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MAURITIUS

SELECTED ISSUES

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African Department

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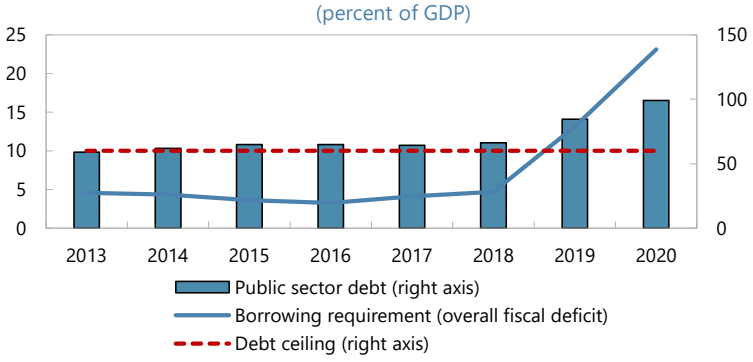
REINSTATING FISCAL RULES IN THE POST-PANDEMIC MAURITIUS: SCENARIOS AND POLICY OPTIONS[1]

This paper reviews the fiscal rules framework in Mauritius with a focus on the calibration of the debt and budget balance ceilings. The paper concludes that a new medium-term debt anchor could be up to 80 percent of GDP compared to the anchor of 60 percent of GDP repealed during the pandemic. Introducing a short-term operational rule based on the overall fiscal deficit ceiling of around 3 percent of GDP would help reduce debt from 99.2 percent of GDP in FY2020/21 to close to the anchor by FY2026/27. The revised debt anchor would better reflect Mauritius' debt carrying capacity while supporting growth. However, the current level of debt stands well above the proposed anchor. A transition period could be considered during which the deficit would gradually decline from 7.6 percent of GDP in FY2021/22 to 3 percent of GDP in FY2026/27 and beyond. Debt sustainability risks should continue to be assessed on the IMF's Debt Sustainability Assessment tools regardless of whether the debt anchor has been met.

A. Introduction

1. The substantial fiscal stimulus and revenue losses coupled with GDP contraction amid the pandemic have contributed to a public debt surge in Mauritius, prompting the authorities to repeal the debt ceiling. Unprecedented high borrowing requirements in FY2019/20, partly driven by a sharp increase in pensions, pushed the public debt to around 85 percent of GDP, from around 64 percent of GDP just two years earlier. The substantial fiscal stimulus to mitigate the health and economic impact of the pandemic, revenue losses, and the contraction in GDP further pushed debt to about 100 percent of GDP in FY2020/21 (Figure 1). With debt well above the then medium-term ceiling of 60 percent of GDP, the authorities repealed the ceiling in 2020 by activating the relevant escape clause. As a result, the fiscal policy currently lacks a debt anchor risking policy discipline in the medium term.

Figure 1. Mauritius: Borrowing requirement and public sector debt
(percent of GDP)



Source: Country authorities and IMF staff estimates.

2. While reinstating a medium-term debt ceiling will be essential to safeguard debt sustainability and fiscal discipline, Mauritius' debt carrying capacity may support a higher ceiling than the repealed level. As an intuitive indicator of the ability to repay debt, government revenue offers an important criterion to assess whether a given debt level is safe. Revenue

[1] Prepared by Félix F. Simione.

mobilization in Mauritius is relatively high and increased significantly in the pre-pandemic years.[2] Moreover, the global economy is facing a new reality of persistently low real interest rates. These factors make higher levels of debt serviceable.[3] On the other hand, it is not clear whether the repealed ceiling was consistent with Mauritius' long-term growth objectives. Given these considerations, revisiting the debt ceiling framework is important as the authorities deploy efforts to reduce debt.

3. The paper is structured in three sections. The first discusses the recalibration of the medium-term debt anchor. The second considers operational rules—based on the overall budget balance and expenditure—to support the medium-term debt anchor. The third section discusses potential reforms to support the implementation of the debt rule.

B. Recalibrating the Medium-Term Debt Anchor

4. The calibration of the medium-term debt anchor follows a two-step approach. The first estimates the *maximum* level of debt that a country can sustain. We estimate such debt limit by using three standard methods that focus on: (i) maximum primary balance (or *fiscal fatigue*); (ii) debt-servicing capacity; and (iii) maximum growth. Once the debt limit is known, the debt anchor is calibrated in a second step considering a safety margin (or buffer) to account for potential macroeconomic shocks. In both steps, this paper follows the methods discussed in IMF (2018a) and David and others (forthcoming).

Step 1: Estimating the Debt Limit

5. Based on the *fiscal fatigue* approach, the debt limit for Mauritius is estimated at about 101 percent of GDP. This method estimates the limit above which debt cannot be stabilized in times of fiscal stress. The rationale is that the maximum level of debt is reached when negative macroeconomic conditions—measured by unfavorable interest rate-growth differential—create an upward pressure on debt, but the government cannot increase further the primary balance to offset this pressure. Such debt limit (D^*) can be approximated as the ratio of the maximum achievable primary balance (PB_{max}) to the interest rate-growth differential (r-g) under stress:

$$D^* = {PB_{max}}/{(r-g)_{stress}}$$

We assume a maximum feasible primary balance of 2 percent of GDP for Mauritius, consistent with cross-country historical experience of the largest primary balances emerging market countries have been able to achieve over certain periods (IMF 2018a; Escolano and others 2014).[4] The interest-

[2] Domestic revenue mobilization in Mauritius, at around 22 percent of GDP in FY2020/21, was among the highest in Sub-Saharan Africa where the median was around 16 percent of GDP in 2020.

[3] Although financial conditions are expected to tighten as the global economy recovers from the pandemic, real interest rates are expected to stay relatively low while public debt is persistently high in several countries. In the European Union, this reality has triggered an ongoing debate on whether the existing debt ceiling of 60 percent of GDP remains adequate, with some proposals to increase it to 100 percent of GDP (Francová and others 2021).

[4] For advanced countries, it is possible to assume a surplus of 4 percent of GDP (IMF 2018a).

growth differential can be approximated by computing the 95th percentile of its historical distribution over the period 2000-2019, estimated at 1.97 percent, respectively.[5] This would result in a debt limit of about 101.4 percent of GDP.

6. Based *on the debt-servicing capacity* approach, the debt limit for Mauritius is estimated at about 100 percent of GDP. This approach focuses on the ratio of interest expenses to revenues (excluding grants) as an indicator of the ability to repay debt. Empirical evidence from emerging markets and developing economies suggest that thresholds for the ratio signaling upcoming fiscal stress would range from 16 to 19 percent (David and others, forthcoming). Using these thresholds, denoted τ, the associated debt limit is computed by using the formula:

$$D^* = \tau\left(\frac{Revenues\,/GDP}{Effective\ Interest\ Rate}\right)$$

Using Mauritius' data for the period FY2015/16 to FY2018/19 and a threshold τ of 19 percent, the debt limit (D^*) is estimated at 100.1 percent of GDP.

7. Based on the *maximum growth* approach, the debt limit for Mauritius is estimated at about 89 percent of GDP. Following Checherita-Westphal and others (2014), this approach estimates a debt level beyond which debt starts to have a negative effect on growth, even when considering the positive effect of public investment—financed through additional debt—on growth. Assuming that public debt is used exclusively for public capital financing (a.k.a. *golden rule*), the optimal debt-to-GDP ratio (D^*) depends on the output elasticity of the public capital stock (α).

$$D^* = (\alpha/(1-\alpha)^2)^{1-\alpha}$$

Assuming for Mauritius a value of α of 0.35, the debt limit is estimated at 88.5 percent of GDP.[6]

8. In summary, the estimated debt limits range from 89 to 101 percent of GDP under a less conservative scenario, and from 75 to 90 percent of GDP under a more conservative scenario (Table 1). The calculations are not free of caveats. For example, the maximum achievable primary balance is based on cross-country experiences. The assumed revenue-to-GDP ratio is based on historical behavior, which can change in the future. Also, the *golden rule* underlying the maximum growth approach could be an unrealistic assumption. In addition, the estimates are significantly sensitive to the assumptions on the effective interest rate. Under the fiscal fatigue approach, if the effective interest rate-growth differential was set at the maximum observed historically, the estimated debt limit would be lower at 74 percent of GDP (Table 1, more conservative scenario). Under the debt-servicing capacity approach, if the assumed interest was set at 4.5 percent rather

[5] The interest rate-growth differential is computed for the period from the fiscal year FY2001/02 to FY2018/19. We exclude the period FY2019/20 and FY2020/21 for which the differential was extraordinarily high due to negative GDP growth amid the pandemic. The effective interest rate is calculated as the ratio of total interest payments (domestic and external) to the total debt stock in the previous fiscal year.

[6] Based on a simple log-log regression of real per capita GDP on public sector capital stock and a time trend for the period 1980-2017, we estimate α at 0.35. IMF (2021) estimates the value of α for WAEMU countries at 0.31. The efficiency of public investment in Mauritius is arguably higher than in WAEMU.

than 4 percent, the estimated debt limit would be lower at 90 percent of GDP (Table 1, more conservative scenario). Considering these uncertainties, the average of the three estimates could be used as the debt limit within each scenario.[7]

Table 1: Estimates of the Debt Limit and Underlying Indicators
(Percent of GDP)

Method	Underlying assumptions		Estimated Debt Limit	
	Less conservative	More conservative	Less conservative	More conservative
Fiscal Fatigue				
Maximum primary balance[1]	2.00	2.00	**101.4**	**74.6**
Maximum r-g[2]	1.97	2.68		
Debt-Servicing Capacity				
Revenue-to-GDP ratio (2015-2019 average)	21.3	21.3	**100.1**	**89.8**
Effective interest rate on debt[3]	4.03	4.50		
Debt-servicing capacity threshold (percent of revenue)	19	19		
Maximum growth				
Output elasticity to public capital stock	0.35	0.35	**88.5**	**88.5**
Average	N/A	N/A	**96.7**	**84.3**
Average with 15 percent buffer[4]	N/A	N/A	**86.7**	**74.3**

Sources: IMF Staff estmates

1\Based on cross-country historical experience of the largest primary balances emerging market countries have been able to achieve.

2\The less conservative scenario takes the 95th percentile of the historical distribution of primary balance for Mauritius. The more conservarive takes the value observed in 2009.

3\The less conservative scenario takes the average in 2015-19, while the more conservative scenario assumes 4.5 percent in line with higher rates observed before 2014.

4\A buffer (or safety margin) of 15 percent of GDP is deducted from the debt limits computed from the fiscal fatigue and debt-servicing capacity aproaches.

Step 2: From the Debt Limit to the Anchor, Accounting for the Buffer

9. The estimated debt anchor for Mauritius ranges from 74 to 87 percent of GDP. The medium-term debt anchor is calibrated as the difference between the debt limits estimated above and a safety margin. The rationale for the safety margin is to provide buffers against adverse macroeconomic shocks that could potentially push debt beyond the limit. Evidence for a large sample of low-income countries (LICs) points to safety buffers usually ranging from 7 to 15 percent of GDP. It is common to set a safety margin of 10 percent of GDP as default (David and others, forthcoming). However, given unprecedented large quasi-fiscal operations in Mauritius in recent years, which increases contingent debt liabilities to the government, it would be prudent to consider a larger buffer. We set it at 15 percent of GDP.[8] Given this buffer, the resulting debt anchor would

[7] Under the fiscal fatigue approach, if the effective interest rate-growth differential were set at the maximum observed historically (in 2009), instead of taking the 95th percentile of its historical distribution to remove outliers, the estimated debt limit would be lower at 74 percent of GDP. Under the debt-servicing capacity approach, if the assumed interest rate of 4 percent was set at 4.5 percent (in line with higher levels observed before 2014), the estimated debt limit would be lower at 90 percent of GDP. In these scenarios, the average debt limit from the three approaches would be lower at 84 percent of GDP. To address the uncertainty arising from these and other issues, the proposed debt anchors allow for buffers as discussed later.

[8] Recent unprecedented quasi-fiscal operations in Mauritius include transfers from the Bank of Mauritius (BOM) to the government in FY2019/20 and FY2020/21 amounting to around 4 and 13 percent of GDP, respectively. The BOM also set up an SPV in 2020 to which it injected Rs 80 billion (18 percent of FY2020/21 GDP) to finance systemically important companies amid the pandemic. These operations have contributed to a significant reduction of the BOM's capital, increasing the need for BOM recapitalization.

be set at 86.7 percent of GDP (less conservative scenario) or 74.3 percent of GDP (more conservative scenario).[9] Taking the average of the two scenarios, the anchor could be set at 80 percent of GDP. Alternatively, if the authorities err on the side of less risk, the anchor could be set at 74 percent of GDP (more conservative scenario), which is more in line with the DSA risk threshold for Mauritius (70 percent of GDP). In any case, the anchor would be significantly higher than the repealed level of 60 percent of GDP. In the remainder of this paper, we set the debt anchor at 80 percent of GDP. It is important to note that setting a debt anchor and undertaking a debt sustainability analysis are different exercises. Debt sustainability risks should continue to be assessed on the IMF's Debt Sustainability Assessment tools regardless of whether the debt anchor has been met.

C. From the Medium-Term Debt Anchor to the Short-Term Operational Rule

10. To help the current level of debt decline towards the estimated medium-term debt anchor of 80 percent of GDP, it will be critical to adhere to a short-term operational rule. The pros and cons of various short-term operational rules have been studied extensively in the literature and are summarized in Table 2. This paper focuses on the overall balance and expenditure rules given their acknowledged desired properties—simplicity of implementation, ease of measurement, monitoring, and communication.

Table 2. Assessment of Fiscal Rules

Budget Balance Rules	
Overall Balance	**Golden**[1]
+ Easy to communicate/monitor	+ Protect public investment
+ Clear operational guidance	+ Intergenerational equity
- Can lead to procyclicality	- Weak link to debt sustainability
- Could lead to changes in composition	- Creative accounting
Cyclically Adjusted and Structural	**Over the Cycle**[2]
+ Foster economic stabilization	+ Good stabilization properties
+ Good operational guidance	- May entail too loose/tight stance
- Difficult to compute and monitor	- Difficult to monitor and enforce
Expenditure Rules	**Revenue Rules**
+ Easy to communicate/monitor	+ Raise revenues or limit tax burden
+ Allow macroeconomic stabilization	- No direct link to debt sustainability
+ Clear operational guidance	- Can lead to procyclicality
+ Can ensure debt sustainability if well designed	
- Could lead to changes in composition	
- May reduce incentive to mobilize revenues	

Source: IMF (2018b)

1\ Golden rules impose a ceiling on the overall deficit net of capital expenditure (also known as *current balance*)

2\ Budget balance ceiling typically set and assessed as an average over the years encompassing all stages of the business cycle, including both expansionary and contractionary stages.

11. The overall balance that would stabilize debt at the anchor (80 percent of GDP) is estimated at -4.2 percent of GDP if convergence to the anchor is not time-bound. In the absence of shocks and stock-flow adjustments, and when the share of foreign currency debt is small, the debt-stabilizing overall balance (OB) can be obtained by using the standard relationship linking the debt-to-GDP ratio (D) and long-term nominal GDP growth (θ):

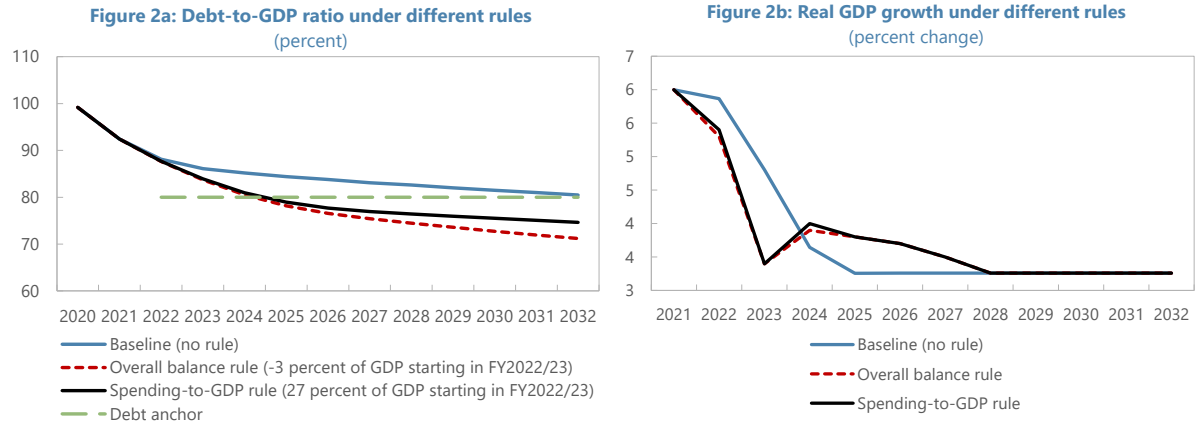
[9] The buffer is not applied to the debt limit estimated from the maximum growth approach. If the debt anchor is calculated as the level maximizing growth, there is no need to deduct a buffer since countries should try to be as close as possible to optimality (David, Eyraud and Sode, forthcoming).

$$OB = \left(\frac{-\theta}{1+\theta}\right) D$$

For a debt anchor of 80 percent of GDP and assuming Mauritius' potential nominal GDP growth of 5.5 percent, the overall balance stabilizing debt at the anchor is estimated at -4.2 percent of GDP, assuming an instantaneous adjustment. However, with a deficit target of 4.2 percent of GDP, convergence to the anchor would not be achieved even after 30 years. As this convergence period is too long, a smaller deficit target would be needed for a faster convergence. Using a *fiscal rules selection* tool developed in the IMF's Fiscal Affairs Department, we simulate the impact on the debt-to-GDP ratio from setting (i) a floor for the overall budget balance and (ii) a ceiling on the expenditure-to-GDP ratio, assuming a *desired* convergence period of no more than 10 years.[10]

12. Debt could be reduced towards the anchor (80 percent of GDP) by FY2024/25 by immediately adjusting the overall balance-to-GDP ratio to -3 percent, or alternatively adjusting the total spending-to-GDP ratio to 27 percent, starting in FY2022/23. Under both rules, the debt-to-GDP ratio would reach the anchor in FY2024/25, whereas it would remain at around 85 percent in the baseline (no rule) scenario (Figure 2a). However, the real GDP growth under the two fiscal rules scenarios would be lower than without the rules in the first years (Figure 2b). Moreover, while they are consistent with reducing debt towards the anchor, the scenarios under the two rules would likely be unrealistic given the large and frontloaded adjustment that would be needed.

Figure 2: Debt-to-GDP Ratio and Real GDP Growth Under Different Fiscal Rules

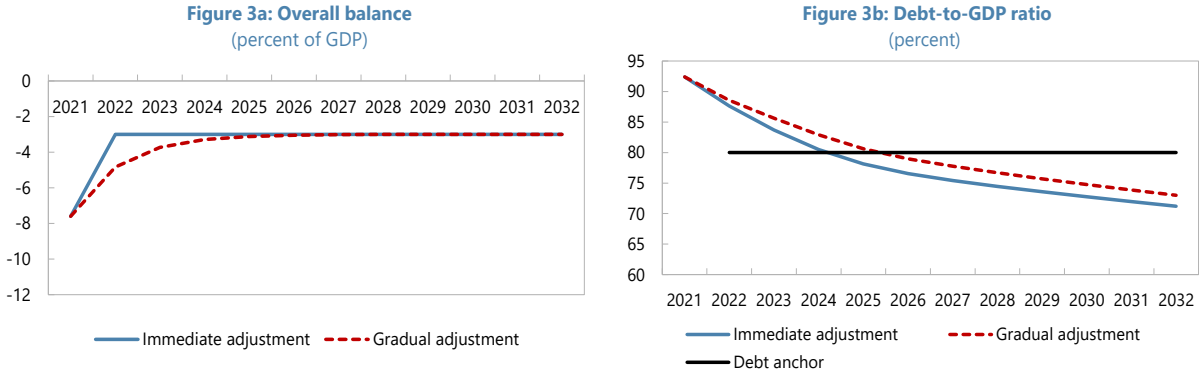


Source: IMF staff estimates.

[10] The effect of rules is simulated over 15 years based on assumptions on fiscal multipliers and the output elasticity of revenue and expenditures. For simplicity, the tool assumes that (i) the effective average interest rate on debt remains the same as in the baseline; (ii) all rules are implemented by adjusting primary spending only; and (iii) the adjustment in primary spending affects GDP through instantaneous and lagged multiplier effects. Once the change in GDP is computed, the simulations also account for the impact that the change in GDP has on revenue and spending-to-GDP ratios. The primary spending multiplier is assumed to be 0.5 contemporaneously (which is within the medium of normal times multipliers summarized in Batini and others 2014) and 0.1 one year after the adjustment. The revenue and primary spending elasticities to output are assumed to be 1 and 0, respectively.

13. A gradual adjustment of the overall balance would allow convergence to the debt anchor while safeguarding growth (Figure 3). As the economy is still recovering from the pandemic, a transition period could be considered during which the deficit would exceed the 3 percent of GDP target discussed above. We consider a scenario in which the fiscal deficit would gradually converge from 7.6 percent of GDP in 2021 to around 3 percent of GDP in FY2026/27 and beyond, instead of an immediate adjustment in FY2022/23. In this scenario, the debt ratio would reach the medium-term anchor two years later, in FY2026/27.

Figure 3: Overall Balance and Debt-to-GDP Ratio Under Alternative Adjustment Paths



Source: IMF staff estimates.

D. Improving Enforceability of the Debt Rule

14. To strengthen the enforceability of the medium-term debt anchor, a key step would be to adopt a short-term operational rule. The repealed debt ceiling of 60 percent of GDP lacked short-term operational guidance.[11] The authorities could consider introducing an operational rule, defined as the ceiling on the overall balance as percentage of GDP, which would be binding in the short term. The authorities already communicate their yearly fiscal stance in terms of the overall budget deficit, but there needs to be clarity on whether and how the deficit relates to the medium-term debt anchor. This issue could be addressed by formally setting a rule for the overall budget deficit. The calibrated ceiling for the fiscal deficit discussed earlier (3 percent of GDP) could be taken as a reference going forward. A choice would need to be made about whether to make the deficit target binding in every single fiscal year or allowing it to be reached on average across two or three years to introduce some flexibility. While the deficit ceiling would be expected to be binding in the short term, the medium-term debt anchor should ideally allow temporary deviations. This is because public debt is inherently persistent and affected by many developments other than changes in the overall budget balance.

[11] Almost 10 percent of countries with rules-based fiscal frameworks have a debt rule without an operational rule, while 15 percent have an operational rule without a debt rule (Eyraud and others 2018).

15. Further reforms can help enforce the operational rule, while allowing for flexibility. Successfully reinstating fiscal rules would require much more than setting a ceiling on the overall budget deficit. Other important steps include committing to a credible medium-term fiscal framework and compliance with rules.[12] To improve compliance, considerations could be given to creating an independent fiscal council that would monitor the rule. Moreover, introducing well-designed escape clauses would be important in anticipation of shocks that could challenge compliance with the rule (IMF 2020). Robust escape clauses can help achieve flexibility, a desired property of fiscal rules. While the repealed debt rule had an escape clause, the clause was vague as it allowed for deviations from targets in exceptional circumstances without a well-defined set of exceptional events. Hence, the clause was activated frequently and without guidance on returning to the debt anchor, potentially weakening the credibility of the rule. Considering international experience, the escape clause could be strengthened by making it more detailed, covering a limited and well-defined range of circumstances that could justify its activation. It could also include some guidance on returning to the anchor after the event triggering the escape clause ends.

E. Conclusions

16. There is room to revise up the medium-term debt anchor for Mauritius, while safeguarding debt sustainability objectives. A medium-term debt anchor of up to 80 percent of GDP could be considered. This finding builds on the calibration methods that average results from models accounting for historically feasible primary balances, debt-servicing capacity, and growth objectives. The higher anchor reflects mainly the fact that Mauritius has a strong debt-carrying capacity in line with its well above-average tax revenue-to-GDP ratio. To reduce the currently high debt level (99.2 percent of GDP in FY2020/21) towards the proposed anchor (80 percent of GDP), an operational rule could be adopted consisting of a ceiling for the overall deficit of 3 percent of GDP. To reduce the negative effects of the fiscal adjustment on growth, a transition period could be allowed during which the deficit would gradually decline to 3 percent of GDP in FY2026/27 and beyond, pushing the debt ratio to the anchor in FY2026/27. Debt sustainability risks should continue to be assessed on the IMF's Debt Sustainability Assessment tools regardless of whether the debt anchor has been met.

[12] Mauritius did not have a good track record of complying with its repealed debt ceiling of 60 percent of GDP.

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ADDRESSING CLIMATE CHANGE IN MAURITIUS: FINANCING AND REFORM OPTIONS[1]

This paper reviews the financing and reform options to address climate change adaptation and mitigation in Mauritius. It finds that there is a significant financing gap to meet the authorities' 2030 climate targets. The total financing gap represents 1.6 percent of GDP per year through 2030, with a higher share for adaptation than mitigation. Given Mauritius' limited fiscal space and elevated debt vulnerabilities, fully financing adaptation and mitigation will require a mix of external grants and concessional loans. However, donor financing has been limited and mostly directed to mitigation, despite adaptation being more critical in Mauritius. Mauritius could step up reforms to gain greater access to global climate funds and climate-related debt instruments, such as green bonds, which have recently seen growing demand including from small island states. Such reforms include, but are not limited to, improving the track record of planning, appraisal, execution, and reporting of climate-related projects, which is among the key eligibility criteria for climate financing. The paper discusses measures specific to Mauritius, with a focus at the government level.

A. Background

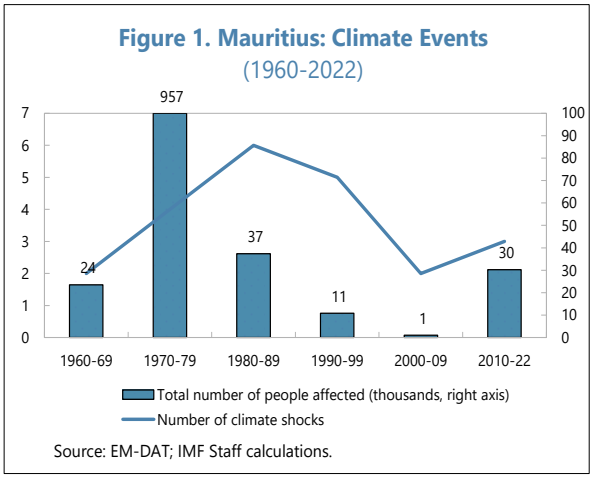
1. Climate change has become a growing concern in Mauritius, threatening the prospects for long-term economic resilience. Around 90 percent of Mauritius' households are aware of climate change, and a great majority perceives it as a threat, including to food and water security. The average sea level and mean temperature have increased over time. Climate-related shocks are frequent, with an average of four adverse events—predominantly tropical cyclones—taking place every 10 years. The last decade has seen a surge in the number of people affected by climate-related shocks in Mauritius, particularly in 2018 amid tropical storm *Berguitta* (Figure 1).[2] Calculations based on the Emergency Events Database (EM-DAT) show that, over the period 1960-2022, Mauritius experienced 22 extreme weather events, each causing socio-economic damage costing USD 160-245 million on average (1.5-2.3 percent of FY2021/22 GDP).[3] Real GDP growth in the years of extreme weather events was lower by 1.3 and 2.5 percentage points, on average, compared to one year before and after, respectively (Figure 2).[4] If unaddressed, climate shocks risk disrupting Mauritius' quest for social and economic resilience.

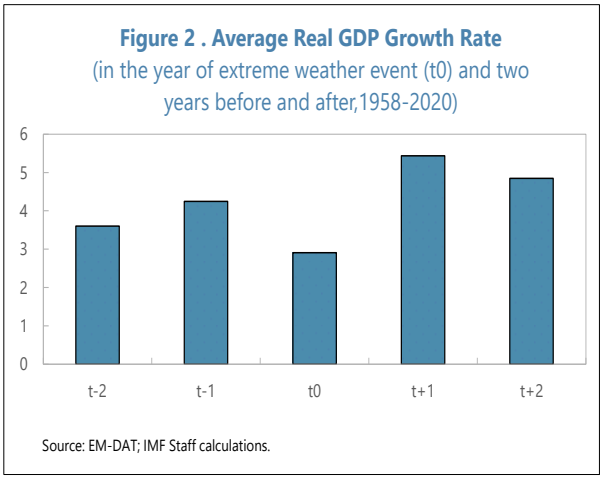
[1] Prepared by Félix F. Simione (AFR), Robert Clifton and Isabel Rial (FAD).

[2] Climate change is a multidimensional phenomenon. While Figure 1 shows a declining number of extreme weather events between 1980 and 2009, the average temperature has increased consistently since 1961 (Figure 2), as well as the average sea level. The East Africa region has seen an increase in the number of extreme events, making this a risk for Mauritius.

[3] The lower average excludes the devastating cyclone *Gervaise* in 1975 that affected over 800 thousand people with a socio-economic damage estimated at over USD 1 billion. The monetary estimates are adjusted for inflation.

[4] The calculations are based on 12 (out of 22) extreme weather events during 1958-2020 selected such that the two years before and after the event do not coincide with another weather event shock. The analysis does not control for other potential factors that may have impacted growth along with weather shocks.





2. To address climate change threats, the authorities have developed a policy framework and engaged in international initiatives. A Climate Change Act entered into force in April 2021 aiming to ensure compliance with international climate change agreements and set national objectives and targets. In their 2021 *Nationally Determined Contribution* (NDC) document under the United Nations Framework Convention on Climate Change (UNFCCC) the authorities have set ambitious objectives to support climate change mitigation and adaptation. On mitigation, the key objectives by 2030 are to reduce the overall greenhouse gas (GHG) emissions by 40 percent, increase the share of energy generation from green sources to 60 percent, phase out the use of coal, and increase energy efficiency by 10 percent relative to 2019. On adaptation, the key objectives are to expand the knowledge base on climate change risks and their impact on communities and increase resilience of human activities by improving governance and enhancing disaster preparedness and response, notably for infrastructure. The adaptation framework also integrates policy interventions for Fisheries (Blue Economy), Tourism, Biodiversity, Forestry, Agriculture and Coastal Zone.

3. While climate change entails multiple dimensions, *adaptation* is more critical for Mauritius. UNFCCC data suggest that Mauritius accounts for only 0.01 percent of the global GHG emissions. Yet it is among the most exposed to natural disaster shocks and ranks low in terms of adaptive capacity (World Risk Index 2021). This calls for more urgent measures to strengthen adaptation to climate change. On average, adaptation accounted for around 78 percent of total budgetary climate change expenditure over the period 2011-14 and FY2017/18, while mitigation accounted for the remaining 22 percent. Nevertheless, Mauritius has implemented notable measures on mitigation.

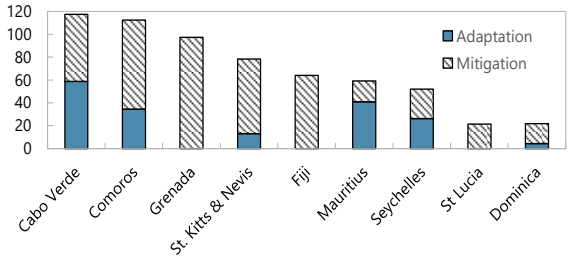
4. The remainder of the paper is structured in three sections. Section B discusses the financing gap and options to finance climate change adaptation and mitigation in Mauritius, with focus on accessing international climate funds. Section C discusses reforms to improve access to climate financing. Section D concludes.

B. Financing Climate Change

Assessing the Financing Gap

5. Achieving authorities' climate goals will require significant financial resources, with adaptation taking the largest share. Estimating the costs of climate adaptation and mitigation is a challenging exercise, mainly because there is no agreed quantitative adaptation target. There is a very wide range of estimates in the literature reflecting differences in targets, scenarios, assumptions, sector coverage, and investment periods (UN Adaptation Gap Report 2021).[5] The Mauritian authorities' own estimates stated in their NDC point to a required USD 2 billion and USD 4.5 billion for effective mitigation and adaptation, respectively, for a total of USD 6.5 billion by 2030. 35 percent of this amount would be covered by government resources and domestic private sector contributions, with the remainder covered by donors and other external sources. While Mauritius' required financing is among the highest in dollar terms across small islands states, it is significantly lower as a percentage of GDP (Figure 3).

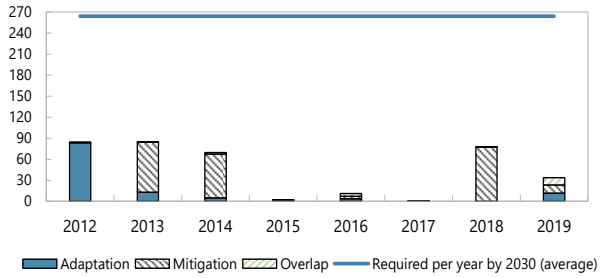
Figure 3. Mauritius: Climate change required financing by 2030 as reported in countries' NDCs
(percent of 2021 GDP)



Source: UNFCCC; Nationally Determined Contributions document

6. External funds from bilateral donors can help fill the financing gap but have been limited relative to the authorities' expectations and mostly directed to mitigation. If external donors were to finance 65 percent of total adaptation and mitigation needs as envisaged in the authorities' NDC—corresponding to USD 4.3 billion over FY2014/15-FY2029/30—this would require financing of USD 264 million on average per year, of which USD 183 and USD 81 million for adaptation and mitigation, respectively. However, actual external donor financing—mostly through grants and in a few cases through concessional loans—was significantly short of this threshold over 2012-2019, with combined disbursements for adaptation and mitigation peaking at around USD 85 million in 2013. Moreover, although adaptation is more critical than mitigation for Mauritius, adaptation received less disbursements over the period (Figure 4).

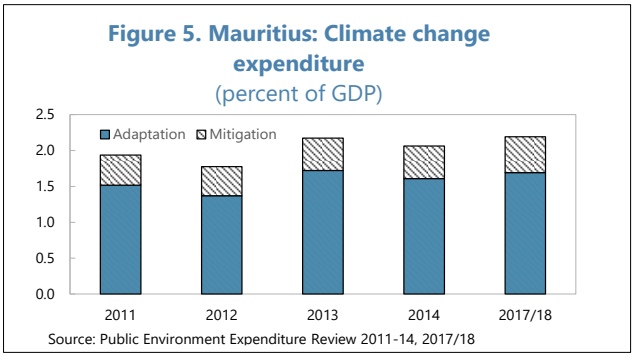
Figure 4 . Mauritius: Actual External Climate Finance, 2012-2019
(USD million)

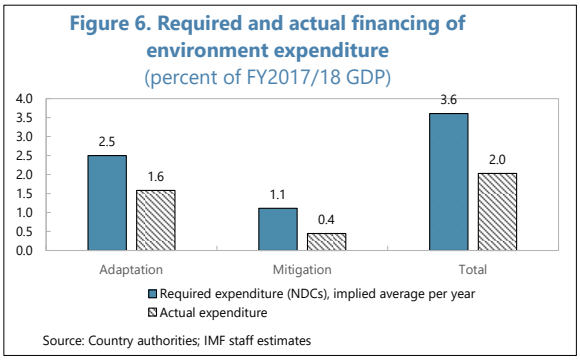


Source: OECD; IMF staff estimates.

[5] For example, for developing countries, estimated total adaptation costs range from USD 155 to 330 billion per year by 2030 (UN Adaptation Gap Report 2021). For Pacific Island countries, average investment needs for climate-proofing infrastructure range from 6.5 to 9 percent of GDP annually. They are much higher for some countries such as Kiribati (over 25 percent of GDP) and Tuvalu (over 15 percent of GDP), as discussed in IMF (2021b) and IMF (2021c).

7. Fully financing adaptation and mitigation will be nearly impossible without a mix of further external grants or concessional loans. Actual total climate change expenditure in Mauritius is on average 2 percent of GDP per year, of which adaptation accounts for around 1.6 percent of GDP (Figure 5).[6] To achieve the NDC goals by 2030 (both adaptation and mitigation), staff estimates that the authorities would need to spend, on average, about 3.6 percent of GDP per fiscal year over the period 2014/15-2029/30 (Figure 6).[7] This leaves a potential financing gap of 1.6 percent of GDP per year on average (around USD 180 million per year). The financing gap for adaptation (0.9 percent of GDP) is higher than for mitigation (0.7 percent of GDP). Given Mauritius' limited fiscal space and elevated debt vulnerabilities, closing this gap will require a mix of grants and concessional loans.





Filling the Financing Gap: The Role of Global Climate Funds and Bonds

8. Several international climate funds provide Mauritius with a tangible opportunity to raise additional climate financing. There are several multilateral donor-funded climate funds worldwide committed to finance climate adaptation and mitigation through grants, concessional loans and guarantees. The most active includes the Adaptation Fund, the Global Environment Facility, and the Green Climate Fund (Table 1). *Climate Funds Update* tracks 27 climate funds as of January 2022, each aiming at different objectives and regions of focus. The combined amount of financing approved from such funds to several countries amounted to USD 3.5 billion and USD 3.7 billion in 2020 and 2021, respectively. However, the actual disbursements—USD 345 million and USD 84 million, respectively—fell significantly short of commitments.

[6] The precise figure was Rs10.3 billion (2.16 percent of GDP) in FY2017/18 according to the 2018 *Tracking Public Sector Environment Expenditure* Assessment under Mauritius' Ministry of Finance, Economic Development and Planning. In estimating the financing gap discussed next, given the lack of multi-year projection of climate change expenditure, it is assumed that actual expenditure will remain constant at 2 percent of GDP through FY2029/30.

[7] The annual average is computed by dividing the total adaptation and mitigation costs (stated in Mauritius' NDC) by the number of years in the period FY2014/15-FY2029/30. The ratio to GDP takes as a reference the nominal GDP in FY2017/18 which is the latest period for which data on annual climate change expenditure are available from PEER.

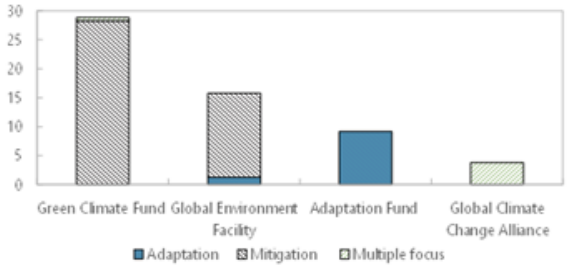
Table 1. Mauritius: Selected Multilateral Climate Fund's Pledges, Approvals and Disbursements of Funds

Fund	Fund focus	USD million			# of projects
		Pledge	Approval	Disbursement	approved
Adaptation Fund (AF)	Adaptation	1160.0	870.7	522.0	270
BioCarbon Fund Initiative for Sust. Forest Landscapes	Mitigation	367.4	98.3	0.0	5
Clean Technology Fund (CTF)	Mitigation	5783.2	5657.5	1806.2	166
Forest Carbon Partnership Facility - Readiness Fund	Mitigation	468.8	314.3	278.0	46
Forest Carbon Partnership Facility - Carbon Fund	Mitigation	874.5	0.0	0.0	0
Forest Investment Program (FIP)	Mitigation	748.6	617.7	276.1	53
Global Environment Facility (GEF4)	Multiple	1083.0	930.7	930.7	227
Global Environment Facility (GEF5)	Multiple	1152.4	825.9	485.9	233
Global Environment Facility (GEF6)	Multiple	1117.2	906.0	207.4	240
Global Environment Facility (GEF7)	Multiple	728.4	1559.4	0.0	180
Global Climate Change Alliance (GCCA)	Multiple	1652.8	891.4	540.1	107
Global Energy Efficiency and Renewable Energy Fund	Mitigation	281.5	223.6	89.1	19
Green Climate Fund IRM (GCF IRM)	Multiple	10322.1	9510.7	2332.9	641
Green Climate Fund (GCF-1)	Multiple	9999.2	833.0	92.3	31
MDG Achievement Fund	Adaptation	89.5	89.5	89.5	18
Partnership for Market Readiness	Mitigation	131.5	82.4	64.4	42
Pilot Program for Climate Resilience (PPCR)	Adaptation	1151.8	1021.9	734.7	106
Scaling Up Renewable Energy Program (SREP)	Mitigation	778.6	674.2	131.4	83
Special Climate Change Fund (SCCF)	Adaptation	379.8	284.0	180.7	72
UN-REDD Programme	Mitigation	344.9	342.0	336.5	39

Source: Climate Funds Update

9. Mauritius has received some financing from climate funds, but the amounts have been small relative to the potential available and disproportionally aimed at mitigation. Mauritius has had slightly higher access to climate funds compared to many small island states. However, approved financing—only USD 58 million grant during the whole period 2008-20—is small given the potential available.[8] Moreover, only half of the approved amount was disbursed, possibly reflecting challenges in meeting disbursement conditionalities. In addition, while the authorities' NDC points to higher financing needs for adaptation, disbursed funds have disproportionally financed mitigation (Figure 7) which tends to be a permanent feature of most climate funds.

Figure 7. Mauritius: Financing from Climate Funds by area of intervention
(2008-20, USD million)



Source: Climate Funds Update; IMF staff estimates

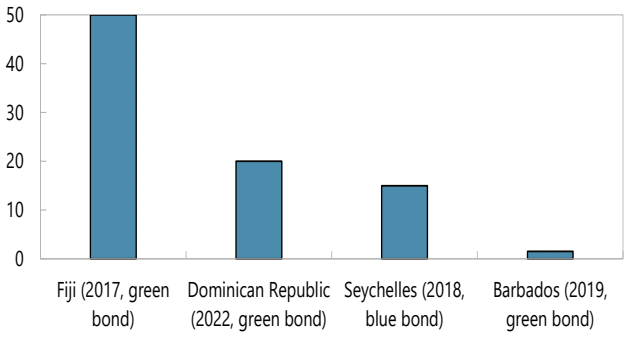
10. To secure greater access to climate funds, Mauritius could explore a *direct* access modality which will require a process of *accreditation* by climate funds. Almost all climate funds' disbursements to Mauritius during 2008-20 were made through indirect access modality whereby non-government multilateral agencies were the implementing actors of the underlying

[8] Financing for Mauritius during 2008-20 was approved by Green Climate Fund (USD 28.8 million), Global Environment Facility (USD 15.8 million), Adaptation Fund (USD 9.2 million) and Global Climate Change Alliance (USD 3.8 million), all in form of grants.

projects on behalf of the Government.[9] To broaden *direct* access, the authorities could step up efforts to secure Mauritius' *accreditation,* a process that enables countries to receive and manage funding directly without the need of an intermediating accredited agency.[10] This direct access modality would be a complement, not a substitute for, indirect access. However, accreditation is a lengthy, onerous, and complex process that requires countries to demonstrate a strong track record of planning, appraisal, execution, and reporting of climate-related funds, projects, and data.[11]

11. Climate- and environment-related bonds are another alternative to mobilize financing with flexibility to address debt service shocks, but they are still at an infant stage in Mauritius. The so-called *green* and *blue* sovereign bonds are issued to finance climate- and ocean-related projects, respectively, often with some tax incentives to investors. While green bonds have mostly been issued by the World Bank and advanced countries, they are also trending among small island states like Mauritius (Figure8).[12] For example, Fiji became the first developing economy to issue a USD 50 million sovereign green bond in 2017 to finance projects related to crop resilience, flood management, and reforestation. Barbados and Grenada have also issued sovereign bonds with natural disaster clauses. Under the Barbados version, when an independent agency makes the declaration of a natural disaster, there is an immediate 2-year suspension of debt-servicing, and the bond maturity is automatically extended for two years (Barbados' NDC 2021; Ho and Fontana 2021; Anthony and others 2020). This allows access to financing, while providing space to respond to climate shocks that can impair the ability to service the bond. Another example is Seychelles, which issued the world's first sovereign blue bond in 2018, raising USD 15 million to finance marine projects, with a World Bank guarantee, and a loan from the Global Environmental Fund to cover interest payments (World Bank Press Release, 2018). Mauritius' green bond frameworks—the last of which released in

Figure 8 : Selected island states issuing green/blue bonds
(USD million)



Source: Climate Funds Update; IMF staff estimates.

[9] Ten out of twelve disbursements during 2008-20 were directed to projects for which the implementing agencies were international non-government actors such as the UNDP and UNEP. It is important to align these projects with national authorities' priorities.

[10] Mauritius' Ministry of Environment, Solid Waste Management and Climate Change is currently in the process of becoming accredited as a National Implementing Entity under the Adaptation Fund. The Mauritius Renewable Energy Agency has expressed interest in getting accredited as a Direct Access Entity under the Green Climate Fund.

[11] Requirements for accreditation also include macroeconomic stability and availability of good climate data and knowledge. Mauritius is well positioned in these areas relative to most countries.

[12] Green bonds can also be issued by private corporations.

December 2021—are relatively new.[13] Making green and blue bonds more popular among potential issuers and investors in Mauritius could benefit from reforms.

C. The Way Forward: Reforms to Expand Access to Climate Financing

12. Mauritius could secure higher financing through climate funds and green bonds by achieving accreditation and improving climate-related public investment management. Successfully applying to climate financing is a complex process that requires countries to demonstrate a strong track record of planning, appraisal, execution, and reporting of climate-related funds, projects, and data. The authorities could consider setting up a detailed roadmap towards (i) securing accreditation to climate funds and (ii) strengthening the existing green financing framework to generate interest among potential green and blue bond issuers and investors.[14] This roadmap could entail several reforms. Below we focus on those concerning climate-related public investment management (PIM), which are more relevant in cases of government-led climate projects.

13. While Mauritius' public infrastructure governance framework has steadily strengthened in recent years, further improvements would be helpful. Following the 2017 *Public Investment Management Assessment* (PIMA), several PIM measures were introduced to strengthen institutional arrangements, procedures, and practices underpinning public infrastructure projects. In 2021 the authorities agreed to participate in a pilot of the *Climate Change Public Investment Management Assessment* (Climate PIMA), which yielded useful insights on how to further improve Mauritius' infrastructure governance to make it more resilient to the impact of climate change. The 2021 Climate PIMA identified several PIM practices and procedures that should be strengthened along the planning, allocation, and implementation phases of the public investment cycle.

14. Specific regulations need to be fully developed to further support planning and coordination of climate-related investment projects. National and sectoral strategies and plans for public investment are consistent with the government's climate objectives and targets, but they are mainly focused on adaptation. The *Disaster Risk Reduction Strategic Framework* and related action plan provides centralized guidance for ministries, departments, and agencies (MDAs) to plan climate change-related projects. Yet, there are neither central nor subnational government regulations, nor land-use or building codes that address potential climate concerns for infrastructure projects.

[13] The Financial Services Commission of Mauritius issued Guidelines for the issue of Corporate and Green Bonds in Mauritius in December 2021. The Guidelines supplement the Guide to Sustainable Bond Issuance issued by the Bank of Mauritius in June 2021. These instruments provide an overview of the requirements and process for the issuance of green bonds.

[14] A green financing framework is a document created by the recipient of funds or issuer of bonds that clearly articulates the proposed financing and use of proceeds. For example, some principles and criteria of public climate finance are discussed by Climate Funds Update (2022). Also, voluntary best practice guidelines called the "Green Bond Principles" are discussed by the International Capital Market Association (ICMA 2021).

15. Strong climate-change considerations need to be incorporated into the project appraisal and selection methodologies and criteria. Large infrastructure projects are subjected to appraisal, including environmental impact analysis. However, the appraisal methodologies are neither standardized nor published, and they do not include climate change specific provisions. Similarly, there are no climate change specific criteria used for their selection.

16. Portfolio management and oversight of public investment need to be strengthened. All infrastructure projects are included in the budget, but their climate-related outputs and outcomes are not clearly identified, monitored, or reported. Although not fully operational yet, the government is implementing a new system for *Tracking Public Sector Environmental Expenditures* (TPSEE), as well as upgrading the Public Sector Investment Plan information technology system (i.e., e-PSIP) to monitor delivery progress of all infrastructure projects. The 2020 *Climate Change Act* introduces reporting mechanisms and a climate change database system to enable the assessment, monitoring and reporting of infrastructure projects related to climate change. However, ex-post reviews on infrastructure projects are not systematically conducted, except for externally financed projects. In addition, the methodologies for estimating maintenance needs of infrastructure assets do not address the impact of climate change.

17. The impact of climate change risks on public infrastructure needs to be systematically assessed and monitored in the budget. The *National Disaster Risk Management Strategy* (NDRMS) does not estimate the impact of climate change on infrastructure assets and does not include a plan to mitigate and respond to risks. The budget includes a relatively small contingency allocation to manage the impact of natural disasters on infrastructure assets, and the government does not publish any fiscal risk analysis.

18. Based on this assessment, the following recommendations could be part of a framework to improve Mauritius' eligibility and access to climate financing: (i) review and revise the regulations on land-use and building codes to incorporate provisions related to climate change; (ii) improve, within the new public investment manual, the templates for project appraisal and selection to further elaborate on climate change provisions; (iii) implement an expenditure classification and coding system to identify, monitor, and report climate change public sector expenditure, both current and capital,[15] (iv) strengthen the capacity of MDAs to implement systematic ex-post reviews of major infrastructure projects, particularly those with climate change implications; (v) develop maintenance manuals and guidelines for all MDAs involved in delivering and maintaining major infrastructure projects, including climate change provisions; and (vi) develop and publish a fiscal risk statement in the budget, including a chapter identifying climate-related risks.

D. Conclusions

19. Mauritius has a significant financing gap to meet its 2030 targets to address climate change adaptation and mitigation. The total financing gap is estimated at 1.6 percent of GDP per

[15] The TPSEE is a step in the right direction, but it should be revised to better incorporate infrastructure investment

year by 2030, and it is higher for adaptation (0.9 percent of GDP) than for mitigation (0.7 percent of GDP). Given Mauritius' limited fiscal space and elevated debt vulnerabilities, fully financing climate change action will require external grants and concessional loans. Donor financing has been limited and, despite adaptation being more critical in Mauritius, financing has mostly been directed to mitigation. Mauritius could step up reforms to gain greater access to global climate funds and climate-related debt instruments, such as green bonds, which have recently seen growing demand, including from small island states. Such reforms could aim at improving the track record of planning, appraisal, execution, and reporting of climate-related projects, which is among the key eligibility criteria for climate financing. In the case of Mauritius, specific measures could include reviewing the regulations on land-use and building codes to incorporate climate change-related provisions; improving project appraisal and selection to further elaborate on climate change provision; implementing a tracking system to identify, monitor and report climate change spending; strengthening the capacity to implement ex-post reviews of major climate-related infrastructure projects; developing guidelines for all MDAs involved in delivering and maintaining major infrastructure projects, including climate change provisions; and developing and publishing a fiscal risk statement in the budget, including a chapter identifying climate-related risks.

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IMPACT OF DIGITAL RUPEE ON LIQUIDITY MANAGEMENT AND MONETARY POLICY TRANSMISSION[1]

This paper assesses the potential impact on liquidity management and monetary policy transmission of various designs of CBDC—Digital Rupee—in the context of the new monetary policy framework that the Bank of Mauritius plans to adopt in 2022. It finds that issuing digital currency—especially when remunerated—may not bring clear advantages for liquidity management and may lead to complications for the transmission of the policy rate to market rates. A simpler option of non-interest-bearing retail Digital Rupee could be a safer option as it would lead to a lower risk of interference with policy transmission.

A. Background and Objective of the Paper

1. Mauritian authorities aim to foster digitalization by leveraging emerging technologies and introduce central bank digital currency (CBDC) to support public policy objectives such as efficiency and stability of the payment systems in the digital age. The country has established digital infrastructure and mobile data availability and penetration required to support digital payments. In 2019, the Bank of Mauritius (BOM) launched a National Payment Switch consisting of two components: Instant Payment System (IPS) and Card Payment System (CPS).[2] The authorities have set out the Digital Mauritius 2030 Strategic Plan. Despite an advanced digitalized payment ecosystem, Mauritius remains a cash-based economy and managing cash is very costly. The Bank of Mauritius intends to issue Digital Rupee (DR) to achieve objectives that include: (i) reducing physical Rupee in circulation in order to reduce the cost for issuing, circulating, accessing, and managing cash; (ii) providing the population with a digital form of central bank money, including for the informal sector; (iii) bringing resilience to the current payment infrastructure of the country; (iv) preparing the economy to accommodate innovative products that would automate payments such as tax through smart contracts; (v) preserving the sovereignty of the Mauritian rupee by curbing the adoption of cryptocurrencies; (vi) preserving financial integrity by reinforcing anti-money laundering and combating the financing of terrorism (AML/CFT) measures.

2. The paper aims to analyze the possible impact of the DR on liquidity management and monetary policy transmission in Mauritius. As this is a very new area and with ongoing debates, we abstain from claiming that our discussion is complete, or any conclusions are final. However, the

[1] Prepared by Mikhail Pranovich (AFR) and Tao Sun (MCM). The authors are grateful for insightful discussion and comments received from participants of the MCM seminar on CBDC as well as from MCM divisions during the review process: Cemile Sancak (AFR), Simon Gray, Ismail Arif, Romain Veyrune, Kelly Eckhold, Manmohan Singh and Darryl King (all MCM).

[2] While Mauritius has established a good digital infrastructure, its current payment landscape is dominated by banks with limited Fintech development. The broadband penetration rate is 91 percent, and the mobile phone subscription rate is 151.9 percent. Mobile internet is widely available through prepaid packages available on any of the Mobile Network Operators. Internet banking is increasingly used by consumers. Although e-commerce and online services are not yet widespread in Mauritius, the trend is gaining ground. In addition, while most commercial banks have channels for internet banking and some also have channels for mobile banking, the two biggest banks account for more than 40 percent of the total banking assets. Fintech is yet to be developed, and the market share of the three firms as compared to the traditional borrowing/lending sources is relatively small. The adoption of cryptocurrencies and stablecoins currently remains low. The BOM indicated losing monetary sovereignty as a concern, and banks issued a statement that users should burden the risks of using crypto currencies.

paper contributes to debates and analysis to help the BOM make an informed decision about the design, pilots, issuance, and capacity building. This paper could be timely as the BOM is heading towards a modernized inflation targeting framework supported by an effective interest-rate-based management. It appears important in this context to analyze the impact of DR on liquidity management and monetary policy transmission. In what follows we primarily focus on the first step in policy transmission, i.e., from the policy rate to the short-term rate.

3. The paper concludes that the simpler design of non-remunerated retail DR seems to be less distortive and hence preferable. When discussing the impact of DR on liquidity management and monetary policy transmission, the paper investigates both retail and wholesale DR with different design options with respect to remuneration. It appears that wholesale DR impacts liquidity management more directly. In both cases of remunerated retail and wholesale DR, the impact on monetary policy transmission may be adverse as it potentially blurs the policy signal.

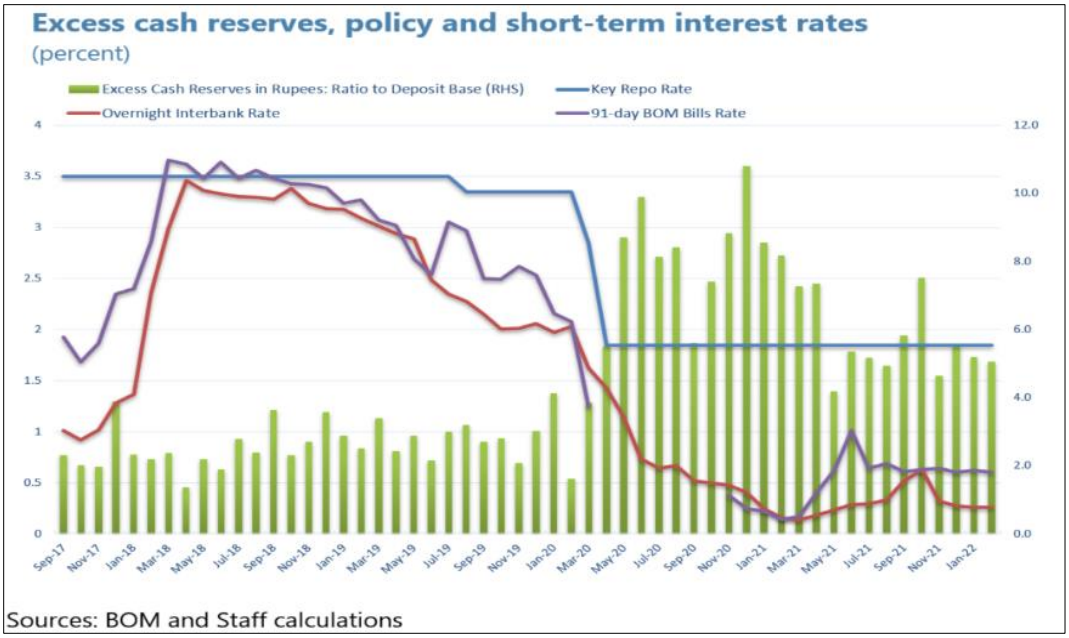
4. The paper proceeds as follows. Section I describes the key aspects of the new monetary policy framework that the BOM plans to roll out in 2022. It serves to identify the specific country conditions in which DR issuance will occur and the effect on transmission of the policy rate and liquidity management is analyzed. Section II presents several dimensions in which DR is issued: assets used to exchange for, remuneration, and redeemability. Section III discusses the possible impact of DR on liquidity management and monetary policy transmission, and section IV concludes.

B. Modernizing Monetary Policy Framework in Mauritius

5. The BOM has announced introducing inflation targeting framework back in 2006, but its practical implementation remained incomplete. No formal quantitative inflation objective has been announced, and the effectiveness of the domestic liquidity and interest rate management was limited. The latter was mostly because the system of policy instruments either lacked some important elements or was not clearly parameterized till recently, including: (i) effective standing facilities were absent for most of the time since 2006 and hence there were no constraints to the interest rate volatility in the money market, (ii) the main open market operations (OMOs) were of medium-term (three months) rather than short-term (7 or 14 days) maturity, (iii) the interest rate that the BOM used in its bill auctions often deviated from the announced key repo rate—the policy rate, (iv) the reserve averaging period was relatively short at two weeks and borrowing from required reserves was constrained.

6. Historically the system was dominated by structural liquidity surplus, which was less than fully sterilized by the BOM and therefore limited the effectiveness of the interest rate management and blurred the policy signal. Because the liquidity surplus was not fully absorbed by the BOM instruments, the excess liquidity remained in the system. It became especially visible when the BOM actively intervened in the market to purchase FX during 2016-2019, and the amount of excess liquidity increased substantially. Although the direction of FX interventions reversed during the pandemic period of 2021-22, and large amounts of foreign reserves were sold, the excess domestic liquidity remained. At that time, it was fueled by other factors including large fiscal deficit monetization and quasi-fiscal expenditures financed by the BOM, and again, not fully sterilized

through the BOM instruments. As a result, BOM's interest rate management was not effective with the money market interest rate systematically and substantially below the announced policy rate or the rate that the BOM attached to its main OMOs. The monetary policy transmission of the announced monetary policy rate was hence blurred.



Sources: BOM and Staff calculations

7. The BOM envisions modernizing its monetary policy framework by adopting an explicit inflation target. The BOM intends to announce a medium-term inflation objective as a target range of 2 to 4 percent, which should allow for more flexibility and recognize that the central bank might not be able to steer inflation to a particular value in the short run. At the same time, the bank will prefer and act accordingly to see the inflation close to the midpoint of the range. In the context of inflation targeting framework inflation forecast will be an intermediate target.

8. The key policy interest rate will signal the policy stance and define the level of the operating target. The policy interest rate will need to be transmitted to the short-term money market interest rate, which will be an overnight money market rate. The task of the BOM will then be "to put money where its mouth is," that is, to deploy the system of monetary policy instruments to ensure that the overnight rate is aligned with announced policy rate.

9. To transmit the level of the policy rate to the overnight market the BOM will deploy a new system of instruments based on the mid-corridor system. The symmetric interest rate corridor will be defined by standing overnight deposit and credit facilities. The width of the corridor will be constant around the key policy rate and will define the maximum amplitude for the interest rate fluctuations in the overnight market. The key policy instrument that the BOM will deploy in main OMOs will be of 7 days maturity and be traded in weekly fixed-rate full-allotment auctions. The rate will be fixed at the level of the announced policy rate. The key instrument will be deployed in combination with the reserve averaging mechanism and fine tuning and longer-term structural liquidity operations.

10. To inform the discussion in the subsequent sections we primarily look at how introducing DR will affect liquidity and monetary policy transmission in the context of modernized monetary policy framework, while the structural liquidity position will still be in surplus.[3] Under structural surplus liquidity conditions, the key policy instrument deployed in OMOs will be the BOM bills. For effective interest rate management, the amount of excess liquidity held by banks at their accounts in the BOM should decline to close to zero.[4] Further, we evaluate the following:

- **Impact on liquidity surplus.** In the past, with banks holding mostly long positions in liquidity and given a limited amount of government securities in the BOM's portfolio, the ability to conduct reverse repos was constrained. The BOM thus leaned towards the issuance of BOM bills for liquidity management. Due to less than full sterilization through the BOM's OMOs, the rupee excess liquidity was at Rs28 billion, while about Rs130 billion of liquidity was further absorbed by BOM instruments by end-2021. Because mopping up liquidity will likely remain important going forward, it appears useful to analyze whether issuing DR may impact the liquidity surplus.
- **Impact on liquidity sterilization costs.** The cost of removing liquidity surplus through the BOM bills reached Rs2.1 billion in 2021 and may increase in the coming years as the BOM normalizes the policy stance and possibly mops up larger amounts to eliminate the excess. It is then useful to consider whether and how issuing DR may affect the costs of liquidity sterilization.
- **Impact on transmission of the policy signal given by the key policy rate.** In the context of inflation targeting and modernized operational framework, the BOM will manage the interest rate. The question then is whether issuing the DR may potentially interfere with the policy signal defined by the key policy rate.

C. DR issuance: Three Dimensions

11. CBDC is a digital form of fiat money issued by a central bank for either the public ("general purpose" or "retail'' CBDC, rCBDC) or for financial institutions and financial market payments ("wholesale" CBDC, wCBDC). CBDC is a direct liability of the central bank, different from other direct central bank liabilities such as balances in traditional reserve or settlement accounts. The closest analogy for the rCBDC is physical currency in circulation. Issuing wCBDC means that it will be available to banks as the means of final settlement. The closest analogy for wCBDC is domestic reserve money. Among the major CBDC design choices, a key consideration is along three dimensions in issuing CBDC—assets used to exchange for CBDC, remuneration, and redeemability.

12. In theory, three options of *assets to exchange for DR* can be considered when issuing DR: (i) currency in circulation, (ii) bank domestic reserves, and (iii) high-quality liquid assets (HQLAs)

[3] If the structural liquidity position changes to deficit, it will not fundamentally change our analysis and preliminary conclusions. As any central bank deploying the interest-rate-based framework, the BOM would need to change the direction of main OMOs to inject liquidity.

[4] We note that some precautionary buffer of excess liquidity may still be held by banks, while all involuntary excess reserves should be absorbed to deliver effective policy transmission.

such as government bonds. In order not to break the uniformity of the payment system, DR would be issued and exchanged at par for other forms of central bank money (currency in circulation and reserves), thus maintaining the fungibility of the monetary base.

13. Introducing DR against currency in circulation means that users would swap the DR for physical Rupee. To the extent that DR is accepted as a substitute for physical Rupee in circulation, a reduction in the latter may take place. In such a case, domestic reserves in the BOM will not change as some currency in circulation could be converted to an equal amount of DR (Rs1 billion in panel 2 in Annex I).[5] On the other hand, the demand for physical Rupee may not change, and the amount in circulation will not necessarily decrease if DR is seen as a complement to physical Rupee.

14. In the following sections we focus on issuing DR when it is exchanged for domestic reserves. Introducing DR against domestic reserve money would mean that banks would be exchanging domestic reserves to an equal amount of DR (Rs1 billion in panel 3 in Annex I). We note here that the equivalent reduction in conventional domestic liquidity would take place when wholesale DR (wDR) is issued against reserves. However, when retail DR (rDR) is issued against reserve money, this does not imply that domestic reserves would ultimately decline by an equivalent amount. Depending on public preferences, the substitution in this case may be for both deposits (and other interest-bearing assets) and for currency in circulation. While substituting for deposits will ultimately lead to decrease in stock of domestic liquidity, substituting currency in circulation will not.

15. Two options are available with respect to *remuneration* dimension: non-interest-bearing and interest-bearing CBDC. The views regarding remunerating CBDC vary in the literature. For example, Pfister (2019) suggests that wCBDC could be remunerated at the same interest rate as required reserves to keep reserves and CBDC at par, as well as to ensure simplicity and efficiency, even if this might lead to a substitution of wCBDC for reserves.[6] The pros and cons of the design with remuneration is also considered in the paper by BIS (2018), and it is found that the desirability of this for monetary policy purposes remains questionable although the remuneration rate would directly affect the deposit and other asset rates in some of the designs such as rCBDC.

16. *Redeemability* refers to the ability of the holders to exchange DR for other assets (e.g., physical Rupee, deposits, and reserve money) and different forms of limits or caps can be used as mitigation measures for risks related to the introduction of DR. For example, by setting a cap on how much reserve can be exchanged for DR in each period, or by selecting banks with

[5] However, the share of DR issued in this way is expected to be very limited in an increasingly digital payment system.

[6] According to Pfister (2019) setting rCBDC's remuneration rate below or equal to the interest rate of reserves would dissuade institutions from holding the rCBDC and thus keep it for the public. In addition, rCBDC's remuneration rate should also be below or at the same level as that of wCBDC if the latter is also issued, to avoid creating arbitrage opportunities for wCBDC holders. rCBDC's remuneration rate could put a floor to bank deposit rates, and a remunerated rCBDC would raise this floor. Therefore, the remuneration rates between rCBDC and wCBDC should be coordinated. In any case, whether rCBDC is remunerated or not, the following inequalities need to be respected: interest rate on required reserves ≥ interest rate on wCBDC ≥ interest rate on rCBDC ≥ Effective lower bound.

strong capital position as leading distributors of DR, the degree of liquidity reduction could be managed, and the risk of bank disintermediation could be mitigated. Such caps may be especially important as transitional arrangements that aim to ensure financial stability when new DR is first introduced. A similar cap can be applied on the conversion from bank deposits to DR in terms of daily transaction and/or DR balance limits to mitigate risks of bank disintermediation and liquidity volatility in case it turns out that such volatility tends to increase with the introduction of CBDC. Existing CBDCs such as the Central Bank of Nigeria's eNaira and People's Bank of China's E-CNY, both have certain caps on transaction and balance limits to ease the crowding-out of bank deposits.[7]

D. Possible Impact of Issuing rDR

17. *Introducing non-interest-bearing* rDR would create relatively less pressure on banks' deposit outflows, and hence, the reduction in domestic reserves and the impact on monetary policy would be more limited. The impact on domestic liquidity and policy transmission seems to be more limited since it is more likely in this case that the end-users will be less inclined to substitute interest-bearing assets. Hence, the substitution is relatively more likely for currency in circulation (i.e., the growth rate of physical Rupee may be lower) with a more limited reduction in the amount of end-user deposits and systems' liquidity surplus. Given that the reduction in deposits is more limited, it also implies that sensitivity of liabilities to the policy rate changes should largely remain unchanged. The impact on the conduct of operations in the new framework, liquidity sterilization costs, and the policy transmission from introducing rDR would then be more limited if there is more substitution for currency in circulation rather than for deposits. To the extent that some substitution for deposits takes place, the reduction in deposits and system's liquidity may occur and the premium in deposit rates may increase implying a new equilibrium for the deposit interest rates. In addition, non-interest-bearing rDR creates less pressure on bank deposits and intermediation when the policy rate is away from the zero lower bound. In contrast, in the environment of ultra-low rates, there might be a stronger incentive to switch to rDR from deposits and hence stronger disintermediation.

18. *Interest-bearing rDR* would mean that DR can be used as both the store of value and the means of payments, and the impact on liquidity and policy transmission may be larger than that for non-interest-bearing rDR. The opportunity to receive a return on rDR makes it more attractive than physical currency. Also, DR will compete with other financial assets, including bank deposits, relatively more than in the case of non-interest-rate bearing rDR. Therefore, due to

relatively stronger substitution for deposits, the amount of the latter and total liquidity surplus held by banks at the BOM would decline. The transmission of the policy rate may become weaker as the demand for assets sensitive to current and expected changes in the key policy decreases.[8] As the supply of deposits may become relatively smaller, the equilibrium interest rate on deposits may increase due to higher premium that banks will need to pay in such circumstances.

[7] The PBOC has put in place a system frictions to prevent the rapid spread of bank runs. It uses a tiered design of e-CNY wallet with different caps on transaction and balance for different types of e-CNY wallets (PBOC, 2021).

[8] This is also the case of the pressure on financial sector intermediation from issuing CBDC.

19. The end effect on the central bank costs of monetary policy may be ambiguous when issuing interest-bearing rDR. On the one hand, the cost of sterilizing surplus through OMOs may be lower as may be the cost of managing physical Rupee. On the other hand, remunerating rDR adds to the costs.

20. Further challenges for setting monetary policy and complications for policy transmission appear in this case. It may be argued that because rDR remuneration rate directly competes with the rates for assets (e.g., deposits), then the transmission of changes from the former are stronger.[9] However, there is an associated risk for monetary policy transmission. It is not clear how to make sure that the rDR remuneration rate and the key policy interest rate prevailing in the short-term money market are set consistently, so that arbitrage opportunities are not created, and that the rDR remuneration rate does not interfere with signaling the policy stance and the policy transmission does not become blurred.[10]

21. Constraining *redeemability* by introducing caps and limits on exchanging DR for other assets in either of the cases—non-interest- or interest-bearing rDR—may help constrain the adverse impact on liquidity management and transmission mechanism. Such constrains would also limit the attractiveness of rDR and therefore the demand for it, and the substitution of other assets and the interference with the policy rate signal. We note, however, that the same effect could be achieved by limiting the issuance (i.e., the supply of rDR) in the first place.[11]

22. Volatility patterns of system's liquidity may change when rDR is issued and may require more frequent fine-tuning operations. The issue may seem to be less pressing for the conduct of operations by the BOM in the context of the new policy framework that assumes conducting OMOs as fixed-rate full-allotment auctions. Such operations do not require the BOM to forecast system's liquidity to parameterize the auctions. However, banks will have to account for changes in volatility when managing their own liquidity and deciding their transactions with other banks and the BOM, e.g., with respect to bids for the BOM bills. In case volatility increases in the system, the BOM will need to mitigate it by deploying fine-tuning operations more actively or banks will need to make more active use of required reserve averaging mechanism.

E. Possible Impact of Issuing wDR

23. Introducing wDR against bank reserves implies a more direct interaction with the liquidity and operational elements of the new monetary policy framework. We note that wDR remains a means of settlement, whether it is remunerated or not. For that reason, the structural liquidity position—in now broader sense of the sum of DR and conventional domestic reserves—

[9] See for example discussion in the BIS (2018).

[10] This is similar to the argument that an interest-rate-managing central bank in normal circumstances should control the interest rate only one rate in a particular segment yield curve—usually the short-term (overnight) segment.

[11] A similar argument could also be offered in the cases of wDR considered in the next section: the wDR issuance (supply) could be restricted, rather than constraining redeemability from wDR back to reserves.

would remain the same, and the issuance of wDR would not change the principal task of managing liquidity by the BOM in the new operational framework. The central bank would still need to conduct operations to ensure that no excess liquidity is left in the system to align the money market interest rate with the policy rate.

24. Non-interest-bearing wDR is unlikely to impact liquidity management or the transmission mechanism significantly. It appears that wDR would only be used *intraday*, i.e., at the end of each day, banks will redeem wDR for conventional reserves to allocate liquidity in the BOM instruments or to top up required reserve balances. The demand for wDR may hence be more limited with no clear positive impact on managing liquidity, reducing monetary policy costs, or improving transmission.[12]

25. If interest-bearing wDR is issued, it may become attractive as a substitute for conventional domestic reserves and may compete with the BOM's money market instruments, however the case for remunerating wDR seems weak. The combination of remuneration and possible efficiency gains from using wDR—including security and other technological advantages of an alternative payment system—may prompt banks to reallocate from holding conventional reserve money and possibly reduce the amount of liquidity surplus allocated in the main BOM instrument at the policy rate. Then it may appear as if wDR helps reduce sterilization costs. Importantly, however, wDR should not be seen as yet another instrument to absorb liquidity surplus: in fact, reallocating to wDR is just swapping into another form of liquidity. As a result, wDR becomes an equivalent of excess liquidity but is not an equivalent of the BOM instrument used in OMOs.[13] The excess in the new framework should be absorbed through main OMOs—which will bring the costs back—or otherwise it will interfere with the BOM's efforts to manage the money market rate. Besides, remunerating another form of liquidity in the framework where conventional required reserves are not remunerated would interfere with the interest rate condition put forward in Pfister (2019).[14]

26. Setting the interest rate on wDR would create a complication as it interferes with the key policy signal. Indeed, as suggested by many in the literature, if institutional investors could hold wDR without limits, the remuneration rate could become the hard floor for money market rates. However, the efficiency gains from using wDR are hard to measure directly. Therefore, it is difficult to say ex-ante what should be the rate that the BOM pays on wDR compared with the policy rate to avoid arbitrage. For example, in the environment of liquidity surplus, the risk is to set the interest rate on wDR inconsistently high, so that the result could be a reduction of demand for the short-term instruments used in OMOs. Similar to the case of remunerating rDR, the interest rate on wDR would be interfering with the main policy signal effected through OMOs. It seems reasonable

[12] In principle, one could imagine a design of required reserve maintenance mechanism that banks could be allowed to use their wCBDC balances to fulfil domestic reserve requirements in parallel with conventional reserves. In this case the incentive will appear to keep wCBDC overnight (rather than intraday only) to fulfil the required reserves.

[13] The main BOM instrument, the bill, temporarily ties up liquidity and prevents banks from using it for the period of holding.

[14] Because the BOM does not remunerate required reserves in the new framework, it also follows from the condition in Pfister (2019) that the remuneration rate on both retail and wholesale CBDC should be set to zero. In particular, even if conventional required reserves are remunerated—as in some other central banks—this condition does not suggest that CBDC has to be remunerated.

for the central bank to control only one short-term rate, as highlighted in Bindseil (2004). That is, the policy rate should continue to define the rate in the short-term OMOs for conventional liquidity held as fixed-rate full-allotment auctions for BOM bills, while standing facilities will define the symmetric interest rate corridor, as the BOM envisions in the new framework.

F. Revisiting Assumptions: Possible Impact of Issuing DR if Excess Liquidity Remains in the System

27. Excess liquidity remaining in the system may indicate that the new framework implementation is not complete, however, issuing DR in such circumstances will not necessarily improve the policy transmission. That would imply that the interest rate management remains not effective, and the overnight money market rate deviates from the policy rate. Issuing rDR against reserves may initially reduce the amount of excess liquidity in the system. However, given that BOM's policy operations would still not aim at fully absorbing the liquidity through OMOs on a systematic basis, the excess liquidity may reemerge if, for example, the BOM reduces absorption of liquidity in the BOM bills or driven by other liquidity factors, the surplus increases again and exceeds the sum of demand for DR and supply of the main BOM instruments. Also, for DR that is remunerated the problem of the blurred policy signal and transmission would not only remain in place but potentially aggravate. Already before issuing DR the policy signal would remain blurred in Mauritius as the announced policy rate, the rate in OMOs and the overnight rate in the money market would not be aligned against the backdrop of excess liquidity, and the remuneration rate on DR would add to the multitude of such rates. While issuing wDR may replace some of the conventional excess liquidity, it would not change the aggregate amount of excess and surplus in a broader sense, because wDR is itself the means of settlement and would remain part of aggregate excess and surplus.

G. Conclusion

28. At the current juncture, it appears that issuing unremunerated rDR is a more straightforward option with the least impact, including the adverse, on liquidity management and monetary policy transmission in the context of the new policy framework. When issuing DR, the BOM needs to manage policy tradeoffs and synergies, including managing the possible adverse impact on liquidity management and monetary policy transmission. Importantly, when issuing unremunerated rDR, the interference with the policy signal appears to be lower, which is important for proper functioning of the interest-rate-based policy framework. The objective of improving liquidity management and monetary policy transmission could be better addressed by a more effective system of policy instruments, as is envisaged in the BOM's new policy framework. Although we highlighted and approached some of the questions regarding the impact of DR on liquidity management and monetary policy transmission, further and deeper discussions are warranted before launching DR.

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Annex I. Analytical Balance Sheets of the Bank of Mauritius and Banks (in billions of Rupees)

Commercial Banks				Bank of Mauritius			
Assets		Liabilities		Assets		Liabilities	
Before CBDC Introduction							
Currency	8	The public's deposits	1574	Monetary Gold and SDRs	45	Reserve money	300
Deposits at the Bank of Mauritius	174	Debt securities and loans	174	Currency and Deposits	111	Currency in circulation	50
Credit to the public	736	Deposits from the Bank of Mauritius	0	Securities	190	Deposits of other depository corporations	250
Net Claims on Central Govt	179	Other liabilities	84	Other items	137	Other tems	163
Other assets	924	Equity	189			Equity	20
Total	2021	Total	2021	Total	484	Total	484
CBDC Against Cash							
Currency	7	The public's deposits	1574	Monetary Gold and SDRs	45	Reserve money	300
Digital Rupee	1	Debt securities and loans	174	Currency and Deposits	111	Currency in circulation	49
Deposits at the Bank of Mauritius	174	Deposits from the Bank of Mauritius	0	Securities	190	Digital Rupee	1
Credit to the public	736	Other liabilities	84	Other items	137	Deposits of other depository corporations	250
Net Claims on Central Govt	179	Equity	189			Other tems	163
Other assets	924					Equity	20
Total	2021	Total	2021	Total	484	Total	484
CBDC Against Bank Reserves							
Currency	8	The public's deposits	1574	Monetary Gold and SDRs	45	Reserve money	300
Digital Rupee	1	Debt securities and loans	174	Currency and Deposits	111	Currency in circulation	50
Deposits at the Bank of Mauritius	173	Deposits from the Bank of Mauritius	0	Securities	190	Digital Rupee	1
Credit to the public	736	Other liabilities	84	Other items	137	Deposits of other depository corporations	249
Net Claims on Central Govt	179	Equity	189			Other tems	163
Other assets	933					Equity	20
Total	2021	Total	2021	Total	484	Total	484
CBDC against HQLAs							
Currency	8	The public's deposits	1574	Monetary Gold and SDRs	45	Reserve money	300
Digital Rupee	1	Debt securities and loans	174	Currency and Deposits	111	Currency in circulation	50
Deposits at the Bank of Mauritius	174	Deposits from the Bank of Mauritius	0	Securities	191	Digital Rupee	1
Credit to the public	736	Other liabilities	84	Other items	137	Deposits of other depository corporations	250
Net Claims on Central Govt	178	Equity	189			Other tems	163
Other assets	924					Equity	20
Total	2021	Total	2021	Total	485	Total	485

Source: IMF staff calculations.