to lower long-term interest rates in the wake of the COVID-19 crisis (Hartley and Rebucci, 2020). By purchasing sovereign bonds in secondary markets, BAM would force banks to look for alternative sources of yield, by either increasing

their credit risks (for example by lending to SMEs)[14] or their maturity risks (by providing longer term loans).[15] The implementation of APPs, however, would need to be consistent with the overall BAM monetary policy framework. BAM may quickly lose its hard-won credibility if its APP were to be perceived by market participants as equivalent to monetary financing. Such perception may cause inflation expectations to increase and bring exchange rate depreciation pressures.

We use a semi-structural model calibrated to the Moroccan economy (see Baksa et al. 2021) to simulate the macro economic impact of unconventional monetary policy in Morocco, in the form of BAM buying government bonds in secondary markets. We follow Baksa et al. and consider a scenario where the recovery from the economic recession of 2020 is slower than expected by staff at the time of the 2020 AIV Staff Report (Country Report No. 2021/002).

In the staff baseline scenario, the Moroccan economy is projected to recover slowly from the double impact of the COVID-19 and drought shocks of 2020. Growth is expected to rebound from -7 percent in 2020 to 4.5 percent in 2021 and 3.9 percent in 2022, as the harvest returns to historical average, progress in vaccination allows a gradual improvement in domestic and external demand, and monetary and fiscal policies remain supportive (with little to no change in policy interest rates and in the cyclically adjusted primary fiscal balance during 2021). Still, the sizeable output gap that opened in 2020 would be reabsorbed fully (and inflation will return to 2 percent) only in 2025.

A downside scenario, however, is constructed where slower progress in vaccination and persistent circulation of the virus call for an extension of lockdown measures for most of 2021, both in Morocco and its main trading partners (Figure 8, solid lines). In such a scenario, continued weakness of domestic and external demand and the supply disruptions from the virus containment measures are assumed to slow GDP growth in 2021 to 1.5 percent, keeping the output gap below baseline by about 2 percentage points. Greater fiscal deficit and financing needs cause an increase in the country risk premium. GDP growth would gradually return to baseline in the following years, but more persistent weakness of economic activity would bring additional damage to the economy's output potential.

In Baksa et al. (2021), the model is used to compare the room for further monetary policy easing in the downside scenario, under three different exchange rate regimes: 1) one closer to a *rigid peg* (with very limited use of the flexibility allowed by the band); 2) an intermediate regime where BAM fully utilizes the *flexibility* allowed by the existence of the band around the peg, and 3) an *inflation targeting* (IT) regime, where the 2 percent inflation target is the

[14] An APP of 5 percent of GDP would represent about a quarter of banks' holding of Treasury bonds which are mostly used as a collateral for refinancing.

[15] However, in a scenario of QE, with zero interest on excess reserves and no deposit facility, short-term market rates would converge to zero, as the interest rate paid on excess reserves becomes the de facto policy rate. To maintain its control over short-term market rates through the policy rate, BAM would need to pay interest on reserves, which may reduce QE effectiveness as it would lower incentives for banks to search for yields. This would also expose the central bank balance sheet to maturity risks.

nominal anchor and the exchange rate is left free to float. The central bank reaction is more limited under the rigid peg as the interest rate increases with the rise in the risk premia to eliminate the pressure on the currency. Under the IT regime, the exchange rate depreciation helps close the output gap sooner and bring back inflation faster to the implicit target (Figure 8, solid blue and red lines). In the intermediate (band around the peg) regime (green lines), BAM reduce the policy rate, but the more limited depreciation of the currency means both the output gap and inflation would still remain below the baseline projection.

In this paper we add a scenario in which BAM purchases government bonds in secondary markets (Figure 8, dashed lines). Although our model does not include an explicit equation of the central bank balance sheet, we introduce an APP as an exogenous shock to the term and risk premia in both short-term (1-year domestic bonds) and medium-term (5-year domestic bonds) yields. The shock to the short-term rate, similar to a negative interest rate shock in the Taylor rule, boosts aggregate demand and inflationary pressures, while the shock to the medium-term rate flattens the long-term interest rate and improves potential growth.

We assume that the APP implemented by BAM would amount to 5 percent of GDP, a smaller balance sheet expansion than the one carried by BAM in 2020 in response to the pandemic (8.5 percent of GDP).[16] Given that Morocco has never implemented an APP, the impact of the APP on yields is tentatively calibrated using the average elasticity of sovereign bonds yields to APP in EMEs as estimated in recent literature. In particular, Fratto and al. (2021) show that APPs implemented in EMEs have been effective across the yield curve, with bond yields declining significantly following the APP announcements at maturities between 2 and 5 years as well as 10-year maturity. Based on their calculation, one percent of GDP APP reduces the long-term yields by 30 basis points on average. This is also consistent with the average elasticity for EMEs estimated in Hartley and al. (2020).[17]

Our results, shown in Figure 8, are as follows:

- *Under the rigid peg regime*. The model simulation shows that an APP has a limited impact on inflation and output in this regime. The APP significantly lowers market interest rates, more than offsetting the expected increase in the risk premium under the baseline. However, the impact of the APP on the output gap through the demand channel is relatively limited (+0.1 percentage points of GDP relative to the downside scenario on average from 2021-2025).

- *Under the peg with fluctuation band.* Interest rates fall the most compared to the other two regimes, and the dirham depreciates by almost 1.8 percent within the fluctuation band. However, the need to keep the dirham within the fluctuation band while reacting to

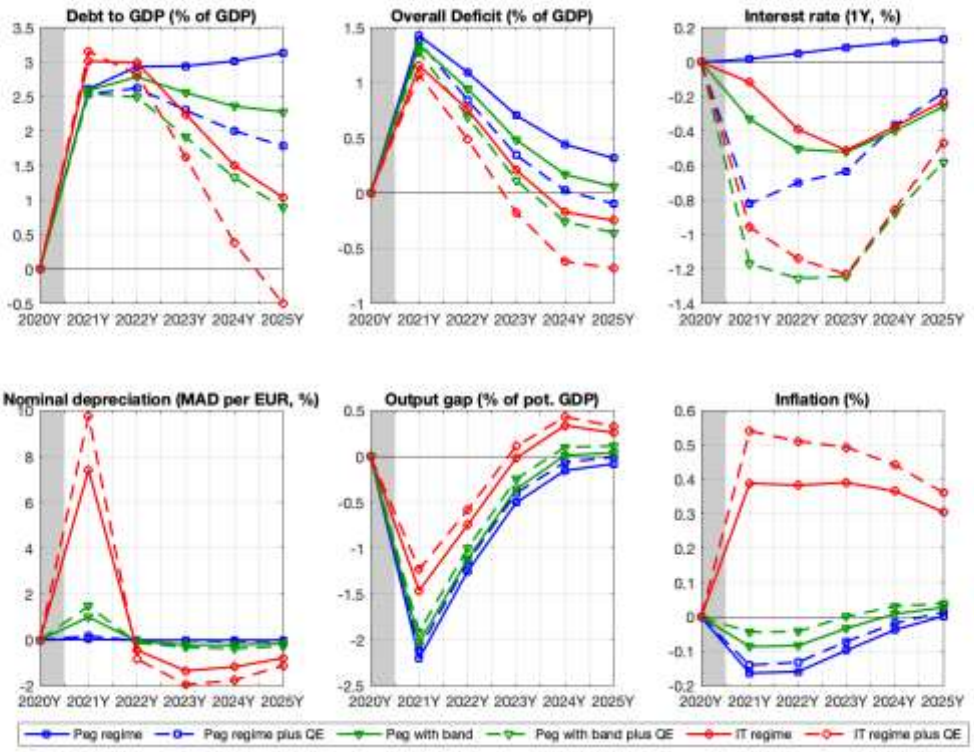
[16] This would represent around 8 percent of the stock of Treasury bonds in Morocco, a significantly smaller share than the European Central Bank's holdings of total outstanding big-four government bonds of around 23 percent in 2018, prior to the COVID19 pandemic.

[17] In our simulations, the exogenous term premium is reduced by 85 and 75 bps in 2021 for short and medium-term bonds, respectively. The cut is smaller in outer years, and equal to 50 bps in 2025, for both short and medium-term bonds yields. The risk premium in medium-term bond yields is reduced by 25 bps.

the lower-than-targeted inflation limits the economic impact of the APP (GDP increases again by 0.1 percentage points relative to the downside scenario on average from 2021-2025).

- *Under an IT monetary policy regime*. Under the IT regime, the short-term rate also falls close to zero and remains at that level till 2024. The exchange rate depreciates more strongly, by about 10 percent compared to the current regime, and through 2024, which would cause inflation to rise in 2021 and slowly approach BAM's 2 percent inflation target. The output gap would close faster, with real GDP increasing by 0.2 percentage point in 2021, helping the debt-to-GDP ratio return to the baseline projection more rapidly. This simulation clearly shows that under flexible exchange rate, the APP is more effective in keeping the interest rate lower for a longer period. With a stronger interest rate channel and the more depreciated real exchange rate, monetary conditions become more supportive of domestic demand, helping to get inflation closer to the targeted level.

Figure 8. Impact of a downside scenario (solid lines) and an Asset Purchase Program (dashed lines) under different monetary regimes



Source: IMF staff simulations
Results are expressed as deviation from the baseline forecast scenario. The baseline forecast scenario is identical with the IMF Article IV projection published in January 2021.

III. CONCLUSIONS

This paper shows that Morocco's real neutral interest rate has been on a downward trend, which has accelerated with the COVID-19 pandemic. We also find that the interest rate channel is relatively weak in Morocco. First, the central bank reaction function to its inflation and output forecasts is limited. Second, the effect on output growth and prices of a contractionary monetary policy shock is muted, as the exchange rate channel does not reinforce the interest channel given limited exchange rate flexibility over most of the 2007-2020 period, and as Morocco has not yet transitioned to an IT framework. Finally, the pass through of policy rate cuts has also weakened recently, with transmission of policy rate cuts declining to the long end of the sovereign yield curve and weakening to deposit rates and to most lending rates, except short-term lending to firms supported by the funding for lending scheme put in place in response to the pandemic.

Monetary policy may be further constrained in a context of historically low levels of interest rates. We do not find a strong weak relationship between the demand for cash and key financial variables in Morocco, possibly indicating the limited role of the policy rate in driving bank deposits in a still largely informal economy. But the heavy reliance of bank funding on non-interest-bearing deposits and short-term savings account may weaken bank capacity to pass through lower policy rates as they may approach the reversal rate.

In that context, policy interest rate cuts could be complemented by an APP, which would help flatten the government yield curve and better sustain domestic demand. However, our simulations show that the existence of a hard peg would limit the effectiveness of an APP, which significantly relies on the exchange rate channel in the model. In the current, intermediate monetary policy regime, an APP would also have limited effects, as BAM would need to at least partially offset the injection of liquidity from the APP to keep the exchange rate inside the band. The APP would become a more effective monetary policy instrument under an IT framework.

While illustrative, these simulations confirm that if monetary policy reaches its effective lower bound, limited and credible recourse to an APP would usefully complement conventional measures and strengthen monetary policy transmission under an IT regime with a flexible exchange rate. The recourse to an APP would need to be consistent with BAM continued, credible commitment to maintain long-term inflation expectations anchored, something that would be easier to communicate once the transition to an IT monetary policy regime is completed.

Appendix I. A Semi-Structural Model with Monetary and Fiscal Policy for Morocco.

The Moroccan semi-structural model that represents the new generation of gap models within the Financial Programing 2.0 framework (Baksa, Bulir and Heng, 2020). The model applies the minimalistic but necessary assumptions to capture the relationship among the main aggregate macroeconomic variables and monetary and fiscal policy. The variables are decomposed into gap and trend components. The gaps describe the short-term cyclical position of the economy, while the trends capture the medium- and long-term potential. Our model consists a dynamic IS curve for the aggregate demand (or output gap) and a Phillips curve for the inflation that connects the real economic fluctuations with the price setting.

The exchange rate and monetary policy regimes are modeled to reflect Morocco's ongoing transition toward an inflation targeting regime with a more flexible exchange rate.[18] Currently, Morocco monetary policy framework is based on an exchange rate peg regime, with a horizontal band of ±5 percent, and a relatively closed capital account. Under the interim regime the nominal exchange rate is determined by the weighted average of two effects: (1) the currency basket; (2) the market effect that adds volatility to the exchange rate. The calibrated weight considers the recent volatility of the nominal exchange rate and the progress the central bank achieved in the way of transition.

$$s_t^{MAD/EUR} = \omega^{PEG} s_t^{MAD/EUR,PEG} + (1 - \omega^{PEG}) s_t^{MAD/USD,FL}$$

where ω^{PEG} denotes the weight of currency-basket-based exchange rate $s_t^{MAD/EUR,PEG}$, $s_t^{MAD/USD,FL}$ is the implicit exchange rate that adds more volatility to the exchange rate through the uncovered interest rate parity condition. The currency basket is defined as the weighted average of the exchange rate vis-à-vis the Euro and the US dollar, with weights equal to 60 and 40 percent, respectively. Adding flexibility through the fluctuation bands implies bigger role for market forces in determining the exchange rate in the short run and this channel is modeled by the uncovered interest parity condition:

$$s_t^{MAD/EUR,FL} = E_t s_{t+1}^{MAD/EUR} + i_t^{EUR} - i_t + prem_t + \varepsilon_t^s$$

where the volatile part of the exchange rate depends on the expected nominal exchange rate, foreign and domestic interest rate differentials $i_t^{EUR} - i_t$ and the risk premium $prem_t$, ε_t^s denotes the transitory shock to the exchange rate.

Due to the presence of capital controls (mainly limiting residents' access to foreign assets), in the short run the central bank can set the domestic policy rate independently from external considerations, while keeping an exchange rate peg. The interest rate has two components: (1) peg-based interest rate with a weight of ω^{PEG}; (2) $1 - \omega^{PEG}$ weighted shadow interest rate consistent with a flexible exchange rate and inflation targeting (or some other price-

[18] The Mundell-Fleming trilemma says that a country must choose between the objectives of free capital mobility, exchange-rate management, and monetary autonomy, as only two can be pursued simultaneously (Obstfeld, Shambaugh, and Taylor 2005).

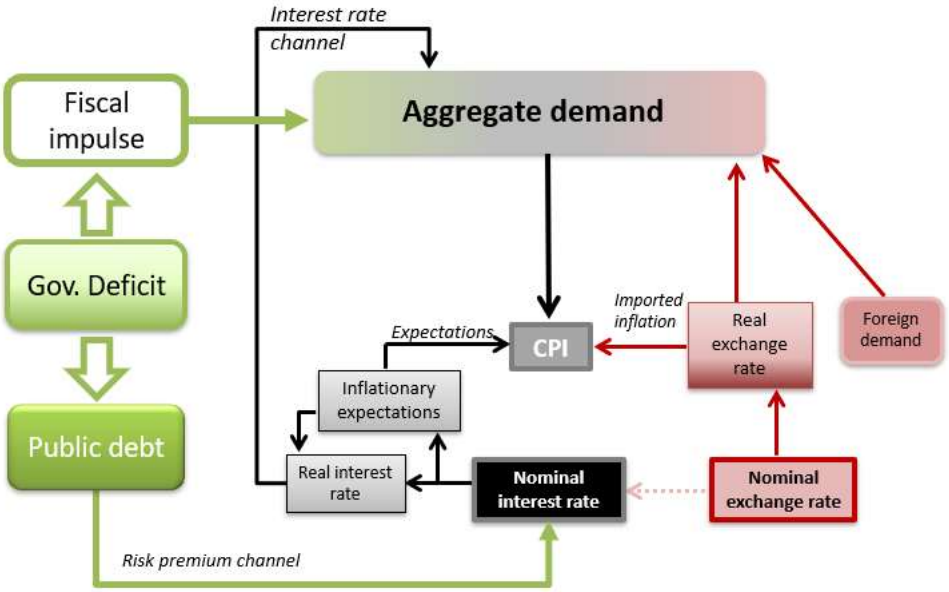
stability oriented regime). The peg-based interest rate is the weighted average of two components: (1) the policy rate set by Bank Al-Maghrib to keep expected inflation around a desired level (the first term in square brackets, weighted by c_1) and (2) the 'financial market driven' interest rate as implied by shadow UIP conditions proxied by the expected exchange rate depreciation and foreign interest rate (the second term in square brackets, weighted by $(1 - c_1)$:

$$i_t = \omega^{PEG}\Big[c_1[c_2 i_{t-1} + (1-c_2)(\tilde{\imath}_t + c_3(E_t\pi_{t+1} - \pi^{Tar}))] + (1-c_1)\big[E_t\Delta s_{t+1}^{MAD/EUR} + i_t^{EUR} + prem_t\big]\Big] + \\ +(1-\omega^{PEG})[c_1^{IT} i_{t-1} + (1-c_1^{IT})(\tilde{\imath}_t + c_2^{IT}(E_t\pi_{t+1} - \pi^{Tar}))] \\ +\varepsilon_t^i$$

The parameter c_1 denotes the ability of the central bank to set, through its sterilization policy, a domestic interest rate that is different from the foreign one, thus effectively proxying the impact of capital controls. The IT-based part, weighted by $(1 - \omega^{PEG})$, is the function of the interest rate smoothing and central bank's reaction to the inflation gap. In the current regime with a more flexible exchange rate the additional inflationary reaction through c_2^{IT} is needed to stabilize prices and cyclical fluctuations. In summary, the parameter ω^{PEG} provides a convenient proxy to capture the degree to which the economy is insulated by the capital flow controls and foreign exchange interventions. Finally, ε_t^i denotes the monetary policy shock.

The separated fiscal block pins down the public debt through the fiscal rule for the cyclically adjusted primary deficit. The debt accumulation is enriched by different maturity and currency structure. The changes in the cyclically adjusted deficit implies fiscal impulse that has an impact on the real economic activity, while the higher than targeted debt ratio imposes positive pressure on the risk premium and slows down the potential growth of the economy.

This model has been calibrated to fit the stylized facts of the Moroccan economy. The model differentiates the agricultural and non-agricultural GDP. The agricultural part is 12 percent of the total GDP and it is a fully exogenous process. The dynamic IS curve describes the fluctuation of non-agricultural GDP gap. The steady state the potential growth of GDP for both components are calibrated to 4 percent. The steady state nominal and real exchange rate appreciation is zero, the foreign inflation target is consistent with the ECB 2 percent target, with the implied domestic inflation target equal to 2 percent. In the fiscal block, the total public debt target is 60 percent of GDP, and the foreign currency denominated share of public debt is 15 percent, 5 percent of the debt is financed from one-year bonds, and the rest is financed from domestic bonds with five-year maturity.



Appendix II. Variables Definition and Sources

Variable	Definition	Sources
Consumer Price Index (log)	Log of the all-items consumer price index (Quarterly)	Haut-Commissariat au Plan (HCP); Haver
Nominal Gross Domestic Product (log)	Log of nominal gross domestic product (Quarterly)	IMF International Financial Statistics
Nominal Effective Exchange Rate (log)	Log of nominal exchange rate index (Quarterly)	IMF International Financial Statistics
Interbank Money Market Rate	Central Bank's policy rate using the money market interbank rate *(Marché monétaire interbancaire)*	Bank Al-Maghrib; available at: www.bkam.ma/Marches/Principaux-indicateurs/Marche-monetaire/Marche-monetaire-interbancaire
Inflation Forecast	The central bank's quarterly inflation forecast starting from 2007Q1.	Bank Al-Maghrib
GDP Growth Forecast	The central bank's quarterly GDP growth forecast starting from 2007Q1. *Since GDP forecasts were only published for the next 2 quarters until 2016, we used BAM's annual GDP growth forecast to estimate the missing 2-3 quarters for each forecasting period.*	Bank Al-Maghrib; IMF staff estimates
Demand Deposit	Demand deposits & Savings accounts with banks denominated in local currency *(Dépôts à vue et comptes d'épargne auprés des banques)*	Bank Al-Maghrib

Local Currency Deposit	Term accounts and certificates of deposit with banks in local currency *(Comptes à terme et bons de caisse auprés des banques)*	Bank Al-Maghrib
Foreign Currency Deposit	Deposits denominated in foreign currency *(Dépôts à vue et à terme en devises auprés des banques)*	Bank Al-Maghrib
Real GDP per capita	Gross domestic product per capita in real terms	World Economic Outlook
CBOE VIX Index	The Chicago Board of Exchange's S&P 500 implicit volatility index.	Haver
Commodity Price Index	Goldman Sachs Global Commodity Price Index.	Bloomberg
Global Monetary Policy (1PC)	The first principal component of Krippner's (2015) shadow policy rates for the euro area, Japan, United Kingdom, and the United States.	Krippner (2015), available at https://www.ljkmfa.com/test-test/international-ssrs/
Temperature Anomaly	GISTEMP air temperature anomaly smoothed over global 250km-spaced grid. Temperature anomaly is assigned to each country-year by finding the point in the grid (with data) closest to the country's capital using longitude and latitude dimensions.	GISTEMP Team (2019) and Lenssen and others (2019). GISTEMP data provided by the NOAA/OAR/ESRL PSD, Boulder, Colorado, USA, from their website at https://www.esrl.noaa.gov/psd/ (accessed on 1/14/2021)

Precipitation Anomaly	NOAA's precipitation anomaly smoothed over global 2.5o-latitude by 2.5o-longitude grid. Precipitation anomaly is assigned to each country-year by finding the point in the grid (with data) closest to the country's capital using longitude and latitude dimensions.	Chen and others (2002, 2004) and Chen and others (2003). PREC Precipitation data provided by the NOAA/OAR/ESRL PSD, Boulder, Colorado, USA, from their website at https://www.esrl.noaa.gov/psd/ (accessed on 1/14/2021)

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