Assessing Public Debt Sustainability in Mauritania with a Stochastic Framework

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Abstract

This work presents a stochastic framework for assessing public debt sustainability and applies it to the case of Mauritania. The sustainability assessment projects solvency and liquidity indicators—public debt stock and gross financing needs relative to GDP—for 2014–23. The analysis uses deterministic scenarios and stochastic simulations to analyze policy options and fiscal risks. The study relies on simple econometric models to generate forecasts of key macroeconomic variables driving the public debt dynamics and to compute debt-distress probabilities and debt thresholds. The study builds on basic techniques to determine optimal portfolios suitable as benchmarks for public debt management. A main result is that, if Mauritania maintains a strong growth performance and pursues sound policies

to balance the budget and take advantage of concessional financing opportunities, it could reduce the public debt from 74 percent of GDP in 2013 to 30 percent by 2023, and the gross financing needs from 12 percent of GDP to 4 percent. Further scaling up capital spending is likely to deteriorate public debt sustainability because the estimated (marginal) growth-dividend is small. A more promising avenue would be to improve the quality of public investment and institutions, as opposed to the volume of capital expenditure. Different debt strategies can significantly affect the liquidity needs and the on-budget interest bill. But it is the fiscal policy geared toward balanced budgets that ultimately would permit Mauritania to improve the solvency indicators, and thus the public debt sustainability.

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Overview

- **Mauritania continues to enjoy macroeconomic stability and growth, sustained by its sizeable natural resources.** Economic performance has been strong over recent years, with real GDP growing at roughly 5 percent in the last decade and accelerating to 7 percent in 2012-13. Inflation was 4.5 percent in 2013, a relatively low level for historical standards. Investment projects are opening new opportunities for economic and social development. Despite this remarkable macroeconomic performance, Mauritania remains exposed to external shocks and heavily dependent on mining exports. Improved fiscal policies have accompanied economic growth, strengthening revenues and supporting public investment.
- **This paper utilizes a stochastic Debt Sustainability Analysis (DSA) to assess Mauritania's public debt prospects and vulnerabilities over the next ten years, consistently with a macroeconomic outlook and a number of alternative fiscal and debt policies.** This framework is neither substitutive nor antithetical to the Debt Sustainability Framework for Low-Income Countries (LIC DSF) jointly developed by the World Bank and the IMF; on the contrary, it is offered as a complementary and distinct analytical perspective to policy makers. The methodology involves stochastic simulations suitable to address macroeconomic uncertainties and fiscal risks, thus improving upon the traditional scenario-analysis approach of the LIC DSF. New insights are then obtained to inform the formulation of fiscal and debt policies.
- **Under this framework, Mauritania's public debt appears to be sustainable in the long term and poses limited fiscal vulnerability provided that robust growth and rigorous fiscal policy are achieved.** Fiscal policies targeting a balanced budget will largely compress the net borrowing needs and thus slow down the accumulation of financial liabilities. A fast-growing nominal GDP, in addition, will boost fiscal revenues and strengthen the capacity to repay the government debt. Mauritania's public debt is then expected to decline from 74 percent of GDP in 2013 to 30 percent by 2023, whereas its gross financing needs fall from 12 percent of GDP to 4 percent. A virtuous combination of strong economic performance and fiscal prudence is required for Mauritania to mitigate solvency risk, reduce the probability of experiencing debt distress, and ensure public debt sustainability.
- **Fiscal risks stemming from unforeseen macroeconomic shocks are relevant to assess the sustainability of the public debt.** Thus, the stochastic DSA aims at providing quantitative estimates of the range of possible debt outcomes resulting in the wake of macroeconomic shocks, as well as their associated probabilities of occurrence. This type of analysis is meant to support policy makers in strengthening fiscal and debt policies on sustainability grounds.
- **Our results clearly indicate that the sound fiscal and debt policies assumed in the baseline scenario have a direct and positive effect on debt sustainability, even in the presence of macroeconomic shocks.** In 2023, there is a 50 percent probability that the debt-to-GDP ratio could be as low as 27 percent and as high as 33 percent, i.e., deviations of +/-3 percentage points around the baseline path. Similarly, there is a 90 percent probability that the debt-to-GDP ratio could lie in the range 24-40 percent, i.e., with wider deviations relative to the baseline path. Thus, the sound policies seeking balanced budgets—which Mauritania is assumed to follow in the baseline scenario—do deliver a large reduction of public debt in 2013-23, even in the presence of macroeconomic shocks. Arguably, even the public debt of 40 percent of GDP by 2023 that would result from very unfavorable shocks represents, for practical purposes, a notable improvement against the current ratio of 74 percent. In other words, fiscal prudence always proves to be effective to strengthen debt sustainability in Mauritania.

- **Public investment policy is a key determinant of Mauritania’s fiscal and debt performance going forward.** Alternative public investment policy options are assessed in this DSA, giving due consideration to estimates of growth-dividends. Public investment implies borrowings to fund spending and higher financial obligations, and, on the other hand, it may (or not) increase the government’s revenues and repayment capacity. While poor-quality investment projects are likely to generate additional financial obligations and ultimately impair debt sustainability, good-quality investment projects would create additional financial obligations as well as resources to *partly* repay them. Our analysis shows that further scaling up public investment—over and above the already robust level of current capital spending—is likely to deteriorate Mauritania’s debt sustainability because the estimated (marginal) growth-dividend is small. Increasing the capital expenditures by 2 percentage points of GDP relative to the baseline scenario is estimated to raise the long-term growth of real GDP by 1.2 percentage points. Given this estimated growth-dividend and the additional borrowings funding higher capital expenditures, the public debt would decrease from 74 percent of GDP in 2013 to 40 percent of GDP in 2023. Thus, the growth-dividend is not sufficiently large to offset the new financial obligations funding the additional public investment. In addition, an insufficient growth-dividend augments the exposure to fiscal risks, even for good-quality investment projects.
- **One of the main findings of this analysis is that Mauritania can further yield positive economic spillovers by improving the quality of its public financial management, especially the public investment management system.** Fiscal multipliers of capital spending can be used as summary indicators of the quality of public investment. On such basis, we show that Mauritania could attain larger (average) growth-dividends and improve its debt sustainability just by raising the quality of public investment.
- **This paper also quantitatively shows that debt management policies can influence Mauritania’s prospective fiscal and debt performance, although the effects are smaller than those produced by fiscal policies.** A Medium-Term Debt Management Strategy (MTDS) Report was prepared in 2012 and characterized Mauritania’s public debt portfolio in terms of its composition and cost-risk profile. The MTDS identified four debt management strategies for the period 2012-15. This paper utilizes these four strategies together with two optimal debt strategies as alternative options. The optimal strategies are useful benchmarks to assess the performance of debt outcomes. Our simulations show that debt policies have a lesser effect in improving debt sustainability, which instead depends by and large on fiscal policies. Debt policies can indeed attenuate the exposure of the on-budget interest bill to macroeconomic shocks affecting the exchange rate and the domestic interest rates. Thus, debt strategies should be geared towards macroeconomic risk management and cannot substitute rigorous fiscal policies as a mean to improve Mauritania’s debt sustainability.

A. Country Context

Mauritania is enjoying macroeconomic stability and growth, sustained by sizeable natural resources. Economic performance has been strong over recent years, with real GDP growing at roughly 5 percent in the last decade and accelerating to 7 percent in 2012-13 (Figure A1). Inflation is now at relatively low levels for historical standards (Figure A2). Mauritania has largely benefited from a recent expansion of mining output (e.g., iron ore production grew by 30 percent in 2013) and high international commodity prices in the mining cluster, conditions that are anticipated to continue into the medium term. Trade, livestock and iron would drive growth in the next few years, while copper, gold and manufacturing are expected to be the fastest growing sectors.

Investment projects are opening new opportunities for economic and social development. Mauritania has scaled-up public investment in the agriculture sector with the objective of expanding arable land by 2015-16. Iron ore production has recently registered a significant expansion, with SNIM (the national iron ore producer) increasing its production by roughly 25 percent, passing from a historical average of 11 million tons to 13 million tons in 2013. Further expansions are planned and the potential output could reach up to 40 million tons by 2025. Copper production alone is expected to almost double in 2014 as new discoveries were recently made. Expansion projects in the gold sector by Kinross (the leading extractive company active in the country), which would triple gold production within 3 to 4 years, have temporarily been put on hold due to the volatility in world prices. A large energy investment plan is under development, including projects to build power plants using gas, wind, and solar. The gas-to-power project, in particular, could more than double the power generation in Mauritania, generate exports to Senegal and Mali, and substantially reduce costs. Electricity connectivity is expected to improve for more than half the urban population living in informal settlements. Business opportunities would open in the Free Trade Area in the northern region of Nouadhibou, which is already attracting international investors and financial institutions.

Despite this remarkable macroeconomic performance, Mauritania remains exposed to external shocks and heavily dependent on mining exports. Mining exports (e.g., iron ore, copper and gold) account for four-fifths of all export receipts and so, even though their contribution to the economic boom is notable, their concentration stands very high in terms of product base and trade partners. On the other hand, Mauritania largely imports mining-related capital goods and around three-quarters of its food requirements. As a consequence, current account imbalances are persistent and particularly sensitive to the volatility of terms of trade between key exports and imports, as well as to Mauritania's ability to attract FDI flows. Climate shocks (particularly droughts) represent another significant source of external vulnerability as they often translate into higher food import requirements, affecting *in primis* the poorest clusters of population.

Main recent fiscal and debt developments

Improved fiscal performance has accompanied economic growth, with government policies strengthening revenues and supporting public investment. Budget deficits used to exceed 5 percent of GDP back in 2007-09, after the *surplus* recorded in 2006 when Mauritania benefited from debt relief. Deficits have hovered around 1 percent since 2010—excluding the *surplus* attained in 2012 when substantial foreign aid in grants helped the government cope with a severe drought (Figure A4). Measures to increase tax bases and the introduction of some new taxes, together with a better coordination among fiscal administrations, were conducive to increase revenues—excluding external grants—from 25 percent of GDP in 2007-11, on average, to 34 percent of GDP in 2012-13. With booming revenues available to spend and an explicit objective to support the growth spurt, the government decisively scaled up capital expenditure—which jumped from 7 percent of GDP in 2007-11 to 13 percent of GDP in 2012-13. Thus, total public expenditure reached 36 percent of GDP in 2012-13, on average, vis-à-vis 31 percent of GDP in 2007-11. The fiscal bonanza not only helped fund additional investment spending, but also contained budget imbalances and reduced the net borrowing needs.

The government is aware of the need to further consolidate fiscal performance, sustain economic growth, improve social spending, and spur the attainment of the Millennium Development Goals (MDGs). The 2014 Budget Law recognizes these goals as well as the importance of capital spending, and defines four guiding principles: (i) sustain productive sector to spur economic growth; (ii) promote employment and income-generating activities; (iii) strengthen access of population to basic services, most notably health, education, water and sanitation; and (iv) develop key infrastructure to continue attracting investment. A recent shift in expenditure priorities is noticeable, with public spending focusing more on investment and human development—especially infrastructure, energy, transportation, and education—and less on consumption—particularly food and fuel subsidies. The phasing-out of subsidies and the abandonment of reactionary approaches to crises, in favor of more systematic methods such as conditional cash transfers programs, are additional evidence of the same shift. Against this background it is critical to enhance public investment management, with a view to ensure that the scaling-up of investment spending is oriented to high-return projects that build macroeconomic resilience and foster productivity and diversification.

Mauritania's public debt is manageable and poses limited fiscal vulnerability, but efforts should be made to bring it down to lower levels. Since debt relief was granted in 2006, the government debt remained around 95 percent of GDP—an admittedly high level (Figure A3). This report considers the public debt to be 74 percent of GDP as of end-2013, assuming a resolution of the Kuwait bilateral debt dispute under HIPC terms. There is little difficulty in managing and servicing financial obligations,

though, because three-quarters of the government debt is concessional loans contracted with multilateral and bilateral creditors on rather soft financing terms. Exposure to currency risk is the only drawback of these otherwise inexpensive foreign liabilities. Mauritania has recently resorted to non-concessional borrowings to finance infrastructure projects; this type of financing should be scrutinized with the utmost attention by the government in order to avoid building vulnerabilities going forward. Domestic liabilities constitute 10 percent of the government debt and thus 7 percent of GDP. T-bills, mainly held by local banks, carry low interest rates but their maturities are extremely short—between 4 to 13 weeks. Exposure to refinancing risk is indeed a concern for policy makers: a National Committee on Public Debt between the Ministry of Finance, the Ministry of Economic Development, and the Central Bank, was convened in 2014 to increase policy coordination and find ways to lengthen maturities of government securities.

Figure A1. Real GDP growth (% , annual).

Source: WEO April 2014

Figure A2. Inflation (% , annual).

Source: WDI

Figure A3. Public debt (% of GDP).

Source: IMF and WB

Figure A4. Fiscal deficit (% of GDP).

Source: IMF and WB

B. Macro-Fiscal Framework for 2014-2023 and Debt Sustainability Analysis

A Debt Sustainability Analysis (DSA) assesses Mauritania's public debt prospects and vulnerabilities in the next 10 years, consistently with a macroeconomic outlook and alternative fiscal and debt policies. The analysis focuses on the gross public debt of the Central Government, including foreign and domestic liabilities.¹ Debt projections are built upon the macroeconomic and fiscal framework prepared by the World Bank that covers the period 2014-23 (Table B1). Information on public debt instruments and financing terms is drawn from the latest Medium-Term Debt Strategy Report (2012) as well as from some updates for 2012-13. Annex I describes the DSA model used in this section.

The baseline outlook envisages the continuation of the strong growth performance observed in recent years. The World Bank macro-fiscal framework is the foundation of the DSA baseline scenario. Real GDP growth rates around 7 percent are expected to be maintained during the period 2014-23, whereas the inflation rates measured by the GDP deflator would converge towards 5 percent per annum. The foreign exchange receipts generated by mining exports would permit to stabilize the nominal exchange rate, and so the local currency is expected to appreciate in real terms.

The baseline outlook is predicated on the preservation of sound policies that seek to achieve balanced budgets and take full advantage of concessional borrowing opportunities. Fiscal bonanza has brought budget deficits down to nearly 1 percent of GDP in recent years, and so now Mauritania is not far from achieving a balanced budget. The baseline scenario assumes that further efforts would be undertaken to consolidate public finances and target a zero-deficit budget in the next few years. Admittedly, these efforts are feasible in the short-term because of the favorable initial conditions whereby deficits are already small. Challenges may arise in the medium- and long-term, though. Mauritania's steps up the income ladder and the inevitable exhaustibility of its non-renewable natural resources are likely to affect some relevant components of government revenue—most notably oil income and mineral royalty and tax receipts—which would decline relative to the size of the economy. If fiscal policies seek to preserve balanced budgets, the Government would have to adjust expenditures downwards *pari passu* and make choices on what spending programs are to be rationalized or expanded at slow motion. If the pattern of policy priorities observed in 2013 persists, a sensible conjecture is that the government would prefer to maintain robust levels of public investment, and instead cut on subsidies and transfers. Against this backdrop, the baseline outlook projects revenues and expenditures to gradually decrease from the current levels of 35-36 percent of GDP to 33 percent of GDP by 2018. As far as debt policies are concerned, the government is expected to pursue a debt management strategy similar to that observed recently, whereby maturing liabilities are re-financed under similar terms. Thus, the composition of the public debt portfolio

¹ In this work, the debt owed to the Kuwaiti Investment Authority is excluded.

would remain heavily biased towards concessional loans. In addition, the baseline scenario assumes that the government seeks to build up a reserve of liquid assets and accumulate cash balances (e.g., bank deposits) by 1 percent of GDP per annum, on average, over the projection horizon.

Provided that growth prospects remain strong and public policies are sound, Mauritania’s public debt could decline as low as 30 percent of GDP by 2023, thus mitigating solvency risk and strengthening debt sustainability. Fiscal policies targeting a balanced budget will largely compress the net borrowing needs—down to the minimum indebtedness necessary to pile up the desired stock of liquid assets—and thus slowdown the accumulation of financial liabilities. A fast-growing nominal GDP, in addition, will boost fiscal revenues and strengthen the capacity to repay the Government debt. A smooth decline in the public debt, from 74 percent of GDP in 2013 to 50 percent of GDP in 2018, and to 30 percent of GDP in 2023, is the noteworthy outcome of such a virtuous combination of strong economic performance and fiscal prudence (Figure B1). Mauritania would then mitigate solvency risk and strengthen debt sustainability. In addition, the country would alleviate liquidity pressures as the gross financing needs decrease from 12 percent of GDP in 2013 to 4 percent of GDP in 2023. It is critical to emphasize that achieving these results requires fiscal discipline and solid institutions supporting policies.

With lower public debt and faster economic growth, Mauritania is much less likely to experience debt distress and difficulties to honor the government debt obligations. The Debt Sustainability Framework for Low-Income Countries (LIC DSF) jointly developed by the World Bank and the IMF, presented in Annex III, is built upon an econometric cross-section model to estimate the probability of a country running into debt distress and facing difficulties to service the public debt. Not surprisingly, the empirical evidence offered by numerous developing countries in different historical circumstances suggests that such a probability decreases with lower public debt, higher economic growth, and sounder policies. This is precisely the mix of circumstances characterizing the baseline scenario for Mauritania. If the country continues to achieve a strong growth performance and the government commits and delivers on prudent fiscal and debt policies, Mauritania can expect to halve its probability of experiencing debt distress, from 15 percent in 2013 to 7 percent in 2023 (Figure B2). This achievement can eventually help reduce borrowing costs to the extent that lower debt-distress probabilities—which ultimately reflect a lower solvency risk—feed into lower credit spreads on government securities. As Mauritania develops its government securities market and transitions away from external concessional funding, the advantages of enjoying lower credit spreads will be apparent.

Fiscal risks stemming from unforeseen macroeconomic shocks, as well as alternative policy options, are worth exploring in order to assess the robustness of the baseline DSA results and to inform decisions on what fiscal and debt policies Mauritania should pursue going forward. Macroeconomic trends characterizing the baseline outlook presented in Table B1 may not materialize as expected if and

when unforeseen shocks hit the Mauritanian economy. To assess the robustness of the baseline DSA results to the occurrence of these shocks—particularly very adverse events—it is good practice to bring alternative projections of key macroeconomic variables into the DSA model. Similarly, the fiscal and debt policies assumed in the baseline outlook may eventually not be pursued going forward. Policy makers in Mauritania may fail to implement these policies or, more fundamentally, they may have strong preferences for other strategies better suited to their objectives, priorities, and institutional and market constraints. It is also good practice, therefore, to consider alternative policy options and confront their outcomes against those of the baseline policies. A comparison of relative performance in terms of debt sustainability should ideally inform any decision on what fiscal and debt policies Mauritania should adopt in the future. In the remainder of this section, a stochastic version of the DSA addresses the fiscal risks induced by macroeconomic uncertainties. The next two sections focus, instead, on alternative policy options.

Fiscal risks and debt sustainability

Fiscal risks arise from the uncertainties surrounding the World Bank macro-fiscal framework upon which the baseline outlook is predicated. The set of consistent macroeconomic projections reported in Table B1 refer to future—and thus uncertain—trends and underpin the DSA results reported so far. *Fiscal risks* arise as the macroeconomic uncertainty spreads to the performance of the government budget and debt. Arguably, Mauritania is subject to external and domestic shocks—e.g., a drop in prices of exported commodities, higher-than-expected oil reserves, droughts and other climate disasters. If and when these unforeseen shocks occur, the macroeconomic, fiscal, and debt outcomes would deviate from those obtained in the baseline scenario. These deviations are determined by three factors: the size of a shock, its probability of occurrence, and the exposure (sensitivity) of the country’s economy and public finances. Shocks inducing large deviations—especially if very likely to occur—should be a serious concern for policy makers because they could derail the government budget and debt path, and lead to an unsustainable debt dynamics. For instance, a significant and protracted drop in prices of exported commodities can slowdown economic growth, reduce tax revenues, widen the budget deficit and net borrowing needs, and ultimately increase the public debt up to imprudent levels—and well above the projected debt path in the baseline scenario. Assessing the robustness of the baseline DSA results to the occurrence of macroeconomic shocks is thus warranted.

From the perspective of debt sustainability, the analysis of fiscal risks aims at quantifying the range of possible debt outcomes that may result as a consequence of macroeconomic shocks, as well as

their associated probabilities. The methodology to assess sources of (and exposure to) fiscal risks undertaken in this study proceeds firstly simulating stochastic shocks to key macroeconomic variables; next, calculating the projection of any public-finance variable of interest for each and every simulation—e.g., budget balance, public debt stock, gross financing needs; and finally, building the probability distribution of that variable—i.e., the range of values and the associated probabilities of occurrence.² The analysis focuses on three macroeconomic variables whose importance for Mauritania’s public finances is uncontroversial and are subject to all sorts of shocks: economic growth (proxied by the real GDP growth), competitiveness (proxied by the real exchange rate), and the cost of domestic borrowing (proxied by the domestic real interest rate on government bills and bonds). Macroeconomic scenarios that bring into the picture the various unforeseen circumstances affecting Mauritania’s growth, competitiveness, and borrowing costs, are built analytically by running a large number of simulations with stochastically-generated shocks to these three variables.³ For practical purposes, each simulation gives rise to an alternative debt projection that naturally departs from the baseline path. The full set of debt projections, therefore, describes all the possible (shock-driven) debt outcomes and permits assessing how robust the baseline DSA results are.⁴ This assessment is easily undertaken through fan charts depicting the range of possible outcomes and their associated probabilities, e.g., the probability distribution of the public debt-to-GDP ratio in a given year along the projection horizon.

Fiscal risks are reflected in fan charts. As explained above, projections of Mauritania’s public debt were obtained from numerous simulations where macroeconomic shocks hit the real GDP growth, the real exchange rate, and the domestic real interest rate. Results are summarized in the fan chart reported in Figure B3. The dotted line represents the baseline (expected) path: the public debt-to-GDP ratio decreases from 74 percent in 2013 to 30 percent in 2023. The colored bands, in turn, depict the probability distribution (density) of the debt outcomes resulting from macroeconomic shocks and stochastic simulations. The bands—which can be seen as defining confidence intervals—indicate that in 2023 there is a 50 percent probability that the debt-to-GDP ratio could be as low as 27 percent and as high as 33 percent, i.e., deviations of ± 3 percentage points around the baseline path. Similarly, there is a 90 percent probability that the debt-to-GDP ratio could lie in the range 24–40 percent, i.e., with wider deviations

² For a similar approach, see Bella (2008), Tielens et al. (2010), Giovanni and Gardner (2008), and Pradelli and Baghdassarian (2013).

³ The econometric time-series model presented in Annex I is used to estimate parameters (e.g., a covariance matrix) that reflect the co-movements of shocks hitting the three macroeconomic variables observed in recent years. The stochastically-generated shocks rely on those parameters as well as on the admittedly arbitrary (albeit widely used) assumption that shocks are drawn from a multivariate Gaussian distribution. In doing so, the generation of random shocks intends to preserve as much as possible the salient patterns of the macroeconomic dynamics of Mauritania.

⁴ Specifically, the baseline DSA results are robust if the range of possible debt paths narrowly concentrates around the baseline path—meaning that macroeconomic shocks hitting the Mauritanian economy would have a limited impact on the country’s fiscal and debt performance—or if any debt path that largely deviates from the baseline path turns out to have a very small probability of occurrence—meaning that macroeconomic shocks that do have a large impact are nevertheless rather unlikely to happen.

relative to the baseline path. For illustrative purposes, Figure B4 depicts the fan chart corresponding to the gross financing needs.

Sound fiscal and debt policies envisaged in the baseline scenario do strengthen debt sustainability even in the presence of macroeconomic shocks. The stochastic DSA suggests two points relevant for policy makers in Mauritania. Firstly, macroeconomic volatility and uncertainty should be taken seriously because the fiscal and debt performance are exposed to adverse shocks. In particular, if unfavorable circumstances unfold, such as lower growth and higher interest rates, the government debt can eventually reach levels significantly above those anticipated otherwise. For instance, the public debt is expected to be 30 percent of GDP by 2023 but in a poor macroeconomic environment it can be as high as 40 percent of GDP. Secondly, it is noteworthy that the sound policies seeking balanced budgets and inexpensive concessional funding sources—which Mauritania is assumed to follow so far—do deliver a large reduction of public debt in 2013-23, not only in the baseline scenario but also in all the simulations undertaken. Arguably, even the public debt of 40 percent of GDP by 2023 that would result from very unfavorable shocks represents, for practical purposes, a notable improvement against the current ratio of 74 percent. In other words, regardless of the adverse macroeconomic shocks that may slowdown the pace of debt reduction, the fiscal prudence always proves to be effective to strengthen debt sustainability in Mauritania. This result, already highlighted in the baseline scenario, turns out to be robust to alternative macroeconomic outlooks that do bring into the picture the shocks the country is exposed to.

A detour: stochastic DSA and scenario analysis

A stochastic DSA has technical advantages vis-à-vis the use of scenario analysis to address macroeconomic uncertainties and fiscal risks. Scenario analysis is another popular methodology to investigate uncertainties and fiscal risks, and it is actually the approach adopted in the LIC DSF to formulate stress tests. Scenario analysis proceeds by introducing a few standardized shocks one-by-one into the DSA model and gauging their individual impact on the fiscal and debt performance. The modelling of shocks is extremely simple: their size is often chosen arbitrarily and not looking at country-specific circumstances; little attention is paid to co-movements (covariances) between disturbances hitting key macroeconomic variables; and there is no consideration whatsoever regarding their likelihood of occurrence. A stochastic DSA, instead, takes all these modelling issues seriously and hence improves upon scenario analysis on purely technical grounds. Both approaches, therefore, should be seen as complements.

A stochastic DSA also has advantages vis-à-vis scenario analysis for the formulation of fiscal and debt policies. The stochastic DSA offers advantages on practical, policy-making grounds that derive from

the explicit recognition of probabilities of events and associated risks. Useful insights for policy makers provided by a stochastic DSA include, *inter alia*, the calculation of the probability that the public debt breach a threshold level that is prudent not to exceed. This is especially relevant when debt levels are high and breaching thresholds may impair a country's access to certain sources of funding (e.g., IDA lending) or trigger pre-payment clauses in loan contracts. Besides, the explicit quantification of the probabilities of shocks help avoiding policy over-reactions that may arise when policy makers are *unduly* focused on preventing events that are perceived to have deleterious effects on public finances because they fail to recognize that those events have a low likelihood of occurrence.⁵ The stochastic DSA is also a useful tool for assessing the performance of policies aimed at mitigating fiscal risks and build resilience, such as fiscal consolidation reducing net borrowing needs and debt stocks.

Table B1. Macro-fiscal framework 2014-2023.

Variables	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
GDP at current prices (billion MRO)	1,252	1,299	1,418	1,566	1,756	1,973	2,218	2,493	2,803	3,151	3,543
GDP at constant prices, annual growth rate (%)	6.7	6.8	6.8	6.7	7.0	7.0	7.0	7.0	7.0	7.0	7.0
GDP deflator, annual growth rate (%)	-0.1	-2.9	2.3	3.5	4.8	5.0	5.1	5.1	5.1	5.1	5.1
Exchange rate MRO/USD (end of period)	302.9	276.4	273.3	273.4	275.6	278.1	280.7	283.4	286.1	288.8	290.1
Exchange rate MRO/USD (period average)	298.8	278.8	274.0	272.5	274.3	276.8	279.4	282.0	284.7	287.4	290.1
Exchange rate MRO/EUR (end of period)	417.7	381.2	376.8	377.1	380.0	383.5	387.1	390.8	394.5	398.2	400.1
Exchange rate MRO/EUR (period average)	412.0	384.5	377.9	375.8	378.3	381.7	385.3	388.9	392.6	396.3	400.1
Exchange rate USD/EUR (period average)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Real exchange rate (MRO/USD), index 2008=10	115.6	113.3	111.1	108.8	106.7	104.5	102.4	100.4	98.4	96.4	94.5
Total revenue (% GDP)	34.6	36.4	36.1	35.9	34.2	33.3	33.2	33.2	33.2	33.2	33.2
Domestic revenue	32.0	32.4	32.8	33.3	31.9	31.0	31.0	31.0	31.0	31.0	31.0
External grants	0.9	2.1	1.4	0.8	0.7	0.6	0.5	0.5	0.5	0.5	0.5
Net revenues from Oil	1.7	2.0	1.9	1.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Total expenditure (% GDP)	35.7	36.0	35.5	35.3	33.9	33.3	33.2	33.2	33.1	33.0	32.9
Interest expenditure	1.3	1.4	1.2	1.2	1.1	1.1	1.1	1.1	1.0	0.9	0.8
Wages and salaries (emoluments)	8.5	8.4	9.1	9.1	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Transfers and subsidies	5.7	5.7	3.9	3.6	3.0	2.5	2.0	2.0	2.0	2.0	2.0
Other current expenditure	1.4	1.5	1.3	1.0	0.8	0.7	0.7	0.7	0.7	0.7	0.7
goods and services	4.9	5.1	5.6	5.6	5.8	5.8	6.2	6.2	6.2	6.2	6.2
Capital expenditure	13.9	13.8	14.5	14.8	14.6	14.6	14.6	14.6	14.6	14.6	14.6
Primary balance (% GDP)	0.2	1.8	1.8	1.8	1.4	1.1	1.1	1.1	1.1	1.1	1.1
Overall budget balance (% GDP)	-1.1	0.4	0.5	0.6	0.3	0.0	0.0	0.0	0.1	0.2	0.3

Notes:

(*) Real exchange rate defined as the exchange rate MRO/USD (per.av.) deflated by GDP deflator and an assumption of a fixed 2% US inflation.

Source: World Bank projections

⁵ The LIC DSF, for instance, conducts various stress tests to assess fiscal risks. For some countries, the shocks used in the stress tests appear too extreme and severe, but indeed they are very unlikely to happen. The LIC DSF could unintentionally over-exaggerate the risks emerging from these shocks because it looks at their size and not at their likelihood—in fact, there is no explicit probability measure associated with the stress-test scenarios. Failure to appreciate both size and probability of occurrence of shocks may bias policy decisions towards very conservative strategies weighting more the risk-mitigation objective, which are usually more expensive than others weighting that objective less.

Figure B1. Debt (% of GDP) and Gross Financing Needs (% of GDP). Baseline scenario.

Source: Authors' calculations

Figure B2. Debt (% of GDP) and Probability of Debt Distress (%). Baseline scenario.

Source: Authors' calculations

Figure B3. Debt (% of GDP). Stochastic simulations.

Source: Authors' calculations

Figure B4. Gross Financing Needs (% of GDP). Stochastic simulations.

Source: Authors' calculations

C. Public Investment: Growth Dividend and Debt Sustainability

Public investment policies are key determinants of Mauritania's fiscal and debt performance going forward. Public investment spending boomed in recent years and arguably supported the economic boom. Currently, capital expenditures are as high as 14 percent of GDP and account from 40 percent of total public expenditure. Weighting so heavily in the budget and being typically financed through borrowings, the public investment policies are decisive for Mauritania's fiscal and debt performance going forward. For public finances as a whole, the new on-budget investment projects undertaken in the last few years have not created *net* public debt because budget deficits were fairly small since 2010—or even a surplus in 2012.⁶ But this pattern may change in the future if budget deficits widen because Mauritania chooses to further boost capital expenditures without a concomitant increase in fiscal

⁶ Mauritania's budget were close to balance and the on-budget investments were funded by contracting new loans, so it must have happened that (part of) fiscal revenues were saved and funded the acquisition of financial assets—including the accumulation of cash balances and Government deposits. As investments created liabilities that match with the financial assets acquired, the additional debt in *net* terms was roughly zero.

revenues, or as a consequence of a decline in some revenue sources not matched with a contraction in capital expenditures (or any other spending program, for that matter).

Alternative public investment policy options are assessed in the DSA. The baseline scenario assumes that the recent public investment boom will be maintained—with capital expenditure averaging 14.5 percent of GDP in 2014-23—while fiscal policy will seek to attain balanced budgets. As argued above, policy makers in Mauritania may fail to implement these policies or may legitimately prefer others. Assessing the implications on debt sustainability of alternative investment strategies is therefore warranted, especially to assess their relative performance and thus strengthen the case for adopting certain options and disregarding others. In this study, an alternative investment policy is considered whereby projects are further scaled up and capital spending increases up to 16.5 percent of GDP in 2014-23, on average, i.e., an additional 2 percentage points of GDP relative to the baseline scenario. The *additional* public investment expenditure is not offset by contracting current expenditures, so *ceteris paribus* fiscal revenues, budgets would turn into deficit.

Public investment implies borrowings to fund spending and higher financial obligations, and it may (or not) increase the government’s revenues and repayment capacity. From the perspective of debt sustainability, public investment policies in Mauritania are to be assessed in two dimensions: i) the borrowings incurred to fund capital expenditures, which increase the debt stock and debt service obligations; and ii) the growth-dividend expected from expanding productive capacity in the country, which would translate into debt repayment capacity provided that the projects are worthwhile and the government can appropriate more revenues in the future, say through taxes. Along these lines, the higher-investment policy described above is evaluated in two different contexts: one scenario in which the *additional* capital expenditure eventually has no growth-dividend whatsoever and, more broadly, no impact on the anticipated macroeconomic trends in Mauritania; and another scenario where the *additional* capital expenditure does deliver a growth-dividend and affects the prospective performance in terms of growth, competitiveness, and borrowings costs—i.e., the three key variables discussed in the previous section.⁷ It should be bear in mind that the analysis conducted here refers to the *additional (marginal)* new investment projects and their potential benefits (if any), as opposed to the overall level of public capital expenditure and related projects assumed in the baseline outlook—whose benefits are probably worthy but not quantified here.

⁷ The econometric time-series model presented in Annex I is used to estimate parameters of dynamic equations that formalize the co-movements of the three macroeconomic variables and the public investment—treated as a policy-driven, exogenous variable—observed in recent years. The scenario with growth-dividend is built on those parameters and thus intends to capture the salient interactions and feedbacks between the macroeconomy and the public capital projects in Mauritania.

Poor-quality investment projects are likely to only create additional financial obligations and ultimately impair debt sustainability. The higher-investment policy situated in the scenario without growth-dividend can be seen as supporting *additional* poor-quality projects with little (if any) contribution to the country's production capacity and the government's revenue-generation capacity, e.g., *white elephant projects* and *bridges to nowhere*. Thus, having implications only on the government's borrowing and financial obligations, the policy will nothing but impair public debt sustainability (relative to the baseline scenario). Indeed, with a scenario-analysis approach and assuming no growth-dividend, Mauritania's public debt would decrease from 74 percent of GDP in 2013 to 46 percent of GDP in 2023 (Figure C1). The poor-quality investment policy induces budget deficits—which are slightly above 2 percent of GDP per annum in 2014-23 because of both higher capital expenditure and interest payments on the new loans financing projects—and thus it creates new *net* borrowing needs but fails to concomitantly accelerate growth of nominal GDP and fiscal revenues. Thus, the debt ratio declines much less than in the baseline scenario—where it reaches 30 percent of GDP in 2023. In addition, the *gross* financing needs—and associated liquidity risks—are much higher than in the baseline scenario, because of both higher budget deficits and principal amortization payments on the new loans financing projects (Figure C2).

Good-quality investment projects, instead, would create additional financial obligations as well as resources to partly repay them. The higher-investment policy adopted in the scenario with growth-dividend, on the other hand, represents undertaking *additional* good-quality projects which do boost the potential for income- and fiscal revenue-generation in Mauritania. Increasing the capital expenditures by 2 percentage points of GDP relative to the baseline scenario is estimated to raise the long-term growth of real GDP by 1.2 percentage points—i.e., to an average annual growth of 8.2 percent in 2014-23, compared against the 7 percent anticipated in the baseline outlook.⁸ Faster growth of nominal GDP and fiscal revenues, in turn, strengthens the government's capacity to repay the new loans financing projects. Given the estimated growth-dividend, the public debt would decrease from 74 percent of GDP in 2013 to 40 percent of GDP in 2023 (Figure C1). Thus, the impairment of debt sustainability observed in the scenario without growth-dividend is partly mitigated. Budget deficits and new *net* borrowing needs still arise, but the sustainability outcomes are less severe thanks to the better performance of nominal GDP and fiscal revenues. It should be emphasized, however, that the higher-investment policy delivers paths of debt and gross financing needs above the baseline paths (Figure C1 and C2). Hence, the growth-dividend—while certainly welcomed—is not sufficiently large to offset the new financial obligations created to fund the *additional* public capital projects.

⁸ Besides, the *additional* capital spending would slightly increase the domestic real interest rate on government bills and bonds, and accelerate the long-term appreciation of the real exchange rate. These two effects, nevertheless, are of small magnitude and so exert little influence on the public-finance outcomes.

Good-quality investment projects with insufficient growth-dividend augment the exposure to fiscal risks. Higher-investment policy not accompanied with an offsetting rationalization in current expenditures tilts budgets towards deficit and deteriorates the performance of public finances (relative to the baseline outlook). The estimated growth-dividend appears insufficient to prevent such deterioration. Furthermore, the policy widens the exposure to fiscal risks precisely because weaker public finances are more sensitive to unforeseen macroeconomic shocks whenever they occur. Fan charts obtained using the stochastic DSA and the scenario with higher investment and growth-dividend are reported in Figure C3 and C4. The dotted line represents the path in the absence of shocks, in which the public debt-to-GDP ratio reaches 40 percent in 2023. The higher-investment policy coupled with macroeconomic shocks may deliver a debt ratio in the range 33-50 percent in 2023 with a 90 percent probability. Thus, if public capital projects are scaled up and yield an insufficient growth-dividend—as this study estimates—there are fewer chances for Mauritania to achieve a large reduction in the public debt in the next 10 years.

Further scaling up the public investment—over and above the current level of capital spending, which is already high—is likely to deteriorate Mauritania’s debt sustainability despite slightly accelerating economic growth. Two recommendations for the policy makers in Mauritania can be drawn from the analysis of alternative public investment options. Firstly, whereas keeping the current level of capital expenditure and seeking for balanced budgets—i.e., the baseline policies—are anticipated to support a strong macroeconomic performance and permit a large reduction in the public debt relative to GDP, an attempt to further scale up capital projects—i.e., the higher-investment policy—would bring the budgets back to deficit and slowdown the pace of debt reduction. Even if capital projects are of good-quality, selected strategically, and implemented efficiently, the estimated (marginal) growth-dividend associated to the higher-investment policy is not strong enough so as to avoid a deterioration of debt sustainability (relative to the baseline policies). In other words, Mauritania should not take for granted that any *additional* investment expenditure is good for the economy and automatically creates the repayment capacity necessary to service the public debt incurred to fund it. Secondly, the stochastic DSA suggests macroeconomic volatility and uncertainty would be more worrisome if higher public investment leads to budget deficits and thus widens exposure to adverse shocks. The government debt may reach levels significantly above those anticipated in the baseline scenario—it can be as high as 50 percent of GDP if a very poor macroeconomic performance unfolds. The window of opportunity offered by a prudent fiscal policy to reduce the government debt and strengthen sustainability will probably narrow if the country’s public spending—even in capital projects—goes beyond the revenue potential, abandons the target of balanced budgets, and requires further borrowings.

Quality of Public Investment: Growth Dividend and Fiscal Multipliers

Mauritania could boost economic growth by improving the quality of public investment—as opposed to its level. Public investment policies not only determine the level but also the quality of capital projects. For Mauritania, improving the public investment management system governing, *inter alia*, the activities of project appraisal, selection, implementation, and evaluation, is probably more promising than further increasing the level of capital spending—which is currently already high. A better quality of investment permits to attain a growth-dividend—boosting the potential for income- and fiscal revenue-generation—without creating pressures on the public expenditure—and ultimately worsening the outcomes regarding the government budget, borrowings, and debt sustainability, as discussed above. The macroeconomic benefits of public investment, therefore, come without the *financial* costs of *additional* capital spending. But there is another type of costs that should not be overlooked: the institutional reforms to the administrative apparatus running the public investment management system will affect stakeholders—civil servants, suppliers, contractors, etc.—and some of them will have to make sacrifices (and even take losses) for the benefit of the system as a whole. The political economy of institutional reform is always complex and has to be handled.

Fiscal multipliers of capital spending can be used as summary indicators of the quality of public investment. A simple methodology to measure the quality of public investment is to use fiscal multipliers of capital spending. Analytically, multipliers measure the impact of the fiscal policy on output, and are computed as the ratio of a change in output to a change in revenues or expenditures (relative to a reference scenario). The policy relevance of fiscal multipliers cannot be exaggerated. But in practice, there are serious difficulties to estimate them and bring them into a fiscal policy framework.⁹

Any evaluation of fiscal policies informed by multipliers should be undertaken with caution because the size of a multiplier varies with country-specific circumstances and several factors identified in the specialized literature.¹⁰ Most of the empirical literature about fiscal multipliers focuses on advanced economies, and there is limited research on emerging markets and low-income countries. In advanced economies, the short-term (i.e., first-year) multipliers generally lie between zero and one in *normal* times, and can exceed one in *abnormal* circumstances such as a severe economic downturn with monetary-policy transmission problems. Besides, spending multipliers seem to be greater than revenue multipliers; overall, a multiplier of 0.6 results from averaging effects of spending and revenues under *normal* times. In

⁹ Estimating fiscal multipliers is a complicated endeavor for reasons such as the lack of reliable and sufficiently-long data series; the statistical problems to isolate the direct effect of the fiscal policy on economic activity as there is actually a two-way relationship between them; and the availability of theoretical models whose implications on fiscal policy and its effects—which would guide the formulation and evaluation of statistical models—are very different.

¹⁰ See Batini et al (2014).

emerging markets and low-income countries, the short-term multipliers are smaller than in advanced economies, with spending multipliers in the range 0.1-0.3 and revenue multipliers in the range 0.2-0.4. Interestingly, these countries may have long-term multipliers with negative values—i.e., expansionary fiscal policies eventually reduce long-term growth—because of a weak institutional environment. The size and persistence of the fiscal multipliers depend on a variety of structural and cyclical factors, anyway.¹¹ Empirical evidence suggests the efficiency of fiscal policy depends on a country's institutional framework, which includes the public investment management system.

Mauritania could attain a significant growth-dividend and improve debt sustainability by raising the quality of public investment. A multiplier of capital spending is the ratio between the *change* in output and the *change* in public investment expenditure. Unfortunately, there is no well-established estimate of such a measure for Mauritania. This study then formulates an alternative indicator whereby the *level* of public investment expenditure is used as denominator, rather than its *change*. The observed relationship between the growth-dividend *per unit* of investment expenditure and the quality of capital spending is thus preserved. Specifically, the better the quality, the higher the indicator—and hence the larger the growth-dividend attained for any given quantity of public investment. For Mauritania, after controlling for other relevant influences on economic growth, the estimated indicator is 0.325 and falls in line with the spending multipliers for developing countries reported above.¹² Scenario analysis is now used to investigate the implications on growth and debt sustainability of improving the quality of capital spending. Starting with the indicator currently at 0.325, a better quality is modelled with two alternative values, 0.35 and 0.375. These figures are still well below the spending multipliers found in advanced economies, and thus they reflect a public investment environment that Mauritania may reasonably be in a position to achieve. The baseline investment policy—i.e., capital expenditure averaging 14.5 percent of GDP in 2014-23—is introduced in the two alternative, better-quality-of-investment scenarios. Enhancing the country's institutional framework—and notably the public investment management system—may increase the average annual real GDP growth in 2014-23 to 7.8 percent if the indicator raises to 0.35, and even further up to 8.3 percent if the indicator reaches 0.375 (Figure C5). In the latter case, the growth performance is as good as that obtained with the higher-investment policy with growth-dividend, but with the advantage that no *additional* capital spending is incurred at all. Faster growth of nominal GDP and fiscal revenues, with no *additional* capital spending, can nothing but improve the public debt

¹¹ Structural factors include the degree of trade openness and labor market rigidity, the exchange rate regime, the size of automatic stabilizers, the level of debt, and the quality of public expenditure management and revenue administration. Cyclical factors refer to the phase of the business cycle and the degree of monetary accommodation to changes in fiscal policy. Persistence of fiscal multipliers is also affected by the persistence of changes in fiscal policy and whether expenditures or revenues are used as policy instrument.

¹² The econometric time-series model presented in Annex I estimates the marginal effect on the real GDP growth rate of an additional unit of public investment relative to GDP, controlling for other relevant factors. The estimated value is 0.325.

sustainability. Mauritania's government debt may then decrease from 74 percent of GDP in 2013 to 25 percent of GDP (or even less) in the better-quality-of-investment scenarios (Figure C6). Therefore, strengthening (and, if necessary, reforming) the existing institutions and policies in order to *do better with the public monies already allocated to capital projects* appears a more fruitful growth and fiscal strategy than *throwing more money* to the same purpose.

**Figure C1. Debt (% of GDP).
Investment scenarios.**

**Figure C2. Gross Financing Needs (% of GDP).
Investment scenarios.**

**Figure C3. Debt (% of GDP).
Higher Investment with Growth Dividend.
Stochastic simulations.**

**Figure C4. Gross Financing Needs (% of GDP).
Higher Investment with Growth Dividend.
Stochastic simulations.**

**Figure C5. Real GDP Growth (%)
Fiscal Multiplier Scenarios.**

**Figure C6. Debt (% of GDP).
Fiscal Multiplier Scenarios.**

D. Public Debt Strategies: Cost and Risk of Debt Portfolios

Public debt management policies can influence Mauritania's prospective fiscal and debt performance. After Mauritania benefited from debt relief and largely reduced the burden of public foreign liabilities, the debt management strategy has been seeking to exploit the external, concessional financing sources available, and to expand gradually the domestic market for short-term government securities. Currently, foreign liabilities represent 90 percent of the total public debt, most of it instrumented through multilateral and bilateral loans, often contracted on concessional terms. Domestic liabilities, on the other hand, are chiefly short-term T-bills. Because of the large share of concessional debt denominated in foreign currencies, the interest bill is fairly light—in the order of 1.5 percent of GDP and just 5 percent of the total public expenditure—but the *exposure* to currency fluctuations is significant. Besides, despite of the domestic debt being small, the need to roll it over at short maturities induces a large *exposure* to refinancing risk and interest rate risk. Weighting so heavily in the built-up of exposure to macroeconomic shocks—especially to exchange and interest rates, the debt management policies can influence Mauritania's fiscal and debt outcomes in the future. Changes in the borrowing strategies cannot be ruled out—e.g., non-concessional borrowings to finance infrastructure projects seem to be on the rise and initiatives to develop the domestic market for government securities are being considered—and thus assessing alternative options for public debt management is justified.

A Medium-Term Debt Management Strategy (MTDS) Report prepared in 2012 characterized Mauritania's public debt portfolio in terms of its composition and cost-risk profile. The MTDS Report analyzed the composition and cost-risk profile of Mauritania's public debt as of end-2011, with the main findings summarized in Box 1. The MTDS constructed stylized, representative debt instruments to adequately describe the financing terms and cost-risk characteristics of the various loans and securities involving a financial liability of the Mauritanian government. These instruments are listed in Table D1, which also reports the outstanding stocks as of end-2011—obtained from the MTDS Report—and as of end-2013—estimated using recent debt data.¹³ The characterization of the public debt portfolio made in the MTDS also applies to the government debt as of end-2013 because the new borrowings in 2012 and 2013 did not involve large issuances of financial instruments very different from those existing as of end-2011.

The MTDS Report assessed four debt management strategies for 2012-15. A *debt strategy* is the combination (*mix*) of financial instruments issued by the government to cover its gross financing needs—

¹³ The MTDS Report maps all domestic government securities, whose maturities are less than one year, to a one-year T-bond, thus realistically assuming that instruments are rolled over *within* the year in volumes that preserve the structure of domestic debt at the beginning of that year. The mapping of external debt instruments is more detailed, as seven different, stylized categories are used to represent the universe of foreign loans.

i.e., most notably, the budget deficit, the principal amortization payments, and the accumulation of financial assets. The debt strategy affects the fiscal and debt performance of a country to the extent that those instruments have different financing terms and cost-risk characteristics. Analytically, the strategy outlines the *composition* of the new borrowings in terms of representative, stylized debt instruments, and over a certain projection horizon. The MTDS Report explored four options for the period 2012-15, described below, and concluded that the current debt strategy should be maintained. The salient features of these strategies are as follows:

Strategy S1 (baseline): external borrowing using mostly concessional, fixed-rate loans from multilateral creditors; and zero *net* domestic borrowing, i.e., new T-bills are issued just to roll over maturing domestic government securities.

Strategy S2: external borrowing using mostly concessional, fixed-rate loans from multilateral creditors; and zero *gross* domestic borrowing, i.e., no new T-bills are issued.

Strategy S3: external borrowing using mostly concessional, fixed-rate loans from multilateral creditors; and non-zero *net* domestic borrowing at short maturities, i.e., new T-bills and a small amount of two-year T-bonds are issued to roll over maturing domestic government securities and raise additional funding.

Strategy S4: external borrowing using mostly concessional, fixed-rate loans from multilateral creditors; and non-zero *net* domestic borrowing at slightly longer maturities, i.e., new T-bills, two-year T-bonds, and three-year T-bonds are issued in volumes higher than those in strategy S3, with the view of further developing the domestic government securities market.

Alternative debt strategies are assessed in the DSA. This study uses the instruments already identified in the MTDS Report—reported in Table D1—and extends the projection horizon to 10 years. A continuation of the current debt strategy—i.e., S1—is the assumption underpinning all the scenarios—including the baseline outlook—presented in Section B and C. Other options, however, are worth exploring in the DSA in order to inform decisions on which policies are preferable to pursue. The options S2, S3, and S4 proposed in the MTDS Report are re-assessed, together with two *optimal* strategies—denoted S5 and S6—whose nature is explained below.

Optimal debt strategies are benchmarks useful to assess the performance of debt outcomes. The debt strategies envisaged in the MTDS Report incorporate a specific approach in terms of objectives and cost-risk preferences. Nevertheless, by construction, these policies are neither *efficient* nor *optimal*. A portfolio is *efficient* if it has the lowest possible cost for a given level of risk. In turn, an *optimal* portfolio is an *efficient* portfolio that best matches the policy makers' attitudes towards risk. Optimal portfolios

represent the best trade-off in terms of costs and risks—given the subjective risk tolerance of policy makers—and so they constitute a natural benchmark to confront against other portfolios—and their underlying debt policies. This work considers two optimal strategies whose derivation is explained in Annex II:

Strategy S5, denoted *unconstrained optimal debt strategy*: it assumes that Mauritania faces no constraints on the volume of concessional financing it may choose to borrow from official lenders. Analytically, S5 results from optimizing the composition of the borrowings in 2014-23 using the 10 debt instruments listed in Table D1. It turns out that S5 involves heavy borrowing from concessional, fixed-rate loans extended by multilateral creditors, through the instrument I1. The policy is useful as a benchmark because of its optimality, but is admittedly un-realistic since multilateral creditors often have a resource envelope allocated to any country and therefore the funds supplied may not be as large as the notional demand for funds.

Strategy S6, denoted *constrained optimal debt strategy*: in sharp contrast to S5, it assumes that Mauritania cannot access any concessional financing at all and is therefore constrained to borrow only from foreign bilateral and commercial lenders and domestic government securities. While the undisbursed funds of concessional loans contracted in the past are assumed to be received in the next few years, all the remaining (residual) gross financing needs are to be covered with the available sources of funding represented by instruments I5 to I10. Analytically, S6 results from optimizing the composition of the residual borrowings in 2014-23 using only those six debt instruments. The strategy involves heavy borrowing from semi-concessional, fixed-rate loans extended by bilateral creditors, through the instrument I6. This policy is also useful as a benchmark because of its (constrained) optimality, and could be seen as reflecting circumstances in which the development of Mauritania makes it less entitled to foreign aid and concessional lending.

Debt policies can do little to improve debt sustainability, which instead largely depends on fiscal policies. With a scenario analysis approach, the implications on debt sustainability of adopting alternative borrowing strategies are explored. It is noteworthy that all the six policies deliver similar debt paths: Mauritania's public debt would decrease from 74 percent of GDP in 2013 to a figure in the range 27-32 percent of GDP in 2023 (Figure D1). Therefore, it is the fiscal policy, as opposed to the debt strategy, that really matters for Mauritania to improve sustainability. Large differences arise, however, concerning liquidity outcomes. Strategies relying more on concessional financing at low interest rates and long maturities—most notably S5, where all financing comes from IDA loans, as well as S2 and S6—imply relatively low annual borrowing needs and debt service obligations (Figure D2 and D3).

Debt policies can attenuate the exposure of the on-budget interest bill to macroeconomic shocks affecting the exchange rate and the domestic interest rates. Interest payments in the government budget are currently low but could increase whenever unforeseen, unfavorable events raise the exchange rate and the domestic interest rates. Debt policies can help mitigating the sensitivity to these financial disturbances and the associated fiscal risks. Introducing the six debt strategies into the stochastic DSA permits an assessment of such opportunities for risk mitigation. Fan charts for each debt strategy are easily computed but it would be burdensome to report all of them. Instead, Figure D4 shows a single indicator summarizing the un-reported fan charts: the percentile 95 of the probability distribution of the interest-to-GDP ratio obtained in each debt strategy. This indicator is a standard cost-at-risk measure and gives the order of magnitude of how high the interest bill could jump if adverse shocks hit the Mauritanian economy. It is noteworthy that, again, the strategies seeking for more concessional financing—S5, S2, and S6—perform relatively better. They prove to significantly reduce the burden of interest payments that might have to be effectuated if adverse shocks occur. In addition, in the underlying fan chart of interest-to-GDP ratio for these three policies, the dispersion of outcomes around the expected path is quite small.

Debt strategies should be geared towards macroeconomic risk management and cannot substitute fiscal policies as means to improve Mauritania's debt sustainability. Three relevant insights for country authorities result from the analysis of debt policies. Firstly, the differences across alternative debt strategies—even considering the optimal portfolios—are less important to render Mauritania's public debt sustainable than the effect of a sound fiscal policy. Secondly, the way policy makers assess risks has relevant implications on debt management. The traditional DSA and MTDS methodologies in often cases apply arbitrary and large shocks (e.g., to exchange rates, interest rates, or both) in order to assess risks. The likelihood of these shocks, however, is very small and thus they are very extreme events that eventually may not discourage the adoption of debt strategies that do increase exposure to them. In Mauritania, for instance, historical data suggest the variance of the exchange rate against the US dollar is not too large—and the exchange rate paths in the stochastic simulations do preserve such a pattern. As a consequence, the strategies with heavy borrowing from concessional sources—which admittedly fuels exposure to currency risk—eventually perform better than others—and S5 is actually the optimal (unconstrained) policy. Thirdly, optimal debt strategies are useful guides for debt management, but it should be recognized that financial cost, risk, and risk tolerance are not the only variables of concern. Public debt managers need to consider other objectives as well. For Mauritania, there is a need to develop the domestic government securities market for both deficit financing and monetary policy implementation. Policies seeking to boost domestic borrowing will help in that regard, despite bringing extra financial cost and risk.

Table D1. Mauritania's Public Debt

Debt	Units	Stock as of end-2011 (excl. arrears)	Stock as of end-2013	Type	Grace period (years)	Maturity (years)	External / Domestic	Currency	Interest rate
Public Debt	Million MRO	661,724	921,849						
Domestic Debt	Million MRO	79,471	93,121						
External Debt	Million MRO	582,253	828,728						
Debt Instruments									
I1. Loans IDA	Million USD	334	1,274	Concessional Loan	10	40	External	USD	Fixed
I2. Loans AfDF	Million USD	75	74	Concessional Loan	10	30	External	USD	Fixed
I3. Loans from other multilateral creditors	Million USD	970	877	Concessional Loan	5	25	External	USD	Fixed
I4. Loans from other multilateral creditors	Million USD	3	2	Concessional Loan	5	25	External	USD	Floating
I5. Loans from Paris Club bilateral creditors	Million USD	56	53	Semi-Concessional Loan	5	20	External	USD	Fixed
I6. Loans from non-Paris Club bilateral creditors	Million USD	580	570	Semi-Concessional Loan	5	10	External	USD	Fixed
I7. Commercial Loans	Million USD	0	0	Market Loan	4	5	External	USD	Fixed
I8. T-bonds with one-year maturity	Million MRO	79,471	93,121	Market Security	0	1	Domestic	MRO	Fixed
I9. T-bonds with two-year maturity	Million MRO	0	0	Market Security	1	2	Domestic	MRO	Fixed
I10. T-bonds with three-year maturity	Million MRO	0	0	Market Security	2	3	Domestic	MRO	Fixed

Sources: Medium-Term Debt Management Strategy MTDS Report (2011 data) and World Bank estimates (2013 data)

**Figure D1. Debt (% of GDP).
Debt-strategy scenarios.**

Source: World Bank calculations

**Figure D2. Gross Financing Needs (% of GDP)
Debt-strategy scenarios.**

Source: World Bank calculations

**Figure D3. Debt Service (% of GDP).
Debt-strategy scenarios.**

Source: World Bank calculations

**Figure D4. Cost-at-Risk 95% (Int. as % of GDP).
Debt-strategy scenarios.**

Source: World Bank calculations

Box 1 – Mauritania's Medium-Term Debt Management Strategy (MTDS) Report

According to the Medium-Term Debt Management Strategy (MTDS) Report for Mauritania, by end-2011 the total public debt was USD 2.3 billion, of which 88 percent were external liabilities and 12 percent domestic obligations. In terms of currencies, 57 percent were denominated in USD (even USD debt formally only accounts for 2 percent), 13 percent in EUR, 12 percent in MRO, 8 percent in CNY, and 10 percent in other currencies (GBP, JPY, LYD). The overall debt portfolio had a fairly low average interest rate of 2.2 percent per year, thanks to the large share of external debt at highly concessional rates, while the average interest rate on domestic debt was 6.1 percent per year.

The MTDS Report assessed three types of risks: refinancing risk, interest rate risk, and currency risk. Refinancing risk was low on external debt and high on domestic debt. Because of highly concessional terms on foreign liabilities, the external debt had an average time to maturity (ATM) of 13 years and a tiny 2.4 percent of it was going to mature in less than 12 months. On the other hand, the ATM of domestic debt—mainly T-bills—was only 6 months and thus 100 percent of it had to be rolled over or repaid in less than one year. Interest rate risk was also low on external debt and high on domestic debt. A small fraction of external debt was linked to floating interest rates. Although T-bills were fixed rate instruments, their short-term maturities make them behave like floating rate instruments, thus creating interest rate re-fixing risk. Currency risk was high as 88 percent of the public debt was denominated in foreign currencies. The tiny fraction of external debt maturing in less than 12 months represented nearly 10 percent of total international reserves—which were equivalent to 3.7 months of imports in 2011.

The MTDS Report concluded that the current debt strategy should be maintained in the period 2012-15, seeking for a positive (albeit declining) net domestic financing as well as for external borrowing through multilateral concessional loans with fixed rates (e.g., IDA lending).

E. Conclusions

This work shows that, provided the country continues to register a robust growth as well as persists on the current path of rigorous fiscal consolidation, the ratio of debt-to-GDP will decrease dramatically over the next decade. A deterministic DSA shows that the debt-to-GDP ratio is expected to fall from 74 percent of GDP in 2013 to 30 percent by 2023. Gross financing needs also will fall from 12 percent of GDP to 4 percent in the same period, which shows that Mauritania's public debt can be sustainable in the long term.

This result is robust also in the presence of fiscal shocks that may stem from unforeseen macroeconomic changes threatening debt sustainability. Our stochastic DSA indicates that in 2023 there is a 50 percent probability that the debt-to-GDP ratio could be as low as 27 percent and as high as 33 percent, i.e., deviations of ± 3 percentage points around the baseline path. Similarly, there is a 90 percent probability that the debt-to-GDP ratio could lie in the range 24-40 percent, i.e., with wider deviations relative to the baseline path. Therefore, sound fiscal and debt policies envisaged in the baseline scenario do strengthen debt sustainability even in the presence of macroeconomic shocks.

The quality of public investment policies appears to be a key determinant of Mauritania's fiscal and debt performance going forward. This paper presents quantitative evidence that Mauritania could boost economic growth by improving the quality of public investment. Such result would be achieved by enhancing the quality of its policies and institutions. By doing this, Mauritania could attain a significant growth-dividend and improve debt sustainability.

With respect to public debt management, this analysis shows that debt strategies can influence Mauritania's prospective fiscal and debt performance, although their effect is smaller than the one deriving from fiscal policy. The simulations presented in this paper show that debt policies have a lesser impact on debt sustainability, which instead depends by and large on fiscal policies. Debt policies can attenuate the exposure of the on-budget interest bill to macroeconomic shocks affecting the exchange rate and the domestic interest rates. Thus, debt strategies should be geared towards macroeconomic risk management and cannot substitute fiscal policies as a means to improve Mauritania's debt sustainability.

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G. Annexes

Annex I: A DSA model for Mauritania.

The stock of public debt measured as a share of GDP, which is widely-used indicator of solvency and debt repayment capacity, depends on four key variables: (i) the initial public debt stock, which results from past borrowing choices; (ii) the primary balance that reflects the current fiscal policies and institutions concerning revenues and spending; (iii) the cost of borrowing, represented by the average interest rate charged on the inherited public debt; and (iv) the growth rate of nominal GDP. Formally, a DSA model postulates a debt dynamics equation to determine the public debt-to-GDP ratio:

$$(1) \quad D_t = \underbrace{D_{t-1}}_{\text{Initial debt}} + \underbrace{PD_t}_{\text{Primary deficit}} + \underbrace{\frac{i_t}{1+\hat{Y}_t} D_{t-1}}_{\text{Interest cost}} - \underbrace{\frac{\hat{Y}_t}{1+\hat{Y}_t} D_{t-1}}_{\text{Growth effect on the debt ratio}}$$

where D_t denotes the public debt-to-GDP ratio at end of year t , PD_t is the primary deficit as a share of GDP, i_t is the average interest rate paid on the inherited public debt, and $\hat{Y}_t$ is the growth rate of nominal GDP that determines the growth effect on the debt ratio.

The macroeconomic and fiscal variables involved in the public debt dynamics are neither isolated nor determined independently. On the contrary, they depend on each other through several interactions and feedbacks, which underlie their co-movements observed in the historical series of every country. For instance, in Mauritania, the output growth depends on the public investment, and the fiscal revenues depend on the economic activity. A realistic DSA model for Mauritania would then enrich the public debt dynamics modelled in equation (1) by introducing a set of relevant behavioral hypotheses—formalized through functional forms—that capture the interactions and feedbacks characterizing the economy. Some of these specificities are brought into the following debt dynamics equation:

$$(2) \quad \underbrace{D_{d,t} + D_{f,t}E_t}_{\text{Debt Dt}} = \underbrace{D_{d,t-1} + D_{f,t-1}E_{t-1}}_{\text{Initial debt}} + \underbrace{CE_{t(Y_t)} + KE_t - T_{t(Y_t)}}_{\text{Primary deficit}} + \dots$$

$$\dots + \underbrace{\frac{i_{d,t}}{1+\hat{Y}_t} D_{d,t-1}}_{\text{Interest cost on domestic debt}} + \underbrace{\frac{i_{f,t} + i_{f,t}\hat{E}_t + \hat{E}_t}{1+\hat{Y}_t} D_{f,t-1}E_{t-1}}_{\substack{\text{Interest cost on} \\ \text{foreign debt} \\ \text{(including valuation effect)}}} - \underbrace{\frac{\hat{Y}_t}{1+\hat{Y}_t} D_{t-1}}_{\text{Growth effect on the debt ratio}}$$

where relevant features are introduced: (i) the public debt ratio D_t is disaggregated into domestic debt $D_{d,t}$ and foreign debt $D_{f,t}$ (converted into local currency using the nominal exchange rate E_t); (ii) the primary deficit ratio PD_t is broken down into primary current expenditure CE_t , capital expenditure KE_t (i.e., public investment), and total revenues T_t (all variables scaled by GDP); (iii) the primary current expenditure CE_t , and total revenues T_t explicitly depend on the nominal GDP Y_t , which used as a proxy for the scale of expenditure programs and the relevant tax bases; (iv) the interest expenditure reflects the cost of carrying domestic and foreign liabilities, with the respective interest rates denoted $i_{d,t}$ and $i_{f,t}$; and (v) the valuation effect of currency depreciation $\hat{E}_t$ on the foreign liabilities is explicitly added to their interest cost.

Debt Dynamics, Financing, and Borrowings

Gross financing needs arise out of the budget deficit and the debt amortizations (principal payments): ¹⁴

$$(3) \quad \underbrace{GFN_t}_{\text{Gross financing needs}} = \underbrace{CE_{t(Y_t)} + KE_t - T_{t(Y_t)}}_{\text{Primary deficit}} + \underbrace{\frac{i_{d,t}}{1+\hat{Y}_t} D_{d,t-1} + \frac{i_{f,t}(1+\hat{E}_t)}{1+\hat{Y}_t} D_{f,t-1} E_{t-1}}_{\text{Interest cost on domestic and foreign debt}} + \underbrace{Am_{d,t} + Am_{f,t} E_t}_{\text{Amortization of principal}}$$

Gross financing needs, on the other hand, are covered with special receipts and use of assets (e.g., privatization, drawdown of government deposits) as well as with new borrowings (e.g., loans contracted, issuance of securities):

$$(4) \quad \underbrace{GFN_t}_{\text{Gross financing needs}} = \underbrace{SRUA_t}_{\text{Special receipts and use of assets}} + \underbrace{BN_t}_{\text{Borrowing needs}}$$

A *debt strategy* is the mix of financial instruments issued to meet the borrowing needs. Each instrument possesses specific financing terms such as currency of denomination, tenor, and interest rate. The debt strategy specifies the shares of borrowing needs that is met with each instrument. For illustrative purposes, the expressions below apply when the strategy specifies shares of domestic and foreign debt instruments to be issued, $w_{d,t}$ and $w_{f,t}$, respectively:

$$(5) \quad \underbrace{BN_t}_{\text{Borrowing needs}} = \underbrace{w_{d,t} BN_t}_{\text{Issuance of domestic debt}} + \underbrace{w_{f,t} BN_t}_{\text{Issuance of foreign debt}} \quad \text{with} \quad w_{d,t} + w_{f,t} = 1$$

The dynamics equations of the domestic debt and the foreign debt are, respectively:

$$(6) \quad \underbrace{D_{d,t}}_{\substack{\text{Domestic debt} \\ (\% \text{ of GDP})}} = \frac{1}{1+\hat{Y}_t} D_{d,t-1} + w_{d,t} BN_t - Am_{d,t}$$

$$(7) \quad \underbrace{D_{f,t} E_t}_{\substack{\text{External debt} \\ (\% \text{ of GDP})}} = \frac{1+\hat{E}_t}{1+\hat{Y}_t} D_{f,t-1} E_{t-1} + w_{f,t} BN_t - Am_{f,t} E_t$$

The DSA model for Mauritania encompasses the equations (2) to (7) and the econometric time-series model presented below. It provides a reasonable, stylized description of the behavior of macroeconomic and public-finance variables in the next few years. The DSA model projects the fiscal and debt variables of interest, e.g., revenues, expenditures, budget balances, net borrowings, and debt-to-GDP ratio. In addition, given assumptions on the financing terms applicable to the public debt instruments, the DSA model also projects variables such as gross financing needs and gross borrowings.

Macroeconomic Dynamics

We consider three decompositions of key macroeconomic variables into nominal and real magnitudes: (i) $(1 + \hat{Y}_t) = (1 + \hat{y}_t)(1 + \hat{p}_t)$, where the growth rate of nominal GDP $\hat{Y}_t$ is broken down into the growth rate of real GDP $\hat{y}_t$ and the domestic inflation rate measured by the GDP deflator p_t ; (ii) $(1 + i_{d,t}) = (1 + r_{d,t})(1 + \hat{p}_t)$, where the domestic nominal interest rate $i_{d,t}$ is broken down into the domestic real

¹⁴ In equations 4 to 7, the gross financing needs, the special receipts and use of assets, the borrowing needs, and the amortizations of domestic and foreign liabilities are all scaled by nominal GDP.

interest rate rd_t and the domestic inflation rate; and (iii) $(1 + \hat{E}_t) = (1 + \hat{e}_t)(1 + \hat{p}_t)/(1 + \hat{p}_{f,t})$ where the nominal currency depreciation rate $\hat{E}_t$ against the US dollar is decomposed into the relative change in the real exchange rate $\hat{e}_t$, the domestic inflation rate, and the foreign inflation rate.

We specify an econometric time-series model—a Vector Auto-regressive (VAR) model—to formalize the dynamic interactions and feedbacks between the real GDP growth rate $\hat{y}_t$, the real currency depreciation rate $\hat{e}_t$, the domestic real interest rate rd_t , and the public investment-to-GDP ratio KE_t . The first three variables are treated as endogenous in the VAR specification, and proxy, respectively, Mauritania’s growth, competitiveness, and borrowing costs for the government. Public investment, instead, is deemed an exogenous, policy-driven variable. The VAR model intends to capture the pattern of co-movements between these four variables, e.g., KE_t affects $\hat{y}_t$ (through the accumulation of physical capital) as well as $\hat{e}_t$ (through the productivity improvements, the foreign-exchange inflows associated to external financing of public capital projects, etc.).

For the purposes of this study, the VAR model is seen as a useful device to represent the stylized behavior of key macroeconomic variables driving the public debt dynamics and to simulate shocks and scenarios. Admittedly, the performance of the VAR model for Mauritania is severely affected by data availability constraints and structural breaks in the development experience of recent years. Hence, a strict scrutiny of the statistical properties of the VAR model is likely to reveal weaknesses and drawbacks, e.g., failures to pass basic specification and forecast tests. Nevertheless, lacking a better macroeconomic modelling device and acknowledging that the Mauritanian economic phenomena being modelled are themselves quite complex, the formulation and use of VAR model is justified in our view.

The VAR is estimated blending the historical data in 2003-13 and the projections in 2014-18 embedded in the baseline macro-fiscal framework. As time series are not long, we consider only one lag of the endogenous variables, i.e., a VAR(1) model. A casual observation to the historical series of the three endogenous variables suggests macroeconomic volatility was excessive in the past and would probably be largely attenuated in the next few years (Figure AI.1 and AI.2). In addition, the real exchange rate appreciated extremely fast in 2003-08 and arguably the prospective pace of real currency appreciation will be much slower. Against this backdrop, in order to smooth the volatility of the VAR forecasts and stochastic simulations, we proceed by estimating the VAR model using data points in 2014-18—drawn from the baseline macro-fiscal framework—and adjusting a few estimated covariances and intercepts. The estimated VAR coefficients are reported in Table AI.1 and the (adjusted) estimates are used in Section C to generate the scenario with growth-dividend consistent with the higher-investment policy. The estimated matrix of covariances of residuals is reported in Table AI.2 and the (adjusted) estimates are used in Section B to generate shocks to the macroeconomic trends characterizing the baseline outlook.

In Section B, the analysis of fiscal risks relies on stochastic simulations of macroeconomic scenarios. Starting with the baseline outlook’s trends reported in Table B1, randomly-generated shocks are added to the real GDP growth rate $\hat{y}_t$, the real currency depreciation rate $\hat{e}_t$, and the domestic real interest rate rd_t . Following standard practices, in any given year, the shocks are generated with a multivariate Gaussian distribution centered in zero and with the VAR residuals’ covariance matrix. Shocks are correlated in any given year, but independent through time. The various (shock-driven) paths of the three macroeconomic variables feed into the DSA model and thus underpin the fan charts of public debt and gross financing needs reported in Figure B3 and B4.

For illustrative purposes, the fan charts in Figure AI.3 and AI.4 correspond to the real GDP growth rate and the nominal exchange rate—derived from the real currency depreciation rate and the domestic and foreign inflation rates. The dotted lines represent the baseline (expected) paths: the real GDP growth stabilizes at 7 percent in the next few years; while the nominal exchange rate smoothly moves within the range of 275-300 MRO per unit of US dollar. The colored bands, in turn, depict the probability distribution (density) of the growth and exchange rate outcomes resulting from macroeconomic shocks and stochastic simulations. The bands indicate that there is a 90 percent probability that Mauritania’s real

GDP will grow as slow as 5 percent per annum, and as fast as 9 percent, in the next ten years. Similarly, with identical probability, the exchange parity can lie in the range of 225-375 MRO per unit of US dollar by 2023.

Table AI.1. VAR model: estimated coefficients, t-statistics in [].

	Growth rate of real GDP (%)	Relative change of real exchange rate (%)	Domestic real interest rate (%)
Growth rate of real GDP (%) - lagged	0.306 [0.64211]	-2.876 [-1.81657]	-0.236 [-0.15491]
Relative change of RER (%) - lagged	0.003 [0.02408]	-0.329 [-0.86196]	-0.198 [-0.53842]
Domestic RIR (%) - lagged	0.172 [1.21590]	-0.758 [-1.60890]	-0.351 [-0.77467]
Intercept	-0.759 [-0.20346]	-5.747 (*) [-0.46428]	8.267 [0.69346]
Public Investment (% of GDP)	0.325 [0.98032]	2.020 (**) [1.83960]	0.117 [0.11042]
R-squared	0.316	0.411	0.227
Adj. R-squared	0.042	0.176	-0.082
Sum sq. resids	82.715	911.335	845.353
S.E. equation	2.876	9.546	9.194
F-statistic	1.155	1.748	0.733
Log likelihood	-34.089	-52.086	-51.522
Akaike AIC	5.212	7.611	7.536
Schwarz SC	5.448	7.847	7.772
Mean of dependent variable	5.441	-3.570	6.612
S.D. of dependent variable	2.939	10.517	8.837
Determinant resid covariance (dof adj.)		12713.8	
Determinant resid covariance		3767.0	
Log likelihood		-125.6	
Akaike information criterion		18.7	
Schwarz criterion		19.5	

Notes: Adjusted values are (*) = 8.5 and (**) = 1.

Source: World Bank calculations

Table AI.2. VAR model: estimated matrix of covariances of residuals.

	Growth rate of real GDP (%)	Relative change of real exchange rate (%)	Domestic real interest rate (%)
Growth rate of real GDP (%)	8.3	-16.4	-21.6
Relative change of RER (%)	-16.4	91.1	53.9
Domestic RIR (%)	-21.6	53.9	84.5

Notes: Adjusted values are one-fifth of all covariances.

Source: World Bank calculations

Figure AI.1. Growth, Real Exchange Rate (RER), and Public Investment.

Source: World Bank calculations

Figure AI.2. Growth and Domestic Real Interest Rate (RIR).

Source: World Bank calculations

Figure AI.3. Real GDP Growth (%). Stochastic simulations.

Source: World Bank calculations

Figure AI.4. Nominal Exchange Rate MRO/USD. Stochastic simulations.

Source: World Bank calculations

Annex II. Optimal composition of public debt in Mauritania.

This work analyses how optimal debt strategies contribute to enhance Mauritania's debt sustainability. We define *debt strategy* as the combination of different instruments that are issued by the government to cover its financing needs. Because of the differences in public debt instruments, we expect that alternative debt strategies will have different features in terms of costs and risks.

A specific portfolio is said to be *efficient* if it has the lowest possible cost for a given level of risk. Alternatively, an *efficient portfolio* can also be defined as the one with the lowest risk for a given level of cost. In turn, an *optimal portfolio* is an *efficient portfolio* that best matches public debt managers' risk tolerance. To find an optimal portfolio we need to incorporate a behavioral assessment of public debt managers by using some sort of utility function. In this work, we consider that the optimal debt strategy is the one that minimizes the certainty equivalent cost of the debt which also depends on the macro-fiscal framework (i.e., a set of central projections, complemented with a stochastic distribution of shocks that might induce outcomes to deviate from the central projections) and the government's risk tolerance (i.e., the subjective willingness of the authorities to bear risk).

Our model uses stochastic simulations to generate the public debt dynamics and finds optimal portfolio allocations by minimizing the certainty equivalent (CE) of the annual interest payment-to-GDP ratio. It allows evaluating the cost-risk trade-off of alternative debt strategies and the sensitivity of the optimal portfolio allocation to changes in the macroeconomic environment. The model has three components: a stochastic scenario generator based on the VAR model (described in Annex I), a debt issuance engine, and an optimization procedure to find optimal portfolio allocations.¹⁵

The debt issuance engine replicates the way the Mauritanian Government refinances the public debt. In a given year, the government has to borrow to finance the overall budget deficit as well as to rollover maturing debts. There are different debt instruments that can be used for that purpose, with a diversity of maturities, currencies, and lenders. We consider a set of ten representative stylized debt instruments close to those described in the Mauritania's Medium-Term Debt Management Strategy MTDS Report. Instruments numbered I1 to I10 are reported in Table D1. These instruments represent a broad spectrum in terms of maturities, exposure to different currencies, and allowance for concessional and market-based debt. Our model assumes that the government chooses an optimal debt portfolio with time-varying shares of the gross financing needs to be covered with each instrument over the projection horizon 2014-2023.

The optimization procedure focuses on the annual interest payments-to-GDP ratio (a proxy of the real carry cost of public debt):

$$(8) \quad \frac{i_{d,t}}{1+\bar{y}_t} D_{d,t-1} + \frac{i_{f,t}}{1+\bar{y}_t} D_{f,t-1} E_{t-1}$$

The optimization procedure involves a number of steps. First, we specify N debt strategies, denoted $S1$ to S_n , that are sufficient to adequately describe the cost-risk trade-off in the portfolio efficient frontier. Second, for each stochastic simulation and a given debt strategy, we compute the public debt dynamics over the period 2014-2023 and the corresponding average annual interest payments-to-GDP ratio. By averaging across simulations, we obtain the average annual interest payments-to-GDP ratio associated with that debt strategy. We repeat this procedure for all debt strategies and then construct a $N \times 1$ vector of mean values. Third, for each stochastic simulation and a given pair of debt strategies, we compute the corresponding variance and covariance of annual interest payments-to-GDP ratios in 2014-2023. By averaging across simulations, we obtain the covariance matrix of annual interest payments-to-GDP ratios associated with those two strategies. We repeat this procedure for all pairs of debt strategies and then

¹⁵ For further references on applied models of optimal public debt portfolio, see Cabral and Lopes (2005), Cabral et al. (2008), and Bolder (2002, 2003, 2005, and 2008).

construct a $N \times N$ covariance matrix.¹⁶ Fourth, using the $N \times 1$ mean vector and the $N \times N$ covariance matrix, we construct the efficient frontier that depicts the debt portfolio with the minimum expected cost (measured by the average annual interest payments-to-GDP ratio corresponding to the debt strategy underlying that portfolio, denoted μ_s) for any given level of risk (measured by the standard deviation of the annual interest payments-to-GDP ratio corresponding to the debt strategy underlying that portfolio, denoted σ_s).¹⁷ Fifth, we postulate the certainty equivalent (CE) of the annual interest payment-to-GDP ratio as the objective function:

$$(9) \quad CE = \mu_s + \frac{1}{2\lambda^+} \cdot \sigma_s^2$$

where λ^+ denotes the *coefficient of absolute risk tolerance* that characterizes the government's risk preferences. The CE is computed for all the portfolios in the efficient frontier. Finally, we find the optimal debt strategy S^* that underlies the efficient portfolio minimizing the CE for a given value of λ^+ .

In our model, the CE should be seen as the fixed amount of interest payment (as share of GDP) that would leave the government indifferent between paying that fixed amount and facing a random variable interest payment with chances of paying more or less. The first term of the CE in (9) is simply the expected value of the random variable interest payment (as share of GDP). The second term is the *additional* interest payment (as share of GDP), over and above the expected interest payment, that the government is willing to make to be indifferent between paying a fixed amount of interests (as share of GDP) and paying a random variable amount. It is thus often interpreted as the *premium* the government is willing to pay in order to eliminate the uncertainty in the interest payment. The lower the level of uncertainty (risk) the government accepts to face, the lower the *coefficient of absolute risk tolerance* λ^+ and the higher the *additional* interest payment (as share of GDP) the government is willing to borne. For simplicity, we report the *coefficient of relative risk tolerance* λ , which is defined as the coefficient λ^+ scaled by the cost of the most expensive debt portfolio in the efficient frontier (measured by the average annual interest payments-to-GDP ratio corresponding to the most expensive debt strategy).¹⁸

In this work, we consider two alternative issuance scenarios to test how optimal public debt management policies can contribute to enhance sustainability and resilience in Mauritania. The first scenario assumes that official lenders would provide as much concessional financing as the authorities find it optimal to borrow from them, so we call it *unconstrained optimal portfolio strategy*. The second scenario assumes that the country will just use the already contracted loans from official lenders but will need to resort to other creditors (bilateral, commercial, and domestic debts) to cover the remaining financing needs. In terms of debt instruments, this scenario considers two types of bilateral semi-concessional debts (Paris Club – I5 and Non Paris Club – I6), a Commercial external debt – I7, and three domestic instruments

¹⁶ Note that the stochastic simulations enable us to characterize the probability distribution (density) of the average annual interest payments-to-GDP ratio associated with one strategy, as well as the probability distribution (density) of the covariance matrix associated with two strategies.

¹⁷ We generate a large collection of debt strategies by computing linear combinations of the initial N strategies, and then we pinpoint 20 portfolios in the efficient frontier with their underlying strategies.

¹⁸ The concepts of CE, λ^+ , and λ are standard in the theory of choice under uncertainty. The CE of a gamble is the amount of money for which an individual is indifferent between receiving that amount of money directly and participating in such a gamble with chances of gaining or losing money, with both actions yielding identical level of utility. The *coefficient of absolute risk tolerance* λ^+ , in turn, can be interpreted as follows: a risk-averse investor is offered to participate in a gamble in which she bets an amount of money X and receives either $2 \cdot X$ or $0.5 \cdot X$ with equal chances, i.e., she faces a 50 percent probability of doubling the bet and another 50 percent probability of losing half of the bet; the maximum amount of money X she would be willing to bet in such a gamble is the *absolute risk tolerance* λ^+ . This coefficient is the reciprocal of the absolute Arrow-Pratt risk aversion coefficient. When the amount of money X is expressed as a proportion x of the investor's wealth W , the maximum proportion x she would be willing to bet in such a gamble is the *relative risk tolerance* λ .

(one year T-bond – I8, two years T-bond – I9, and a three year T-bond – I10). Thus, the strategy optimizes the composition of the residual borrowing, i.e., the gross financing needs net of the available supply-constrained concessional resources, and we call it *constrained optimal portfolio strategy*. The authorities choose the portfolio composition optimally using only the six instruments.

For the *unconstrained optimal portfolio strategies* we obtain an unsurprising result: concessional debt instruments strongly dominate all the others and thus authorities would find it optimal to borrow *exclusively* from official lenders (IDA) to meet their financing needs. In particular, the different optimal portfolios, corresponding to almost all risk tolerance levels, are those with heavy reliance on the USD-denominated concessional loans extended by multilateral banks (instrument I1, with a share above 92 percent in all optimal portfolios) (Figure AII.1).

This dominance is explained both by the low fixed interest rate charged on these long-term loans by multilateral banks and the small variability of the MRO/USD parity in our stochastic scenarios. This limited currency risk stems from the assumed stochastic distribution of shocks, in which the shocks to MRO/USD nominal exchange rate exhibit low variance and low correlation with GDP growth. A common concern when borrowing using foreign-currency denominated debt instruments is the currency risk and the possibility that large depreciations induce jumps in the debt-to-GDP ratio due to valuation effects. Furthermore, there cannot be large *unexpected* valuation effects either, which would otherwise discourage using foreign currency-denominated debt because of concerns on risk. Thus, the unexpected random MRO/USD exchange rate fluctuations are small and do not induce significant jumps in the debt-to-GDP ratio through valuation or growth effects.

The optimal unconstrained portfolio strategies associated with different levels of risk tolerance deliver projections of public debt and interest payments that are fairly similar to the projections in the baseline scenario with a simple non-optimal debt strategy, thus implying that even optimal debt policies can do little to improve Mauritania's debt sustainability and any enhancement should be addressed by the fiscal policy.

When we move to a more challenging issuance scenario, with lower access to concessional loans, which was labeled *constrained optimal portfolio strategies* we also found an unsurprising result: Bilateral (semi-concessional) debt instruments strongly dominate all the others and thus authorities would find it optimal to borrow almost *exclusively* from bilateral lenders (Paris Club and No-Paris Club) to meet their financing needs. In particular, the different optimal portfolios, corresponding to all risk tolerance levels, are those with absolute reliance (share of 100 percent in both scenarios and for all levels of risk tolerance) on the USD-denominated Bilateral Non-Paris Club loans, since they are, in this exercise, slightly cheaper than Bilateral Paris Club loans (Figure AII.2).

As expected, because of the constraints that raise the share of less concessional instruments in all possible portfolio allocations, costs and risks of the constrained optimal portfolio strategy is higher than the unconstrained strategy's.

Figure AII.1. Unconstrained debt portfolio strategy

a. Efficient Frontier. Cost and Risk (% of GDP).

Source: World Bank calculations

b. Efficient Portfolios. Cost and Risk (% of GDP) and Composition (% share of instruments).

Risk	Cost	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
0.10%	1.26%	---	---	---	---	88.0%	---	0.0%	3.4%	2.9%	5.8%
0.47%	1.23%	1.6%	---	---	---	88.2%	---	---	3.1%	3.3%	3.7%
0.47%	1.21%	6.4%	---	---	---	84.2%	---	---	2.8%	2.8%	3.8%
0.47%	1.18%	12.5%	---	---	2.9%	75.9%	---	---	2.5%	2.3%	4.0%
0.47%	1.16%	26.9%	---	---	4.7%	58.5%	---	0.9%	2.2%	1.8%	4.8%
0.47%	1.13%	46.8%	---	---	---	41.0%	---	2.8%	1.9%	1.5%	6.0%
0.48%	1.10%	64.1%	---	---	---	22.0%	---	4.1%	1.7%	1.0%	7.1%
0.48%	1.08%	81.3%	---	---	---	3.1%	---	5.5%	1.4%	0.6%	8.1%
0.48%	1.05%	85.5%	---	---	---	---	---	5.5%	1.1%	0.4%	7.5%
0.48%	1.03%	87.2%	---	---	---	---	---	5.3%	0.7%	0.3%	6.5%
0.49%	1.00%	88.8%	---	---	---	---	---	5.1%	0.4%	0.2%	5.5%
0.49%	0.98%	90.5%	---	---	---	---	---	4.9%	0.0%	0.1%	4.5%
0.50%	0.95%	92.1%	---	---	---	---	---	4.7%	---	---	3.2%
0.50%	0.93%	93.6%	---	---	---	---	---	4.5%	---	---	1.8%
0.50%	0.90%	95.2%	---	---	---	---	---	4.4%	---	---	0.4%
0.51%	0.88%	96.2%	---	---	---	---	---	3.8%	---	---	---
0.51%	0.85%	97.0%	---	---	---	---	---	3.0%	---	---	---
0.52%	0.83%	97.7%	---	---	---	---	---	2.3%	---	---	---
0.53%	0.80%	98.5%	---	---	---	---	---	1.5%	---	---	---
0.53%	0.78%	99.2%	---	---	---	---	---	0.8%	---	---	---
0.54%	0.75%	100.0%	---	---	---	---	---	---	---	---	---

Source: World Bank calculations

c. Optimal Portfolios for Different Levels of Risk Tolerance λ . Composition (% share of instruments).

Source: World Bank calculations

d. Optimal Portfolios for Different Levels of Risk Tolerance λ . Composition (% share of instruments) and Certainty Equivalent CE (% of GDP).

λ	CE	Risk	Cost	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
5.0%	1.2%	0.5%	1.1%	92.1%	---	---	---	---	---	4.7%	---	---	3.2%
10.0%	1.0%	0.5%	0.9%	98.5%	---	---	---	---	---	1.5%	---	---	---
15.0%	0.9%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
20.0%	0.9%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
25.0%	0.9%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
30.0%	0.8%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
35.0%	0.8%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
40.0%	0.8%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
45.0%	0.8%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
50.0%	0.8%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
55.0%	0.8%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
60.0%	0.8%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
65.0%	0.8%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
70.0%	0.8%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
75.0%	0.8%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
80.0%	0.8%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
85.0%	0.8%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
90.0%	0.8%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
95.0%	0.8%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---
100.0%	0.8%	0.5%	0.8%	100.0%	---	---	---	---	---	---	---	---	---

Source: World Bank calculations

Figure AII.2. Constrained debt portfolio strategy.

a. Efficient Frontier. Cost and Risk (% of GDP).

Source: World Bank calculations

b. Efficient Portfolios. Cost and Risk (% of GDP) and Composition (% share of instruments).

Risk	Cost	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
0.10%	1.26%	---	---	---	---	87.96%	0.00%	0.04%	3.36%	0.04%	3.36%
0.10%	1.25%	---	---	---	---	89.0%	0.0%	0.0%	3.3%	0.0%	3.3%
0.10%	1.24%	---	---	---	---	87.4%	2.4%	0.0%	3.2%	0.0%	3.2%
0.10%	1.22%	---	---	---	---	81.3%	8.9%	0.0%	3.1%	0.0%	3.1%
0.10%	1.21%	---	---	---	---	75.2%	15.5%	0.0%	2.9%	0.0%	2.9%
0.10%	1.20%	---	---	---	---	69.1%	22.0%	0.0%	2.8%	0.0%	2.8%
0.11%	1.19%	---	---	---	---	62.9%	28.5%	0.0%	2.6%	0.0%	2.6%
0.11%	1.18%	---	---	---	---	56.8%	35.1%	0.0%	2.5%	0.0%	2.5%
0.11%	1.17%	---	---	---	---	50.7%	41.6%	0.0%	2.3%	0.0%	2.3%
0.11%	1.16%	---	---	---	---	44.6%	48.1%	0.0%	2.2%	0.0%	2.2%
0.11%	1.15%	---	---	---	---	38.5%	54.7%	0.0%	2.0%	0.0%	2.0%
0.12%	1.14%	---	---	---	---	15.7%	77.1%	0.5%	1.9%	0.5%	1.9%
0.12%	1.13%	---	---	---	---	0.0%	92.7%	0.8%	1.7%	0.8%	1.7%
0.12%	1.12%	---	---	---	---	0.0%	93.5%	0.6%	1.6%	0.6%	1.6%
0.13%	1.11%	---	---	---	---	0.0%	94.3%	0.5%	1.5%	0.5%	1.5%
0.13%	1.10%	---	---	---	---	0.0%	95.1%	0.4%	1.3%	0.4%	1.3%
0.13%	1.09%	---	---	---	---	0.0%	95.8%	0.2%	1.2%	0.2%	1.2%
0.14%	1.08%	---	---	---	---	0.0%	96.6%	0.1%	1.0%	0.1%	1.0%
0.14%	1.06%	---	---	---	---	0.0%	97.5%	0.0%	1.0%	0.0%	1.0%
0.14%	1.05%	---	---	---	---	0.0%	98.6%	0.0%	1.1%	0.0%	1.1%
0.15%	1.04%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%

Source: World Bank calculations

c. Optimal Portfolios for Different Levels of Risk Tolerance λ . Composition (% share of instruments).

Source: World Bank calculations

d. Optimal Portfolios for Different Levels of Risk Tolerance λ . Composition (% share of instruments) and Certainty Equivalent CE (% of GDP).

λ	CE	Risk	Cost	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
5.00%	1.22%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
10.00%	1.13%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
15.00%	1.10%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
20.00%	1.09%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
25.00%	1.08%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
30.00%	1.07%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
35.00%	1.07%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
40.00%	1.07%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
45.00%	1.06%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
50.00%	1.06%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
55.00%	1.06%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
60.00%	1.06%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
65.00%	1.06%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
70.00%	1.06%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
75.00%	1.05%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
80.00%	1.05%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
85.00%	1.05%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
90.00%	1.05%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
95.00%	1.05%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
100.00%	1.05%	0.10%	1.25%	---	---	---	---	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%

Source: World Bank calculations

Annex III. Thresholds on Public Debt for Mauritania

We complement our assessment of Mauritania's sustainability of public finances by estimating *thresholds* applicable to the total public debt (as a share of GDP), using the econometric methodology laid out in IMF-IDA (2012). This methodology underpins the Debt Sustainability Framework for Low-Income Countries (LIC DSF) jointly developed by the World Bank and the IMF since 2005. Intuitively, the methodology seeks for a *norm* or *threshold* level of public debt that, if exceeded, would imply a probability (risk) of experiencing debt distress deemed *high* or *excessive*. The threshold gives due consideration to the specificities of Mauritania, most notably its policies, institutions, and growth prospects. Some background about the LIC DSF is worth discussing before estimating debt thresholds.

Debt sustainability and LIC DSF

A forward-looking analysis of public debt sustainability gravitates around a debt indicator, e.g., a country's stock of public liabilities or flow of financing needs, scaled by a measure of repayment capacity such as nominal GDP or fiscal revenues. The sustainability analysis basically confronts a norm on that indicator against projected debt paths over a medium- or long-term horizon. Whenever the projected debt paths breach the threshold, the public debt is deemed to be reaching an *unsustainable* trajectory. A country breaching the norm is expected either to preemptively adopt policies aimed at correcting the budget imbalances, or to head towards facing debt servicing difficulties in the future—which in turn might trigger an abrupt fiscal adjustment or some form of debt default. Different approaches to public debt sustainability analysis derive debt thresholds from theoretical arguments or from empirical observations. There is consensus, however, in that the debt thresholds depend on country-specific financial, macroeconomic and institutional variables, as well as on the tolerance of risk of experiencing debt distress.

The LIC DSF provides a set of thresholds on *external public debt indicators*, derived from econometric studies comparing countries that experienced difficulties to service public and publicly guaranteed foreign liabilities (i.e., an *external debt distress* episode) against countries that did not [IMF-IDA (2004, 2012)]. These studies formulate probit models to investigate the determinants of debt distress episodes and to estimate their probability of occurrence conditional upon external public debt indicators and other explanatory variables. For instance, IMF-IDA (2004) estimate probability models of *external debt distress* using a panel of LIC in the 1980s and 1990s. Distress episodes are identified when a country incurs into large arrears on public liabilities to foreign creditors. Parsimonious probit models are specified including one external public debt indicator, the World Bank's Country Policy and Institutional Assessment (CPIA) score, and a few macroeconomic (control) variables. Debt indicators and policy-related variables are found to be good predictors of sovereign defaults towards foreign creditors: the probability of debt distress increases with the debt indicator and decreases with the quality of policies and institutions measured by the CPIA score. With the estimated coefficients of the probit models, IMF-IDA (2004) calibrate the value of the external public debt indicator that matches an arbitrarily-chosen value of debt-distress probability and fixed values of other explanatory variables. The calibrated value of the debt indicator is precisely the debt threshold associated with the level of risk implicit in the arbitrarily-chosen debt-distress probability—which is set around 20 percent. The LIC DSF actually confronts debt thresholds thus calculated against long-term projections of external public debt indicators. Next, it classifies LIC as high-, medium-, or low-risk of external debt distress, depending on whether breaches are observed or not. Debt thresholds thus demarcate *danger zones* that are useful to anchor policy discussions with country authorities and guide resource-allocation decisions by lenders and donors.

The latest revision of the LIC DSF in IMF-IDA (2012) introduces a number of methodological improvements and, in addition, provides a set of thresholds on *total public debt indicators*. These norms are obtained with an approach along the lines of IMF-IDA (2004) but considering problems to repay public and publicly guaranteed liabilities owed to foreign and domestic creditors (i.e., episodes of *external* and *domestic debt distress*). IMF-IDA (2012) explores probability models of *external* and

domestic debt distress using a panel of MIC and LIC in 1971-2007. A broad spectrum of repayment problems identify debt distress episodes: (i) large arrears on public external debt; (ii) a debt negotiation with the Paris Club; (iii) a large IMF non-concessional financing package (on a disbursement basis); and (iv) an episode of domestic debt default or restructuring, as listed by credit rating agencies, academic papers, and IMF staff reports. Parsimonious probit models include one total public debt indicator, the CPIA score, and a few macroeconomic (control) variables. Debt indicators and policy-related variables turn out to be good predictors of sovereign defaults towards foreign creditors as well as towards domestic creditors. IMF-IDA (2012) calibrate the value of the total public debt indicator that matches an arbitrarily-chosen value of debt-distress probability and fixed values of other explanatory variables. This delivers a debt threshold associated with the level of risk implicit in the arbitrarily-chosen debt-distress probability—which is set around 15 percent. Thresholds and long-term projections of total public debt indicators can be also compared against each other to assess risk of debt distress. However, for reasons laid out in IMF-IDA (2012), the IMF and the World Bank have decided to maintain the total public debt thresholds as indicative benchmarks that are not used to inform the risk rating system for LIC.

Debt thresholds for Mauritania

IDA-IMF (2012) postulates a probit model whereby the probability of a country experiencing repayment problems of any type described above over a one-year horizon depends on four variables: the public debt-to-GDP indicator, an interaction term between a MIC dummy and the public debt-to-GDP indicator, the CPIA score, and the real GDP growth (as a proxy of economic shocks). Thus, $P(Y_{it} = 1) = F(\beta_0 + \beta_1 DEBT_{it} + \beta_2 MIC_{it} DEBT_{it} + \beta_3 CPIA_{it} + \beta_4 GROWTH_{it})$, where the binary indicator Y_{it} equals 1 if the country i experiences debt distress episode in period t , and 0 otherwise. $F(.)$ is the cumulative density function of the standard normal distribution. The covariates to the right are self-explained and measured in the year preceding the debt distress episodes in order to mitigate endogeneity issues. The estimated parameters are reproduced in Table AIII.1.

Thresholds on the Mauritania's public debt-to-GDP indicator are calculated by *inverting* the estimated equation, fixing levels of risk of debt distress—i.e., choosing values of debt-distress probability—and plugging the Mauritania's CPIA score and real GDP growth. The threshold $\overline{DEBT}_{it}$ for an arbitrarily-chosen probability $P(\text{debt distress})$ is calculated using $\overline{DEBT}_{it} = (F^{-1}(P(\text{debt distress})) - (\beta_0 + \beta_3 CPIA_{it} + \beta_4 GROWTH_{it})) / \beta_1$. This paper considers Mauritania's average CPIA score in 2011-13 (equivalent to 3.23) and its average real GDP growth in the next ten years (7 percent per annum). Thus, if the tolerable probability (risk) of debt distress is 15 percent, then the threshold on public debt-to-GDP is 75 percent. If the tolerable risk is 20 percent, instead, then the threshold raises to 95 percent.

Table AIII.1. Probit model and debt thresholds.

Explanatory variables	Coef.	Estimated value	Signif.
Public debt-to-GDP indicator (%)	β_1	1.0080	***
MIC dummy * Public debt-to-GDP indicator (%)	β_2	0.0214	
CPIA score (1 to 6)	β_3	-0.5260	***
Real GDP growth (%)	β_4	-6.1500	***
Constant	β_0	0.3360	
No. of observ.		597	
Pseudo R-squared		0.138	
Sign. *** p<0.01, ** p<0.05, and * p<0.10			

Source: IMF-IDA (2012)