



GUINEA

SELECTED ISSUES

May 2024

This Selected Issued paper on Guinea was prepared by a staff team of the International Monetary Fund as background documentation for the periodic consultation with the member country. It is based on the information available at the time it was completed on May 6, 2024.

Copies of this report are available to the public from

International Monetary Fund • Publication Services
PO Box 92780 • Washington, D.C. 20090
Telephone: (202) 623-7430 • Fax: (202) 623-7201
E-mail: publications@imf.org Web: <http://www.imf.org>

International Monetary Fund
Washington, D.C.



GUINEA

SELECTED ISSUES

April 24, 2024

Approved By

Prepared by Aristide Medenou, Miguel Eduardo Otero Nule (all AFR), Azar Sultanov, Martin Stuermer (all RES), Alejandro Badel, Yunhui Zhao (all SPR), Ha Nguyen, Tolga Tiryaki (all ICD), Judicael Guihy (MCM), Jean-Charles Normand, Oumar Dissou (all AFW), and Melody Manning provided editorial support.

CONTENTS

POTENTIAL IMPACT OF THE SIMANDOU IRON ORE PROJECT ON THE ECONOMY, POVERTY, AND INEQUALITY IN GUINEA	3
A. Introduction	3
B. The Simandou Project and the Iron Ore Market	4
C. Methodology	5
D. Simulation Results	6
E. Discussion and Policy Recommendations	9
APPENDICES	
I. The IMF's Debt, Investment, Growth, and Natural Resources Model	11
II. The Multi-Sector Macro-Inequality Model	12
References	15
NATURAL DISASTERS AND CLIMATE POLICIES IN GUINEA	17
A. Context	17
B. Adaptation	19
C. Mitigation	22
D. Policy Implications	25
ANNEX	
I. The Debt, Investment, Growth, and Natural Disasters Model and the Application to Guinea	29

References	28
RECENT DEVELOPMENT AND RISKS FROM THE SOVEREIGN-BANK NEXUS	31
A. Background	31
B. Risks and Impacts Associated with the Sovereign-Bank Nexus in Guinea	33
C. Policy Recommendations	34
References	35

POTENTIAL IMPACT OF THE SIMANDOU IRON ORE PROJECT ON THE ECONOMY, POVERTY, AND INEQUALITY IN GUINEA¹

This paper examines the potential medium and long-term effects of the Simandou iron ore project on Guinea's economy and income distribution. The paper uses two complementary macroeconomic models. If production began in 2025, the level of real GDP would be around 26 percent by 2030 compared to a baseline scenario without the project. The project would induce a currency appreciation of around 3 percent in 2025 and 2 percent in 2030. It would lead to an increase in employment, but the positive impact on private consumption and inequality could be limited without active policies. Different policy scenarios suggest that spending the potential tax revenues on education and infrastructure results in higher growth and stronger poverty reduction.

A. Introduction

- 1. Guinea is a resource-rich country with an economy mainly based on mining and agriculture.** The mining sector accounted for 21% of GDP in 2022 and over 90% of exports. The country's exports are dominated bauxite, gold and to far lesser extent diamonds, iron ore, and other minerals. Guinea has the largest bauxite reserves in the world. The country benefits from the highest hydroelectric capacity in West Africa, and a rich and untapped agricultural potential.
- 2. At the same time, the country faces poverty and inequality.** About 43% of Guinean households live below the poverty line (INS, 2020). Poverty is more prevalent in rural areas, among women and among people with no education. This situation is coupled with a highly unequal distribution of wealth and income. In 2019, the richest 10 percent of households made 42 percent of total income, while the bottom 50 percent made only 17 percent (Chancel & all, 2022). These levels of poverty and inequality are underpinned by low public spending on education compared to both Sub-Saharan and low-income countries.
- 3. The Simandou iron ore project explores the world's largest undeveloped iron ore reserve.** Located on the 110km-long Simandou hill range, the deposit is estimated to contain approximately 4 billion tons of high-grade recoverable iron ore (Rio Tinto, 2023). Development is being undertaken by international companies based on private investments.
- 4. This study assesses the potential economic and social impact of the Simandou project.** We cover the medium and long-term, focusing on key variables such as GDP, private consumption, public debt, exports and imports, exchange rate, and mining revenues. We evaluate distributional indicators

¹ With the contribution of Alejandro Badel (SPR), Aristide Medenou (AFR), Miguel Otero Nule (AFR), Martin Stuermer (RES), and Azar Sultanov (RES).

such as the poverty rate and inequality. We simulate different policy scenarios to establish what policy mix could benefit Guinea's economy and its people.

5. Results show that the investment of tax revenues in infrastructure and education would foster the positive impact of the project on growth and poverty reduction. If production began to ramp up in 2025, the level of real GDP would be 26 percent higher by 2030 compared to a baseline scenario without Simandou. It would lead to an increase in employment, but the positive impact on private consumption and inequality could be limited without active policies. Spending the potential tax revenues on education and infrastructure results in higher growth and stronger inequality reduction.

6. Our case study contributes to a broad literature on the economic effects of resource booms. One of the key results of this literature stresses that high resource extraction can make countries susceptible to the Dutch Disease (see, e.g., Sachs and Warner, 2001, Sala-i-Martin and Subramanian, 2008; see also Brunnschweiler and Bulte (2008) and Van der Ploeg and Venables (2012) for summaries of the literature). The real exchange rate becomes overly appreciated in response to a commodity boom, causing a contraction of the tradable sector, especially in manufacturing as are hoarded by the booming sector (e.g., Frankel (2012), Krugman (1987) and Arezki et al (2017)). Our paper suggests at the example of Guinea that spending revenues on infrastructure and education as well as carefully planning the medium and long-run public management of revenues can potentially more than offset the negative impacts of the resource curse.

B. The Simandou Project and the Iron Ore Market

7. The project could become the largest iron ore mine in the world. The production could total almost 120 million mt after completion and could double the value of Guinea's current mining exports according to Rio Tinto. The project could make the country the fifth largest producer of iron ore in the world (Text Table 1). The country's share in world production would, however, be relatively small with 4.5 percent. Most likely a bit lower because production in other countries will likely grow until the project is fully completed. The global iron market features a moderate degree of concentration with a Herfindahl-Hirschman-Index of 1,973 (DERA, 2023).

Text Table 1. Guinea: Worldwide Iron Ore Production and Reserves by Country

	Mine production (million mt of usable ore)	Reserves (million mt of usable ore)
World	2,680	180,000
1. Australia	912	51,000
2. Brazil	431	34,000
3. China	394	20,000
4. India	273	5,500
5. Guinea*	120	4,000*

Sources: U.S. Geological Survey (2023), Rio Tinto, IMF staff calculations. Note: * The data for Guinea is based on the estimated production of the Simandou project once completed. The data for the other countries refers to 2021. Reserves are dynamic, meaning they can be expanded by exploration (see USGS, 2023).

8. The project is built and financed by an international consortium. The consortium consists of Rio Tinto, the China Baowu Steel Group Corp and several other Chinese companies. The Winning Consortium Simandou (WCS) and the State of Guinea hold blocks 1 and 2, with stakes of 85 percent and 15 percent, respectively. The Simfer Mining Consortium and the State of Guinea hold blocks 3 and 4 and share 85 percent and 15 percent of its stakes, respectively (DNPEC, 2023). Despite its stakes, the government of Guinea is not contributing toward the investments. Total expected government revenues could amount to 3.4 percent of GDP from 2030 to 2039, compared to total mining revenues of 2.2 percent of GDP in 2022 (Rio Tinto (2023)).

9. The project involves heavy investment in infrastructure. A several hundred kilometers long railroad and a new mining port are planned and being built for exporting the iron ore. The railroad is designed to have an extra-capacity of around 25% destined to non-mining activities including transportation of goods and passengers according to Rio Tinto (2023). It is being developed by WCS-owned Compagnie Transguineen (43 percent), Simfer Jersey (43 percent) and the State of Guinea (15%). According to Rio Tinto, the construction is expected to employ 50,000-60,000 people. The total investment could sum up to roughly 20 billion USD over more than one decade (roughly equivalent in magnitude to Guinea's 2022 GDP). The company expects that the bulk of this investment, i.e., 90%, is planned to be carried out over the first four years (2022-25).

10. The start of the main construction phase is getting closer but is still uncertain. Although discussed since the 1970s, the project only entered its active development phase in 2022. Rio Tinto expects the first production at the end of 2025 and the first exports in the beginning of 2026. While some construction work has already started, the project has still only received 119 out of 208 necessary permits as of January 2023 according to Rio Tinto. Key permits for importing equipment and land permits are still pending. The National Development and Reform Commission of the PR China has also approved the project and the closing by Chinese banks is expected for March 2024 according to Rio Tinto.

C. Methodology

11. We use two complementary models: First, we employ the IMF's Debt, Investment, Growth, and Natural Resources (DIGNAR) model to assess the short- and medium-term macroeconomic impacts of the Simandou project. Second, the IMF's Multi-Sector Macro-Inequality Model (MIMMI) helps us to analyze the impact on poverty and inequality over the long term. The appendix provides details about the underlying assumptions.

12. We simulate several scenarios to parse out the economic effects and to compare different policies to increase the positive spillovers:

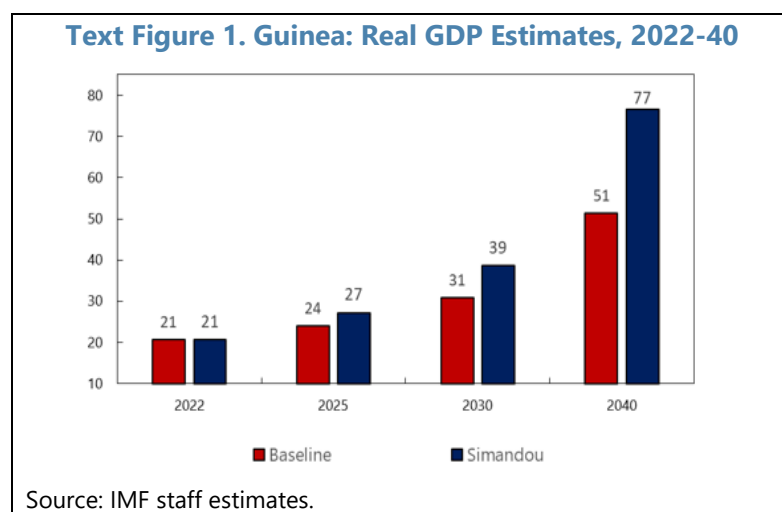
- **Baseline:** Our baseline model for Guinea assumes an average mine production growth rate of 5 percent and an average GDP growth rate of around 5 percent in line with historical averages. The recent fuel shortages are not considered as we consider them temporary, not affecting the project in a significant way.

- **The Simandou project scenario:** We add the expected mining production and exports of the Simandou project to the baseline scenario. They are ramped up gradually starting with 11.4 mt in 2025 reaching a plateau of 118.6 mt in 2030. We also introduce an increase in the infrastructure available to the Guinean economy, as 25 percent of the new rail infrastructure are planned to be available for non-mining activities (see also DNPEC, 2023). We perform a sensitivity analysis of the impact of the Simandou project to variations in the export price. To this end, we consider a shock of plus or minus 15 percent on the iron ore export price.
- **Policy Scenario 1:** This scenario assumes that tax revenues amounting to 3 percent of GDP are used for public investment more broadly starting from 2025.²
- **Policy Scenario 2:** This scenario assumes that tax revenues amounting to 3 percent of GDP per year are invested in infrastructure more narrowly starting from 2025.
- **Policy Scenario 3:** This policy scenario assumes that tax revenues amounting to 3 percent of GDP per year are invested in infrastructure and education in equal shares (i.e., 1.5 percent of GDP in infrastructure and 1.5 percent of GDP in education).

13. The appendix provides more details about the implementation of these scenarios in the two models.

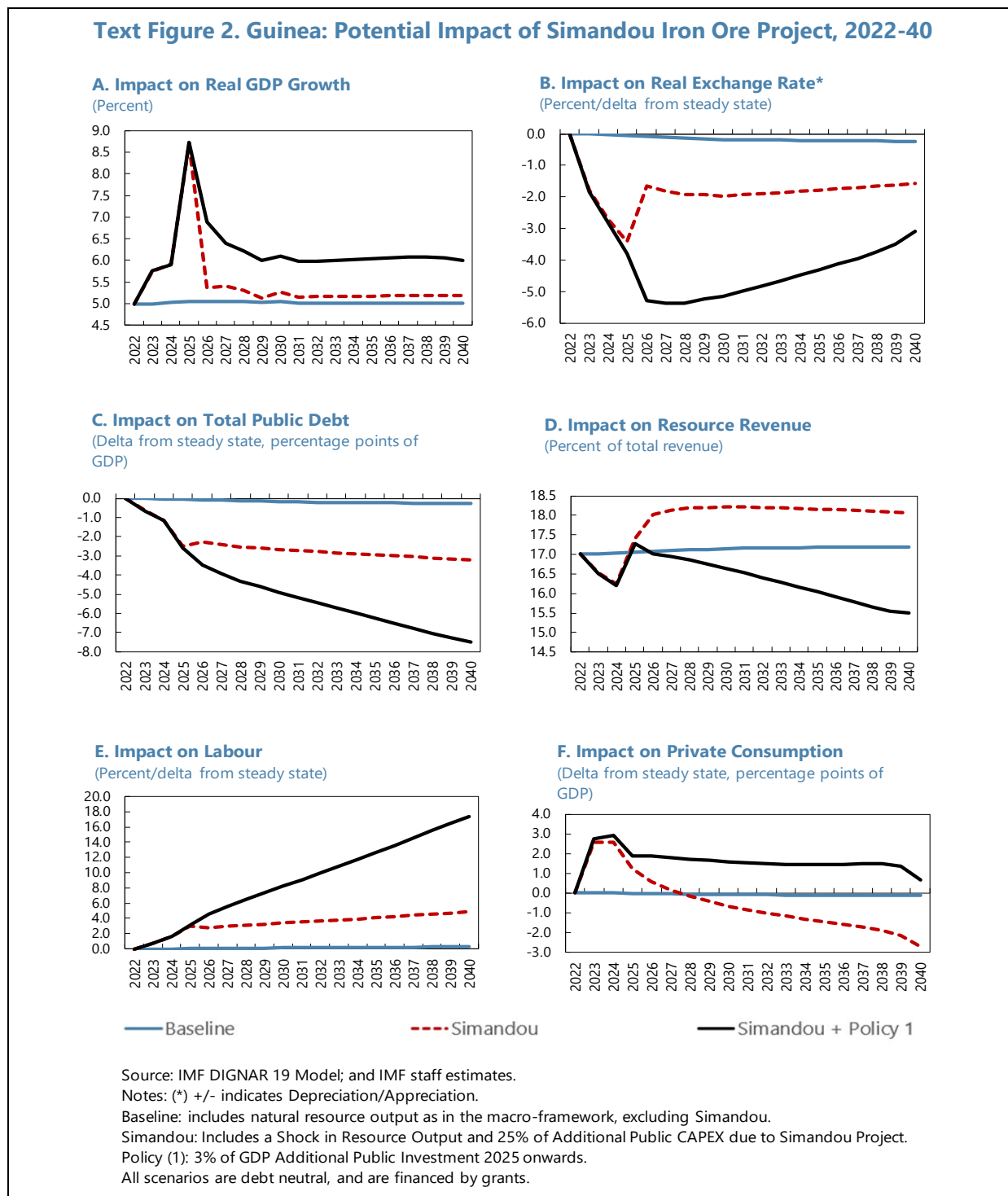
D. Simulation Results

14. The Simandou project could have a significant impact on the Guinean economy. Based on the DIGNAR model, we find that the level of real GDP would be 26 percent higher compared to the baseline without Simandou by 2030 (Text Figure 1). At the same time, the project could induce a currency appreciation of around 3.4 percent in 2025 and 1.8 percent in 2030 (Text Figure 2). In line with real GDP growth, the debt to GDP ratio could fall by 2.5 percent points of GDP in 2025 and 2030.



² Rio Tinto estimates that tax expenses for the entire project will amount to 0.6 bn USD per year from 2025 to 2029, 1.4 bn USD per year from 2030-2039 and 1.8 bn USD per year afterwards. This would average to 3.2 percent of current GDP over the period of 2025 to 2040.

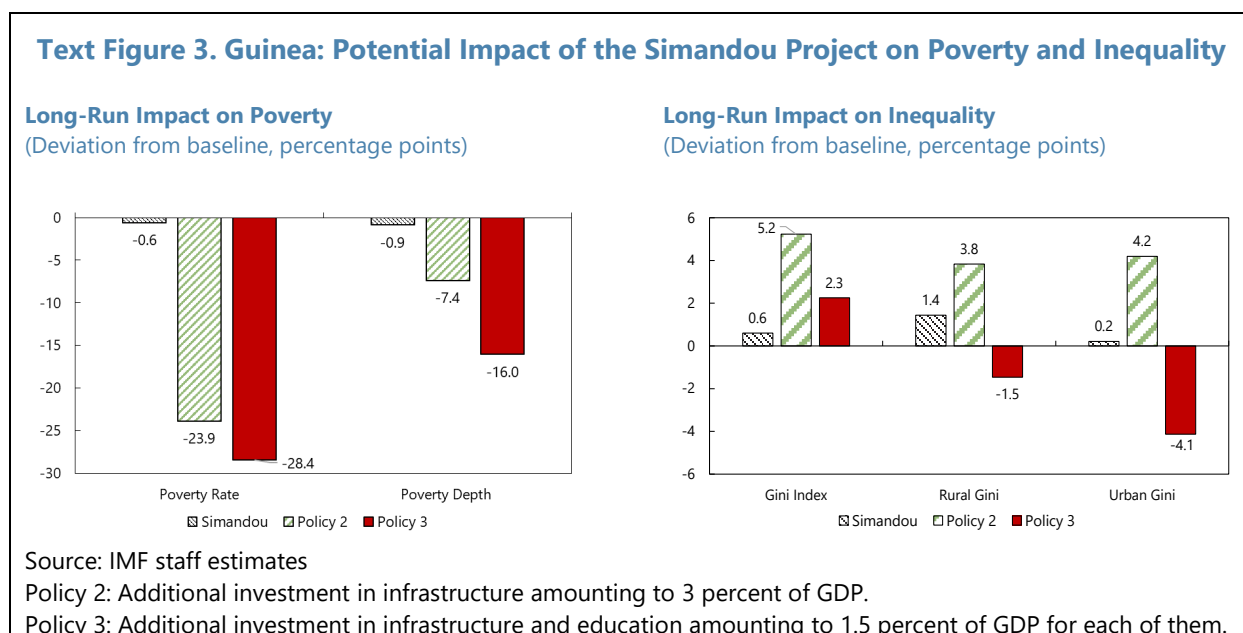
15. The project could lead to an increase in employment, but the positive impact on private consumption could be limited without active policies. The implementation of the project would lead to an increase in employment by about four percent compared to the baseline (Text Figure 2). Private consumption would increase during the construction phase, before decreasing from 2025.



16. Spending tax revenues generated by the Simandou project on public investment would produce stronger positive effects on the economy. Policy Scenario 1 shows that spending tax revenues equivalent to 3 percent of GDP on public investment would help to achieve faster and more sustained real GDP growth and a stronger decline in the debt to GDP ratio (Text Figure 2). It would have the more favorable effect on employment, on growth in the non-mining sector and tax revenues compared to the Simandou scenario without. We show in the appendix that doubling investment efficiency, even stronger positive effects could be derived (Appendix Policy Scenario 1a). We also illustrate there that a scenario consisting of spending 3 percent of GDP each year in transfers has less favorable effects on all other indicators but produces the highest effect on private consumption (Appendix Policy Scenario 1b).

17. The positive impact of the project on the Guinean economy is sensitive to iron ore export prices. A positive shock of 15 percent to iron ore export prices results in a higher effect on the economy than in the Simandou scenario, while a negative shock lowers the positive effects on the economy (Figure A.1 in the Appendix). This latter case is particularly important as there are downside risks to the Chinese economy, the main consumer of iron ore in the world.

18. The long-run social impact would be surprisingly small without an active policy. The MIMMI model shows that the project would reduce the poverty rate only by 0.6 percentage points and the poverty depth (distance by which households fall below the poverty line) by 0.9 percentage points in (Text Figure 3). At the same time, the project could even lead to worsening of inequality, especially in rural areas, as the Gini index, a measure of inequality could increase. This result is explained increasing salaries of the most skilled workers, as mining companies increase the demand for skilled labor.



19. Combining public expenditure on education with infrastructure produces more favorable results on poverty and inequality but also higher economic growth in the long term. Investing tax

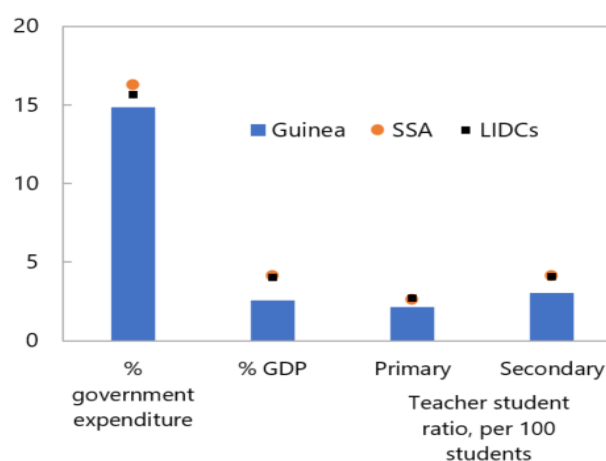
revenues equivalent to 3 percent of GDP into infrastructure would help substantially to reduce poverty (Policy Scenario 2, Text Figure 3). The poverty rate could decrease by 24 percent points, as infrastructure creates positive spillovers to other sectors of the economy and makes labor generally more productive. At the same time, it would increase inequality as high skilled labor would benefit relatively more from infrastructure. Combining public investment in education with infrastructure investment (Policy Scenario, Text Figure 3) produces the highest reduction of poverty across the scenarios.³ While this could decrease inequality in both rural and urban areas, respectively, inequality for the entire country could still rise in a modest way. The inequality raising effects of infrastructure investment would be partially offset by the effects of education that tend to lift the productivity of unskilled workers relatively more.

E. Discussion and Policy Recommendations

20. We recommend to spend the tax revenues from the Simandou project on a mix of education and infrastructure.

The country has low public spending on education and is one of the most illiterate countries in the world. Our results show that a mix of public investment in infrastructure and education would be beneficial both for reducing inequality and the long-term growth of the economy. Education increases labor productivity and, thus, incomes. Among others, the authorities could target measures to promote girls' education. School canteen programs, one of the FSW-funded interventions, could also be continued and made permanent. In addition, well-targeted spending on social protection, such as investments in social services and health care, are not part of our model but would also help to improve standards of living.

Text Figure 4. Guinea: Education Expenditure, Latest Year Available



Source: October 2023 WEO; IMF FAD Expenditure Assessment Tool (EAT); World Bank; and IMF staff calculations

Notes: AE=Advanced Economies; EMDE=Emerging Markets and Developing Economies; SSA= Sub-Saharan Africa; LIC (LIDCs)=Low Income Countries.

21. The authorities can increase positive effects by raising the effectiveness of public investment.

Our additional results in the Appendix show that improving the effectiveness of public investment could further raise positive effects. The authorities have made commendable efforts to improve the execution of public investments. The authorities could implement the recommendations of the C-PIMA report of February 2023, including a unified regulatory framework for public investment management, a bank of projects that have been evaluated and are awaiting selection, capacity building

³ Quality education, clean water and sanitation, affordable and clean energy, and industry innovation and infrastructure are four out of ten sustainable development goals, where major challenges remain in Guinea according to Sachs et al (2023).

in analysis and review of feasibility studies, and the careful integration of public private partnerships (PPP) into public investment.

22. To increase tax revenues, the government can ensure that iron ore from Simandou is exported at a price commensurate with international iron ore prices and that exemptions are limited. Our results show that tax revenues and their investment in infrastructure and education allows for larger positive effects on the Guinean economy. However, collecting tax revenues is a challenge. Despite the mining sector's significant contribution to GDP, mining revenues currently account for only 2 percent of GDP. The authorities can ensure that the start of the Simandou project does not exacerbate this problem. To this end, tax exemptions should be limited, and a fair export price applied, especially for firms of the same holding company. A transfer pricing reform - like the one implemented for bauxite - could be explored. The authorities should strengthen the customs authorities' capacity to control mining exports. The IMF stands ready to support the authorities.

23. The Simandou project underscores the need to diversify Guinea's economy. The mining sector accounts for 21 percent of GDP in 2022. The start of production at Simandou would significantly increase this share and the economy's vulnerability to mining sector shocks. However, proper collection of the tax revenues and investment into education and infrastructure could enable the country to make significant progress in its diversification process and raise the productivity and share of the non-mining sectors. The government could also improve the impact of the project on the local economy and private consumption by promoting more local content in investment spending, encouraging employment, and awarding contracts to local firms where possible.

Appendix I. The IMF's Debt, Investment, Growth, and Natural Resources Model

1. The IMF's Debt, Investment, Growth, and Natural Resources (DIGNAR) Model is a dynamic, stochastic model of a small open economy. It features traded and nontraded sectors as well as a natural resource sector (see Melina, Yang and Zanna (2014) for details). The model is calibrated to match the Guinean economy's main macroeconomic characteristics based on the authorities' data or for the average of low-income countries, where data is unavailable. Text Table A.1. shows the calibrated values for the main parameters. Rio Tinto provided data on the Simandou project.

2. The main feature of DIGNAR is that it includes learning-by-doing externalities in the traded good production to capture potential Dutch disease from spending resource revenues. However, the model also includes a "Dutch vigor" effect, where higher public capital can raise the productivity. This can have a partially offsetting effect.

Text Table AI. 1: Guinea: DIGNAR Model Calibration Parameters

(Latest year available)

1. National accounting	1.a GDP growth rate (in percent)	4.99
	1.b Exports/GDP*100 (in percent)	41.81
	1.c Imports/GDP*100 (in percent)	40.94
	1.d Public consumption/GDP*100 (in percent)	13.74
	1.e Public investment/GDP*100 (in percent)	3.25
	1.f Private investment/GDP*100 (in percent)	13.57
	1.g Mining value added (natural resource production)/GDP*100 (in percent)	19.33
	1.h Public domestic debt / GDP*100 (in percent)	13.42
	1.i Private foreign debt/GDP*100 (in percent)	0.33
	1.j Concessional debt/GDP*100 (in percent)	2.86
	1.k Public external commercial debt/GDP*100 (in percent)	21.42
	1.l Grants/GDP*100 (in percent)	0.46
	1.m Total public revenues/GDP*100 (in percent)	13.01
2. Interest rates	1.r Foreign aid to GDP ratio (in percent)	0.46
	2.a Annualized domestic net real interest rate (in percent)	5.00
	2.b Annualized net real interest rate paid on concessional debt (in percent)	0.00
	2.c Annualized net real risk-free rate (in percent)	4.00
3. Structural parameters	2.d Annualized net real interest rate paid on government external commercial debt (in percent)	5.00
	3.a Steady-state efficiency of public investment (i.e. share of investment turned into actual capital) (in percent)	28
	3.b Share of optimizers (i.e. savers, Ricardian households) in the economy (in percent)	30
	3.c Elasticity of substitution between the two types of labor (in tradables and nontradables)	0.01
4. Natural resource sector	3.d Elasticity of substitution between traded and non-traded goods	0.99
	4.a Share of government natural resource revenues in total government revenues (in percent)	17.02
5. Fiscal policy	5.a Share of labour taxes in total public revenue (in percent)	7.64
	5.b Share of consumption taxes in total public revenue (in percent)	36.50

Source: Guinean authorities; and IMF staff calculations.

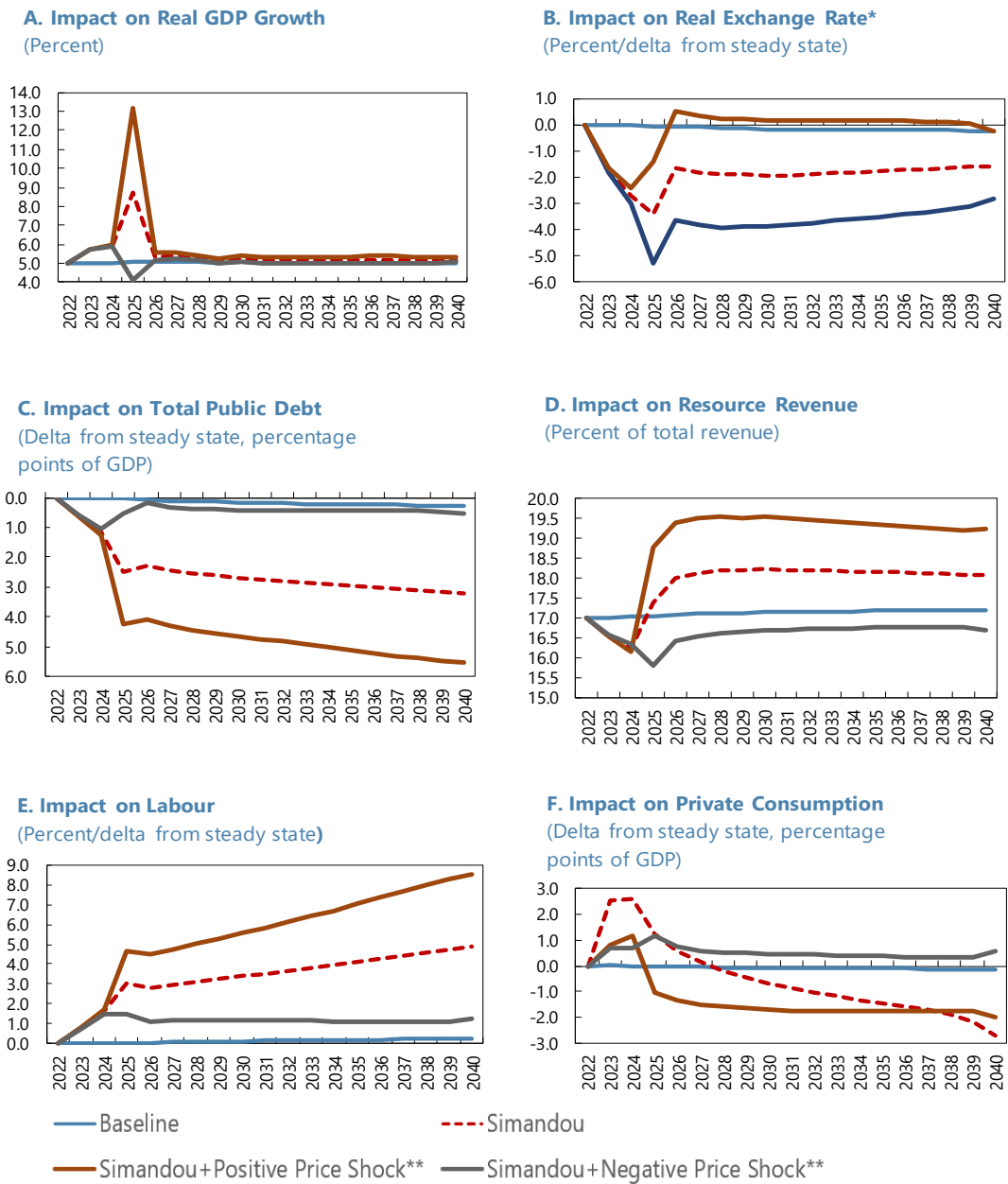
3. To implement the Simandou scenario in the DIGMAR model, we introduce two modifications to the baseline scenario. First, we add the expected mining production of the Simandou project starting from 2025. This increases the growth rate of mining production relative to the base case scenario. To determine the additional production from Simandou, we divide the projected value of exports from Simandou by an expected export price of \$70 per mt provided by Rio Tinto (2023). We also consider the sharing of the rails with non-mining activities as an additional public investment financed by public grants, amounting to 25% of the total value of the investment in the rails (DNPEC, 2023). We assume it to be a grant so that it is fiscally neutral. All private investment in the railroad (75%), mining infrastructure, and in the mining port are modelled endogenously.

4. We assume a Public Investment Efficiency (PIE) of 50% of Sub-Saharan countries average in Policy Scenario 1.

Appendix II. The Multi-Sector Macro-Inequality Model

1. **The model is an infinitely horizon economy macroeconomic model (see Badel and Lyngaas, 2023).** It distinguishes between urban and rural households. These households experience different shocks to labor productivity that vary over time. There are also formal and informal sectors, including in mining, agriculture, manufacture, and service sectors.
2. **The model is calibrated to mimic the Guinean economy and uses policy parameters that can be modified to reflect a particular policy combination, including infrastructure investments, education, and taxation in the mining sector.** The analysis focuses on the long-run impact of the project, so it does not include the macro-inequality impact from the upfront setup investments.
3. **We implement the project in two steps. First, we increase the total factor productivity (TFP) of the mining sector.** We choose the rise in TFP to endogenously match the long-term growth of the mining GDP growth expected after the start of the Simandou project. This growth target is obtained by adding the value of expected mining exports from Simandou, obtained from Rio Tinto (2023), to the observed mining GDP in 2022, calculating the implied growth between 2022 and 2040. Such an increase in TFP endogenously generates new capital and labor flows which represent the execution of the project.
4. **Second, we introduce an increase in the public infrastructure available to the Guinean economy to consider the sharing assumption of rail infrastructure with non-mining activities.** To derive this additional public rail infrastructure in the model, we use 25 percent of half of the total infrastructure investment estimated by Rio Tinto (2022) for 2030. The 25 percent reflect the portion of the railroad that will be shared with the public for non-mining activities. We use half of the total infrastructure investment in this calculation, assuming that one half of total investment is spent on the railroad and one half on the port. Note that the investment in the publicly available new rail infrastructure is exogenously assumed in the model. All other capital investments into the rail, port, and mining infrastructure are determined endogenously as explained above.
5. **Overall, the Simandou project is linked to the Guinean economy marginally through small-time hiring of unskilled workers in rural areas.** We assume that it hires the highest ability workers of the rural area. These workers would otherwise work in agriculture. In general, the impact is small in the absence of any active policy.
6. **In the policy scenarios, high quality, efficient, investment in education raises, by an absolute amount, the working skills of all workers.** This evens the playing field and provides a future of opportunities for technology adoption, and growth.
7. **High quality, efficient and growth-oriented investment in public infrastructure provides a higher productivity for small and large firms, and for informal workers.** It does so by stimulating regional trade and integrating the labor and product markets and insuring the economy against domestic and external shocks through the buildup of more resistant storage, transportation and generation systems. This is reflected in higher productivity, which expands the production possibility frontier, opening future opportunities for foreign and domestic investment.

Figure AI. 1 Guinea: Impact of the Simandou Project Under Different Iron Ore Price Scenarios, 2022-40



Source: IMF DIGNAR 19 Model; and IMF staff estimates.

Notes: (*) +/- indicates Depreciation/Appreciation.

(**) Positive price shock entails a 15% price shock in year 2025; Negative price shock entails a -15% price shock in year 2025.

References

- Aligishiev, Z., Ruane, C., and Sultanov, A. (2023). "User Manual for the DIGNAD Toolkit." IMF Technical Notes and Manuals 2023/03 (TNM/2023/03), IMF, Washington, DC.
- Arezki, R., V. Ramey, and L. Sheng (2017). "News shocks in open economies: evidence from giant oil discoveries". *The Quarterly Journal of Economics*, Vol. 103, p. 155.
- Badel and Lyngaas (2023). Mining Revenues and Inclusive Development in Guinea. IMF Working Paper. No. 23/90. <https://www.imf.org/-/media/Files/Publications/WP/2023/English/wpiea2023090-print-pdf.ashx>.
- Brunnschweiler, C. N. and E. H. Bulte (2008). "The resource curse revisited and revised: A tale of paradoxes and red herrings". *Journal of Environmental Economics and Management*, No. 55.3, pp. 248–264.
- Chancel & all (2022). Income inequality in Africa, 1990–2019: Measurement, patterns, determinants. <https://amory-gethin.fr/files/pdf/CCGMR2022.pdf>.
- DERA (German Mineral Resource Agency) (2023). DERA-Rohstoffliste 2023 Angebotskonzentration bei mineralischen Rohstoffen und Zwischenprodukten – potenzielle Preis- und Lieferrisiken. Download from https://www.deutsche-rohstoffagentur.de/DE/Gemeinsames/Produkte/Downloads/DERA_Rohstoffinformationen/rohstoffinformationen-56.pdf?__blob=publicationFile&v=4 on February 6, 2024.
- Direction Nationale de la Prévision Économique et de la Conjoncture (2023). Impact Économique du projet Simandou: Résultats d'une évaluation prospective.
- Frankel, J. A. (2012). "The natural resource curse: A survey of diagnoses and some prescriptions". *Commodity price volatility and inclusive growth in low-income countries*, pp. 7–34.
- Institute National de la Statistique de Guinée (INS) (2020). Enquête Harmonisée sur les conditions de vie des ménages. https://www.stat-guinee.org/images/Documents/Publications/INS/rapports_enquetes/INS_Rapport_Final_EHCVM_percent20GUINEE_01_03_2021.pdf.
- Krugman, P. (1987). "The narrow moving band, the Dutch Disease, and the competitive consequences of Mrs. Thatcher: Notes on trade in the presence of dynamic scale economies". *Journal of Development Economics* 27.1-2, pp. 41–55.
- Martin, X. Sala-i and A. Subramanian (2008). "Addressing the natural resource curse: An illustration from Nigeria". *Economic Policy Options for a Prosperous Nigeria*. Springer, pp. 61–92.

Melina, Yang, Zanna (2014). Debt Sustainability, Public Investment, and Natural Resources in Developing Countries: the DIGNAR Model. IMF Working Paper, No. 14/50. https://www.imf.org/-/media/Websites/IMF/imported-full-text-pdf/external/pubs/ft/wp/2014/_wp1450.ashx.

Ploeg, F. Van der and A. J. Venables (2012). "Natural resource wealth: The challenge of managing a windfall". *Annual Review of Economics*, No. 4.1, pp. 315–337.

Rio Tinto (2023). Simandou Economic Impact: Preliminary results.

Sachs, J. D. and A. M. Warner (2001). "The curse of natural resources". *European Economic Review*, 45.4-6, pp. 827–838.

Sachs, J.D., Lafortune, G., Fuller, G., and E. Drumm (2023). "Implementing the SDG Stimulus." Sustainable Development Report 2023. Paris: SDSN, Dublin: Dublin University Press, 2023.

NATURAL DISASTERS AND CLIMATE POLICIES IN GUINEA¹

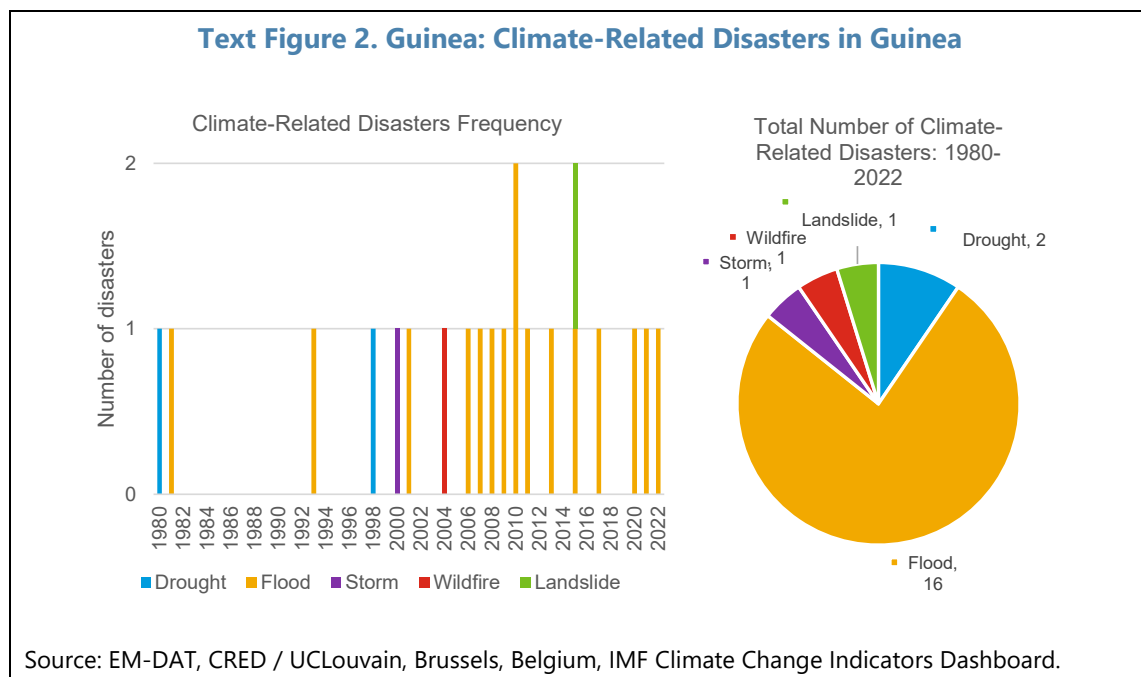
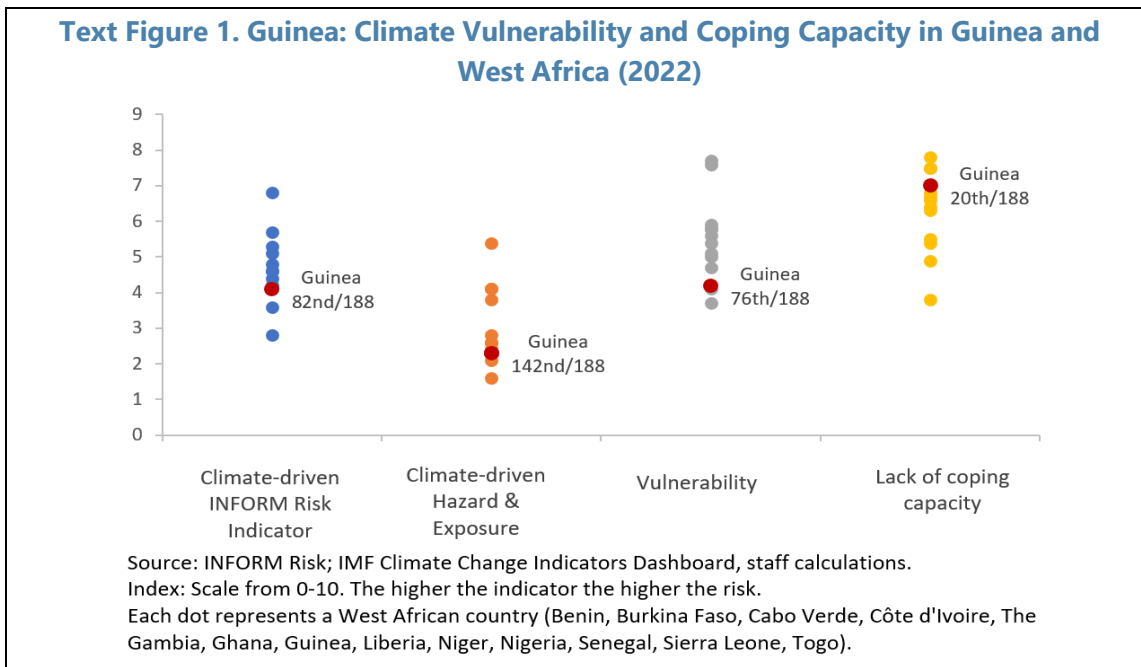
Natural disasters (especially floods) have become more frequent and severe in Guinea, and its large mining sector might push up carbon emissions significantly over time. This Selected Issues Paper focuses on adaptation issues and provides a data-driven analysis of the mitigation issues. Simulations show that ex ante resilience investment, financed by grants and complemented with public investment efficiency reforms, yields best macroeconomic outcomes after natural disasters. Accelerating the implementation of recent TA recommendations on C-PIMA, as well as improving the collaborations between Ministry of Environment and other project planning/implementation ministries, are crucial for enhancing the country's resilience. The authorities should also reduce emissions from the agriculture sector, slow down or reverse deforestation, and continue their ongoing efforts to mitigate emissions, while ensuring the sustainable expansion of Guinea's renewable energy sector.

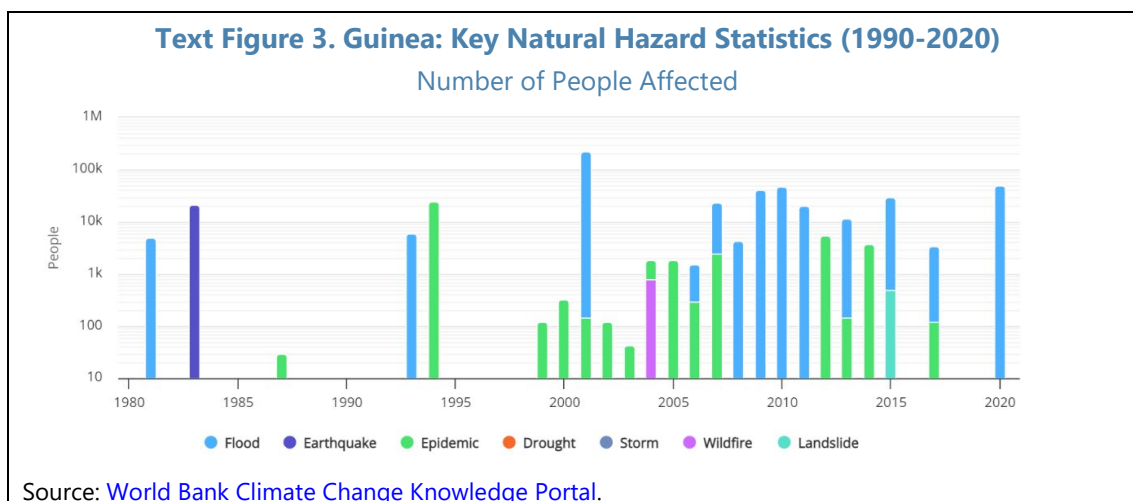
A. Context

- 1. While Guinea's historical exposure to natural disasters and climate change is relatively moderate, natural disasters (especially floods) have become more frequent and severe** (Text Figures 1-3). Building resilience against erratic rainfalls and higher temperatures, as well as mitigating emissions, are macro-critical for Guinea, as the number of affected people has remained high since 2001. The country is highly dependent on mining and agriculture, in total contributing to about 40 percent of the real GDP growth in 2023. Moreover, its capacity to cope with such risks is among the lowest, ranking among the 20 countries with the lowest coping capacity to climate risk in terms of institutional and infrastructural factors. This is, in turn, likely due to the country's long-standing capacity constraints and limited physical connectivity (reflecting the low quality of the country's infrastructure and highlighting the importance of investing in climate-resilient infrastructures, as analyzed in the subsequent adaptation section).
- 2. Guinea's large mining sector might push up its emissions significantly over time, whereas its large hydropower potential provides an opportunity for mitigating emissions.** Given that preventing pollution *ex ante* is less costly than resolving pollution *ex post*, it is crucial for Guinea to act proactively and avoid the old development model of "pollute first, clean up later". Moreover, thanks to the country's rich water resources, Guinea possesses one of the highest hydroelectric potentials in West Africa (estimated at around 6,000 MW), which are pivotal in the country's strategy to establish a new growth engine, harness renewable energy, reduce reliance on fossil fuels, and mitigate climate change.
- 3. This Selected Issues Paper (SIP) focuses on adaptation issues in Guinea, while providing a data-driven and largely descriptive analysis of the mitigation issues.** In addition to examining Guinea's exposure to natural disasters, the SIP simulates their macroeconomic effect and explores

¹ Prepared by Aristide Medenou (AFR), Ha Nguyen (ICD), Miguel Eduardo Otero Nule (AFR), Azar Sultanov (RES), Tolga Tiryaki (ICD), and Yunhui Zhao (SPR) (lead).

options for closing the financing gap using the IMF’s Debt, Investment, Growth, and Natural Disasters (DIGNAD) model (also used by IMF staff for some other countries, including [Rwanda \(2022\)](#), [Seychelles \(2023\)](#), and [Kenya \(2023\)](#), all in the context of the Resilience and Sustainability Trust). The annex then provides an overview of Guinea’s emission patterns using the IMF’s newly developed Machine Learning Toolbox for Climate Policy Analysis, and some descriptive analysis of the hydropower sector.





B. Adaptation

4. This section uses the Debt, Investment, Growth, and Natural Disasters (DIGNAD) model to study the macroeconomic implications of Guinea’s climate adaptation efforts. The DIGNAD model can be used to analyze the additional benefit of investing in more resilient infrastructures (i.e., “adaptation capital”, such as roads that can survive severe floods) relative to investing in standard ones. The model provides a general equilibrium framework to conduct cost-benefit analyses under various scenarios for assessing resilient investment plans and the resulting macroeconomic outcomes. In the model, adaptation capital is more resilient to natural disasters and depreciates less in normal times. However, such capital is also more expensive than standard capital, which would imply a larger cost *ex ante* and highlight the importance of conducting comprehensive cost-benefit analyses. The model is calibrated to match the main macroeconomic characteristics of the Guinean economy (see Annex 1).

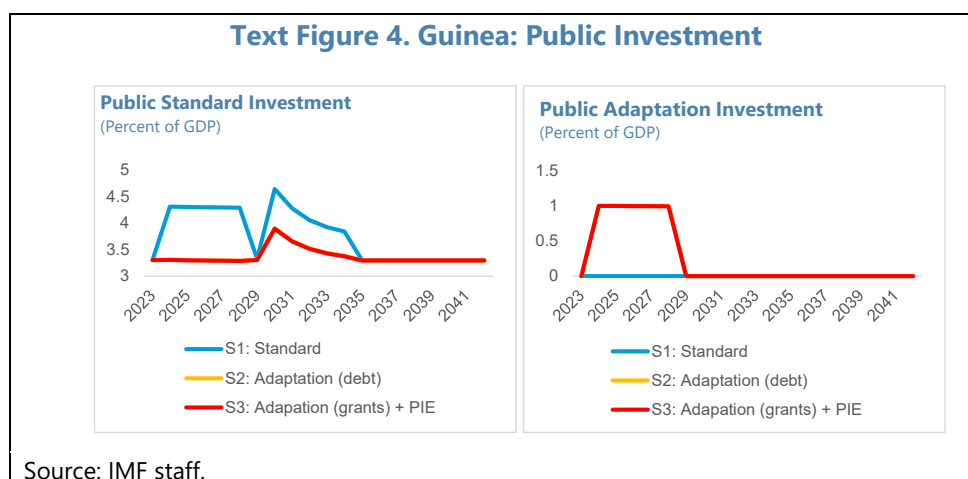
5. We conduct simulations to assess the macroeconomic impact of natural disasters and costs/benefits of different investment and financing options. All the three scenarios we simulate assume that exactly the same natural disaster hits in 2029. And for *all* scenarios, we first consider the case where the *post-disaster* recovery is financed by debt and then consider the case where the recovery is financed by domestic revenue mobilization. Specifically:

- **Scenario 1 (standard):** This scenario assumes that the authorities spend an additional 1 percent of GDP² per year on standard infrastructures above the steady-state values between 2024 and 2028, financed by concessional debt. It serves as a baseline to evaluate the additional benefits and costs of resilience investment in the other two scenarios.

² For low-income and developing countries, the IMF estimates adaptation costs will exceed 1 percent of GDP per year ([Georgieva, 2022](#)); for simulation purposes, a value of 1 percent is used. Moreover, we intend to capture the impact of a hypothetical, reasonably large natural disaster for Guinea. We use the 1 percent because it is widely used in the literature for capturing large natural disasters. In the case of Western Africa, the large floods caused damages of 1.59 percent and 1.96 percent for Burkina Faso (2009) and Niger (2012), respectively.

- **Scenario 2 (ex ante adaptation investment financed by debt):** In this scenario, the authorities decide to spend the additional 1 percent of GDP on the *ex ante* investment in climate-resilient infrastructures (instead of standard infrastructures) between 2024 and 2028, also financed by concessional debt.
- **Scenario 3 (ex ante adaptation investment financed by grants, complemented with Public Investment Efficiency (PIE) reforms):** In this scenario, the aforementioned 1 percent of GDP adaptation investment is instead financed by grants. This assumption also captures the possibility that the adaptation investment is financed by some “windfall” revenues, e.g., those from the Simandou project.³ Scenario 3 also assumes that PIE reforms are implemented, leading to an increase in the PIE from 50 percent to 70 percent.⁴

6. Investing in resilient capital *ex ante* reduces the damage of natural disasters and the need for additional public expenditure to support the post-disaster recovery. Text Figure 4 shows public investment before the disaster hits in 2029. The blue, yellow, and red lines show investment under Scenarios 1, 2, and 3, respectively.⁵ The left panel shows investment in standard infrastructures and the right panel shows investment in resilient infrastructures. The *ex ante* adaptation investment is lowest in Scenario 1 and highest in Scenarios 2 and 3 between 2024 and 2028, consistent with our assumptions. However, in Scenario 1, because the government has not invested in resilient infrastructures *ex ante*, the natural disaster causes the biggest damage to the economy, and thus the *ex post* investment must rise more due to the larger reconstruction needs.

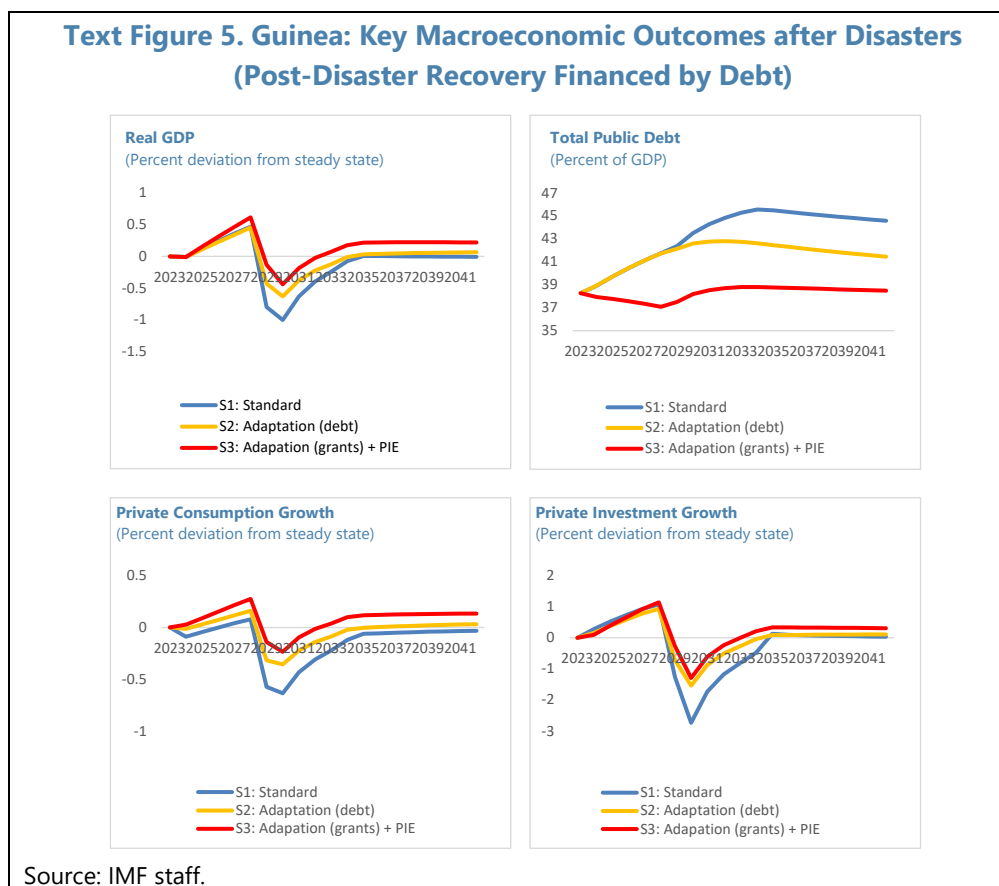


³ Guinea is a resource-rich country in metals-minerals with a significant potential to generate resource revenues, creating an indispensable fiscal space for public investments in infrastructure and human capital. In addition to having the world’s largest bauxite mineral reserves that constitute the country’s greatest export item, Guinea has also rich endowment of high-grade iron ore, gold, diamonds, as well as other minerals. Increasing the revenue-mobilization potential of the country’s mining activity through enhancing the public financial management, as well as implementing new extraction projects, such as the Simandou iron ore project, would serve as an important financing resource for Guinea’s investment needs.

⁴ We consider the increase of PIE from 50 percent to 70 percent based on Kararach et al. (2022). In that study, Guinea’s PIE index is 50 percent, Senegal’s 40 percent, Africa’s average 61 percent, and the three best performers’ PIEs in the sample (Rwanda, Namibia, and Malawi) are 100 percent. Therefore, the increase from 50 percent to 70 percent would bring Guinea closer to the level of Mauritius and Morocco.

⁵ Note that the yellow and red lines are almost overlapping with each other.

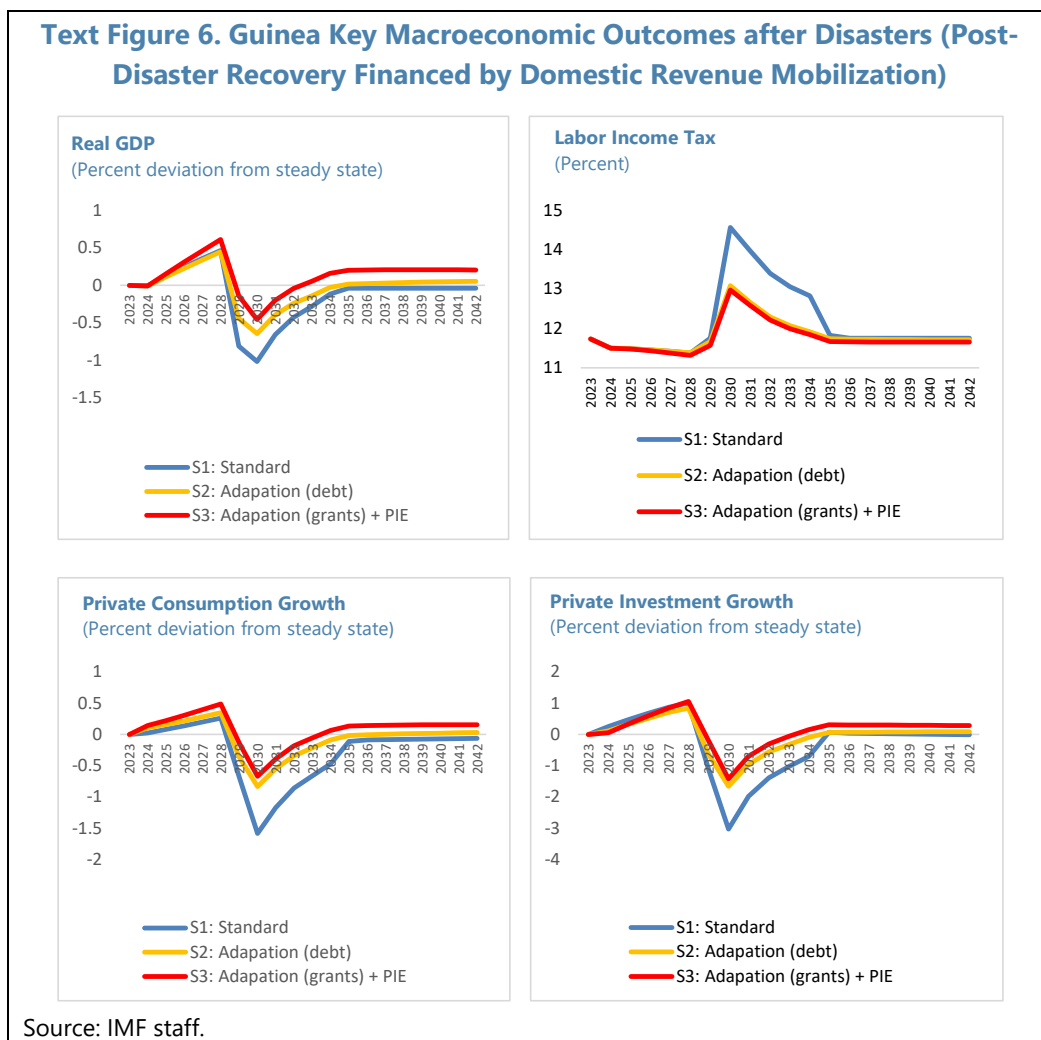
7. When the post-disaster recovery is financed by debt, *ex ante* adaptation investment complemented with PIE reforms yields the best outcomes. In *Scenario 1*, the natural disaster causes the largest GDP loss by about 1.5 percent.⁶ Hence, a large amount of public infrastructure investment is needed to support the post-disaster recovery (Text Figure 5), leading to higher total public debt. In *Scenario 2*, the natural disaster causes a smaller GDP loss thanks to the accumulation of resilient capital. Before the disaster hits in 2029, public debt rises to finance the *ex ante* adaptation investment. However, after the disaster hits, the public infrastructure investment need is less than in Scenario 1 (Text Figure 5), leading to a lower total public debt accumulation in the *long run* (the top-right panel of Text Figure 5). And in *Scenario 3*, the natural disaster causes the smallest GDP loss and lowest rise in public debt among the three scenarios. After the disaster, thanks to the accumulation of resilient infrastructures and the improvement in investment efficiency, the economic damage and the required *ex post* reconstruction investment is the lowest; moreover, because the *ex ante* resilience investment is financed by grants, the rise in public debt is the lowest after the disaster (Text Figure 5).⁷



⁶ The top-left panel of Figure 4 shows GDP going from 0.5 percent above the steady-state level in 2028 to about 1 percent below the steady state in 2029.

⁷ Additionally, private investment growth and private consumption growth (a proxy for welfare) are highest under Scenario 3, further supporting the desirability of Scenario 3.

8. When the post-disaster recovery is financed by domestic revenue mobilization, Scenario 3 still yields the best outcomes among all three scenarios. Under this assumption, labor income tax (instead of debt) must rise to pay for the post-disaster reconstruction in all three scenarios. Scenario 1 (standard) yields the largest losses of GDP and largest rise in labor income tax rate, while Scenario 3 (adaptation investment combined with PIE reforms) yields the smallest losses of GDP and the smallest rise in labor income tax rate (Text Figure 6). The tax rate rises the most in Scenario 1 (to 14.5 percent) and less so for Scenarios 2 and 3 (about 13 percent). Private investment growth and private consumption growth (a proxy for welfare) are highest under Scenario 3, further supporting the desirability of Scenario 3.



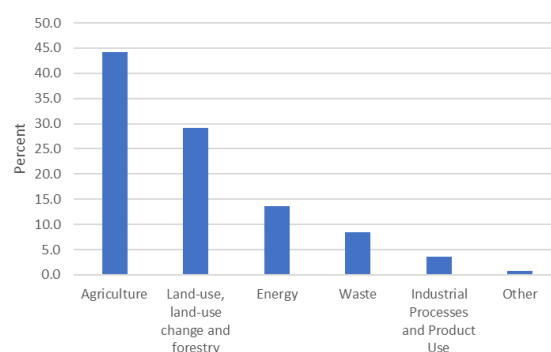
C. Mitigation

9. This section provides an overview of Guinea’s emission dynamics using a machine learning toolbox, as well as some descriptive analysis of its hydropower sector. To realistically address the climate challenge, carbon emissions have to fall substantially at a speed rarely witnessed in history, making it crucial to identify *dramatic* changes in emission patterns. With its well-established, data-driven

machine learning method, the Machine Learning Toolbox for Climate Policy Analysis (MLCPA)⁸ imposes minimal assumptions on the underlying emission patterns and is able to identify such pattern changes. Moreover, the tool applies a robust decomposition of emissions based on an accounting identity. As such, it identifies the channels (through which emissions are affected) and links emissions to not only traditional climate policies but also broad socio-economic policies/events.

10. Guinea’s greenhouse gas (GHG) emissions mainly come from the agriculture and land-use, land-use change and forestry (LULUCF) sectors, followed by the energy sector. The top two sectors’ GHG emissions accounted for 73.4 percent of the total in Guinea in 2022 (Text Figure 7), reflecting the high methane emissions from agriculture and negative consequences of deforestation. The energy sector also contributed to 13.7 percent of the total GHG emission in Guinea. Note that our subsequent analysis focuses on CO₂ emissions because the MLCPA climate tool was designed to be applicable in a cross-country setting, where (valid) CO₂ data are available for more countries than the GHG data. The share of CO₂ emissions in the total GHG emissions averages at 45.3 percent from 2000 to 2022,⁹ and we will delegate the analysis of non-CO₂ GHG emissions to future studies.

Text Figure 7. Sectoral Decomposition of Guinea’s GHG Emissions (2022)



Sources: [IMF Climate Change Dashboard](#); IMF staff.

11. Guinea’s annual CO₂ emissions have experienced a broadly increasing pattern since 1965, with a dramatic acceleration in 2014.¹⁰ This is displayed in Text Figure 8, where the black dots are the actual emission data, the black solid line is the machine learning-fitted emission pattern, and the two vertical lines denote “trend shifts” (i.e., significant changes in the slope) and “level shifts” (i.e., significant changes in the level), respectively.¹¹ As shown in Text Figure 8, throughout the past half a century, there have been only one mild downward trend shift in 1981 and another short-lived downward trend shift in 2011.¹² Moreover, important global climate initiatives, such as the 1992 United Nations Framework Convention on Climate Change and the 2015 Paris Agreement, were not associated with downward trend shifts in Guinea’s emissions, consistent with the grave global challenge of climate change faced by

⁸ The tool was developed in the context of the Climate Innovation Challenge and launched in the 2023 Annual Meetings. More details can be found [here](#).

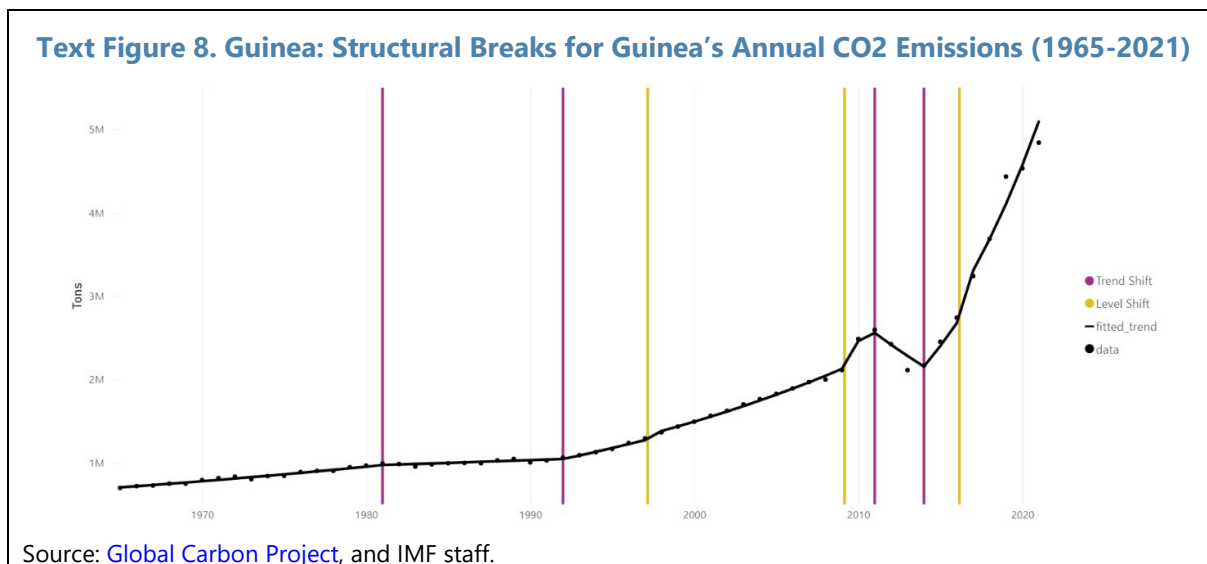
⁹ Calculated based on the [IMF Climate Change Dashboard](#).

¹⁰ Emissions from LULUCF are excluded despite their importance (Guinea has lost a quarter of its forest cover since 2000 according to the [Global Forest Watch](#)).

¹¹ Both types of breaks are called “structural breaks”. This figure does not control for any other factors, so it is an “unconditional” analysis of the emission pattern.

¹² As seen in the Kaya decomposition below, this downward trend shift in 2011 does *not* seem to be driven by the lower mining activities associated with the global financial crisis.

all countries. Instead, since 2014, emissions in Guinea have increased much faster than before, although the level of emissions still stays relatively low.



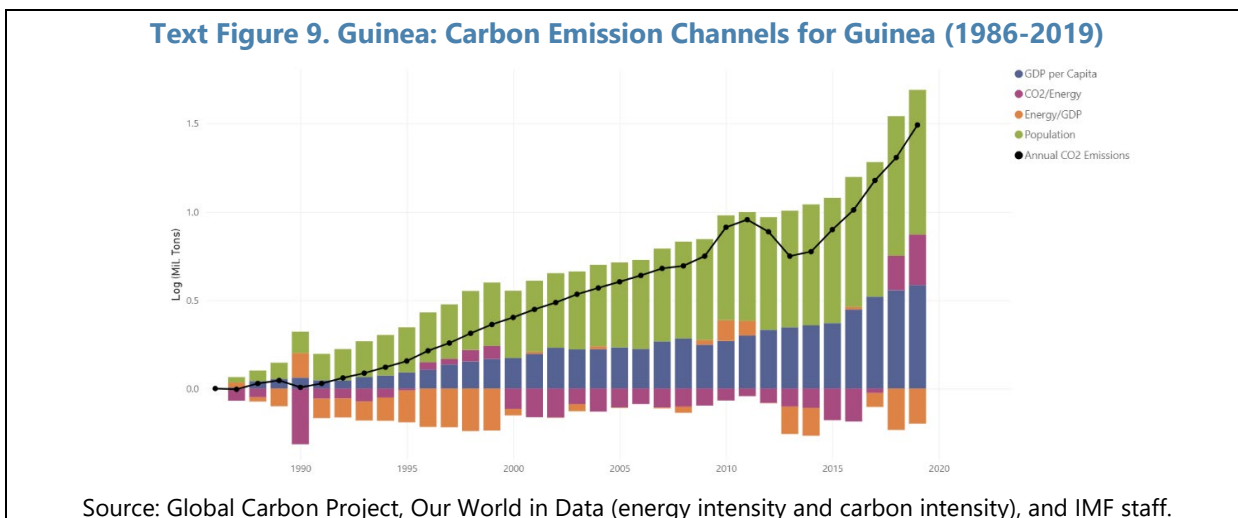
12. The above emission pattern mainly reflects the improvement in Guinea’s GDP per capita, an increase in population, as well as the higher energy intensity. The MLCPA tool decomposes CO2 emissions according to the Kaya Identity:

$$CO_2 = \underset{\substack{\updownarrow \\ \text{Demographics}}}{Population} \times \underset{\substack{\updownarrow \\ \text{Development Stage}}}{\frac{GDP}{Population}} \times \underset{\substack{\updownarrow \\ \text{Econ Structure}}}{\frac{Energy}{GDP}} \times \underset{\substack{\updownarrow \\ \text{Energy Structure}}}{\frac{CO_2}{Energy}}$$

Population reflects a country’s demographics. GDP per capita reflects its development stage. Energy usage per each dollar of GDP (“energy intensity”) reflects the structure of an economy, which will increase as the share of heavy industries increases.¹³ And CO2 emission per energy usage (“carbon intensity”) reflects the energy structure: If a country uses cleaner energy sources, then its carbon intensity tends to be lower. As shown in Text Figure 9, emission contributions from both GDP per capita and population have experienced steady increases since 1965. Moreover, although energy intensity was an important contributor to decrease emissions (relative to the 1965 level) during the 1990s, this was no longer the case throughout most of the 2000-2019 period, likely reflecting increased deforestation and a higher share of the mining sector in the economy. Finally, carbon intensity had been contributing negatively to total emissions between 2000 and 2017, although this trend reversed in 2018 and 2019.¹⁴

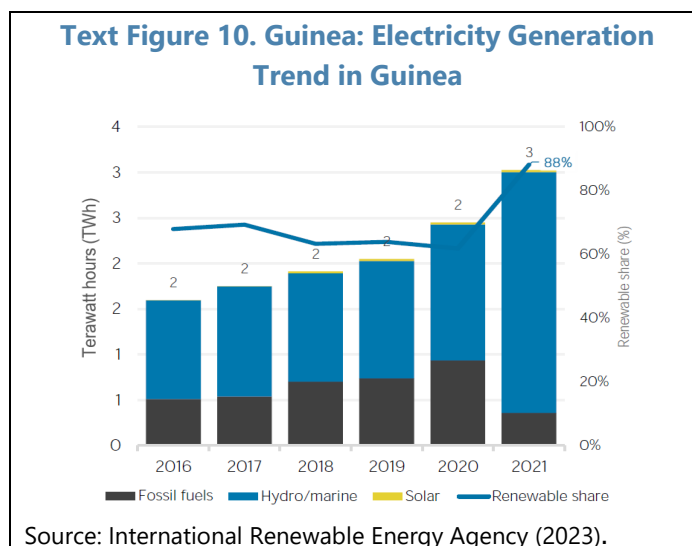
¹³ The energy intensity and the structure of the economy can be affected by policies not directly related to climate change.

¹⁴ As seen in the next paragraph, this seems to be a *temporary* reverse because the share of renewable energies increased again in 2021.



13. The share of hydropower in the energy mix has been high and has increased further in recent years, possessing the potential to mitigate Guinea’s emissions.

As shown in Text Figure 10, the share of electricity generated with hydro and marine powers¹⁵ stayed above 60 percent since 2016 and increased dramatically to 87 percent in 2021 (the year with the latest data). Together with another 1 percent from solar power, the share of electricity generated by renewable energies accounted for 88 percent in 2021. The Souapiti Dam, with a capacity of 450 MW, plays a significant role in Guinea's renewable energy landscape. It is part of a broader initiative to exploit the country's hydroelectric



potential and is complemented by other projects such as the Amaria Dam (300 MW), Koukoutamba Dam (294 MW), Kaleta Dam (240 MW), and the Fomi Dam (90 MW).¹⁶ The Souapiti project, in particular, not only generates significant amounts of clean electricity but also helps regulate the flow of the Konkouré River, enhancing the efficiency of downstream hydropower operations like the Kaleta Dam and the stability of electricity supply throughout the year (given the seasonality of rainfalls).

D. Policy Implications

14. The authorities are progressing on implementing both adaptation and mitigation policies.

In the National Adaptation Plan, Guinean authorities outlined enhanced adaptation goals, particularly in the priority sectors of agriculture, livestock, forestry, coastal, and water resources. And in the 2021

¹⁵ Marine power is the energy carried by ocean waves, tides, salinity, and ocean temperature differences.

¹⁶ Source: energycapitalpower.com. <https://energycapitalpower.com/top-hydropower-projects-in-guinea-conakry/>

publication of their Nationally Determined Contribution, they committed to net zero emissions from the mining sector by 2040. They adopted a decree in May 2023, covering climate impact assessment for projects, collection/enhancement of past emission data, and so on (to be signed into an executive decree in June 2024). They are also working with the World Bank and other partners to provide some trainings and to actively explore the implementation of carbon pricing (including the set-up of an Emission Trading System).¹⁷

15. In terms of adaptation, early adaptation investment *ex ante* will likely result in higher growth and lower rise in debt *ex post* after a disaster hits. Scenario 3 presented above, which features adaptation investment financed by revenues from the grants and public investment efficiency reforms, yields the best long-term growth, debt, and welfare outcomes among the three scenarios, reflecting the role of resilient infrastructures in limiting the damage of disasters. If authorities invest in adaptation investment over a longer horizon, allowing public adaptation capital to accumulate more while the disaster hits on a later date, the impact of the natural disaster would be even more mitigated. This argument highlights the importance of investment in adaptation investment as early as possible to cope with natural disasters.

16. Tapping grants, “windfalls revenues”, and other concessional financing sources for resilience investments are crucial in preserving medium-term debt sustainability. The implementation of Guinea’s National Adaptation Plan would cost at least USD14 billion,¹⁸ and its financing should not jeopardize Guinea’s debt sustainability. In addition, stepping up public adaptation infrastructure investment plans should also be accompanied by reforms to raise public investment efficiency. Moreover, the authorities should prioritize public investment in adaptation programs with *positive externalities*, as well as address market imperfections and existing policies that make private adaptation inefficient (Bellon and Massetti, 2022).

17. Implementing recent TA recommendations on C-PIMA and enhancing the collaborations between Ministry of Environment and other ministries are crucial. Involving Ministry of Environment at project budgeting and planning stages would ensure that the resilience to natural disasters is taken into account from the beginning. Moreover, it is vital to enforce the implementation of climate-resilient elements during the construction and inspection stages of projects, including through enhanced collaborations between Ministry of Environment and other project planning/implementation ministries.

18. In terms of mitigation, the authorities should continue their ongoing efforts. These include signing and enforcing the climate executive decree, which is expected to be signed in June 2024 and cover both public and private projects. They should also continue the productive engagements with multilateral partners to design and implement carbon pricing (including the set-up of an Emission Trading System and the proper calibration of emission quotas), while ensuring high compliance of the main stakeholders. Reducing emissions from the agriculture sector and slowing down or reversing deforestation are crucial for arresting the rising trend of the total GHG emissions. Promptly completing

¹⁷ The IMF-World Bank’s Climate Policy Assessment Tool (CPAT) tool (see [this](#) link and Black et al., 2023) can be used to analyze carbon pricing and other mitigation policies. We will delegate this to future analysis.

¹⁸ This is according to the authorities’ estimate (see [IMF, 2023](#)) and amounts to more than 70 percent of 2021 GDP.

the compilation of granular climate data is also essential for enhanced monitoring and assessments of carbon emissions.

19. To ensure the sustainable expansion of Guinea's renewable energy sector, targeted initiatives in infrastructure, policy, and diversification are essential. The authorities should accelerate the completion of the transmission infrastructure to fully utilize the production capacity of Souapiti and other hydropower dams, including by channeling hydropower to industrial consumers (which would contribute to mitigating emissions further and enhance Souapiti's commercial viability). Continue the ongoing venturing into solar energy to further diversify Guinea's energy mix,¹⁹ while avoiding over-capacity in its domestic market through thorough feasibility studies and market analyses.

¹⁹ Guinea has a large solar power potential. The first solar power (Khoumaguéli, 40 MW) is being developed and, with donor support, the authorities plan to organize a competitive procurement scheme to deliver an additional 100 MW of solar. According to [AfDB \(2021\)](#), to keep up with demand, Guinea will need to add 600 MW of solar capacity to the generation fleet by 2030.

References

- Aligishiev, Z., Ruane, C., and Sultanov, A. 2023. "User Manual for the DIGNAD Toolkit." IMF Technical Notes and Manuals 2023/03, International Monetary Fund, Washington, DC.
<https://www.imf.org/en/Publications/TNM/Issues/2023/06/05/A-User-Manual-for-the-DIGNAD-Toolkit-531886>.
- Badel, A., and R. F. Lyngaas, 2023. "Mining Revenues and Inclusive Development in Guinea." IMF Working Paper 23/90. Washington, DC: International Monetary Fund.
- Bellon, M., and E. Massetti, 2022. "Economic Principles for Integrating Adaptation to Climate Change into Fiscal Policy." IMF Staff Climate Note 2022.001, International Monetary Fund, Washington, DC.
<https://www.imf.org/en/Publications/staff-climate-notes/Issues/2022/03/10/Economic-Principles-for-Integrating-Adaptation-to-Climate-Change-into-Fiscal-Policy-464314>
- Black, S., I. W.H. Parry, V. Mylonas, N. Vernon, and K. Zhunussova, 2023. "The IMF-World Bank Climate Policy Assessment Tool (CPAT): A Model to Help Countries Mitigate Climate Change." IMF Working Paper 23/128. International Monetary Fund, Washington, D.C.
<https://www.imf.org/en/Publications/WP/Issues/2023/06/22/The-IMF-World-Bank-Climate-Policy-Assessment-Tool-CPAT-A-Model-to-Help-Countries-Mitigate-535096>
- Buffie, E.F., A. Berg, C. Pattillo, R. Portillo, and L. F. Zanna, 2012. "Public Investment, Growth, and Debt Sustainability: Putting Together the Pieces." IMF Working Paper 12/144. International Monetary Fund, Washington, D.C.
- Fan, Y., D. Lederman, H. Nguyen, and C. Rojas. 2023. "Calamities, Debt, and Growth in Developing Countries" *IMF Economic Review*.
- Georgieva, K., 2022. "Getting Back on Track to Net Zero: Three Critical Priorities for COP27." IMF blog.
<https://www.imf.org/en/Blogs/Articles/2022/11/04/getting-back-on-track-to-net-zero-three-critical-priorities-for-cop27>
- IMF, 2019. "Estimating the Stock of Public Capital in 170 Countries."
https://www.imf.org/external/np/fad/publicinvestment/pdf/csupdate_jan17.pdf
- IMF, 2023. "The Role of Agriculture and Climate Change in Food Security." Staff Report for Guinea's 2022 Article IV Consultation and Request for Disbursement under the Rapid Credit Facility, Annex IX, IMF Country Report No. 23/43, January 2023.
- Kararach, G., J. Oduor, E. Sennoga, W. Odero, P. Rasmussen, and L. Balma, 2022. "Public Investment Efficiency, Economic Growth and Debt Sustainability in Africa." Working Paper Series N° 365, African Development Bank, Abidjan, Côte d'Ivoire.
- Marto, R., C. Papageorgiou, and V. Klyuev, 2018. "Building Resilience to Natural Disasters: An Application to Small Developing States," *Journal of Development Economics*, Vol. 135, pp. 574–586.
<https://doi.org/10.1016/j.jdeveco.2018.08.008>

Annex I. The Debt, Investment, Growth, and Natural Disasters Model and the Application to Guinea

1. The Debt, Investment, Growth, and Natural Disasters (DIGNAD) model by Marto, Papageorgiou, and Klyuev (2018) is used to study the macroeconomic implications of Guinea’s climate adaptation efforts.¹ DIGNAD is an extension of the Debt-Investment-Growth (DIG) model by Buffie et al. (2012) by introducing natural disasters and allowing for public investment in adaptation infrastructure, which is more climate-resilient but also more expensive, as well as in standard infrastructure. It is a general equilibrium model that differentiates the macroeconomic impacts of public investment in both types of capital, and their implications for debt in an intertemporal setup. Investing in adaptation infrastructure reduces output losses and damages to physical assets in the face of natural disasters, overall enhancing the resilience of the economy and economizing on the fiscal costs of post-disaster recovery. Previous applications of the model show that adaptation investment in resilient capital also raises the productivity of standard capital by mitigating the impact of natural disasters, and hence stimulates private investment as well.

2. The model is calibrated to match the main macroeconomic characteristics of Guinean economy based on various historical averages and empirical estimates. We consider a hypothetical case in which a natural disaster hits Guinea in 2029. Floods are the most common natural disasters in Guinea. We examine large floods (those that cause more than 1 percent of GDP in physical damage) in the EM-DAT database.² Among these large floods, the global average physical damage is 4 percent of GDP. Data from the IMF (2019) suggest that total capital stock (including public and private capital) in Guinea as of 2017 is 130 percent of GDP.³ Assuming Guinea’s total capital stock is 150 percent of GDP as of now, the disaster would cause 4 percent/150 percent = 2.7 percent damage to total capital (2.7 percent of public capital and 2.7 percent of private capital is damaged). In addition to the damage to capital stock, we assume that the flood will cause a 1.5 percent output loss, consistent with the average empirical estimates (see Fan et al., 2023). We set steady-state effective consumption tax rates at 7.52 percent and labor income tax rates at 11.73 percent.⁴ Public investment efficiency is set at 50 percent.⁵ Other key parameters are matched to Guinea’s economy and shown in Text Table 1. Some of

¹ More details on the DIGNAD model can be found [here](#). We will also coordinate with the WB team, particularly on the adaptation analysis and policies, given that they are also working on adaptation with structural models.

² EM-DAT contains data on the occurrence and impacts of over 26,000 mass disasters worldwide from 1900 to the present day.

³ The 2019 value is 120 percent of GDP, which is similar to that in 2017. The 2019 value will be used in the updated results.

⁴ Badel and Lyngaas (2023) report that “According to the KPMG Fiscal Guide for Guinea (KPMG 2019), the statutory rates for value added, corporate taxes on non-mining non-oil sectors and labor income taxes are 18, 25, and 29 percent, respectively. The labor tax combines wage tax and social security.” They also calculate “a tax gap for value added taxes of $\text{gap}_{\text{cons}} = 100(1 - 6.02/14.4) = 58.2$ percent. We approximate the tax gaps for other taxes as the midpoint between two gaps, that is 53.10 percent. Tax gaps are calculated by taking into account the overall tax potential, the size of the informal sector, etc. So, the effective tax rate after correcting for the tax gap would be $18 \text{ percent} \times (1 - 58.2 \text{ percent}) = 7.52$ percent for consumption (VAT), and $25 \text{ percent} \times (1 - 53.1 \text{ percent}) = 11.73$ percent for labor income.

⁵ Following data and discussions by Kararach et al. (2022).

the structural parameters that are not available specifically for Guinea (e.g., related to adaptation capital) are taken from Marto, Papageorgiou, and Klyuev (2018). While the simulation results in the following section are based on assumptions under different scenarios, the findings are broadly robust within a reasonable range for the relevant parameters.

Text Table AI. 1. Guinea: Calibrated Parameters and Initial Values

Definition	Value (percent)
Return on standard infrastructure investment	25
Return on adaptation infrastructure investment	30
Public standard infrastructure investment to GDP ratio	3.3
Depreciation rate of standard public infrastructure	7.5
Depreciation rate of standard public infrastructure	3
Public investment efficiency	50
Grants to GDP ratio	0.5
Labor income tax rate	11.73
Consumption tax rate	7.52
Public domestic debt to GDP ratio	13.6
Public concessional debt to GDP ratio	2.89
Public external commercial debt to GDP ratio	21.73

Source: IMF staff.

RECENT DEVELOPMENT AND RISKS FROM THE SOVEREIGN-BANK NEXUS¹

Guinea's banking sector is increasingly exposed to sovereign risk through the central government, local governments, state-owned enterprises (SOEs), and the central bank. As a share of banks' total assets, total exposure has increased from 15. percent of at end-2014 to almost 30 percent as of December 2023. This increase is due among others to increased finance needs for infrastructure projects, low demand for credit from the private sector, and underdeveloped capital markets. This annex provides an overview of the sovereign-bank nexus and associated risks. Policy recommendations conclude the note.

A. Background

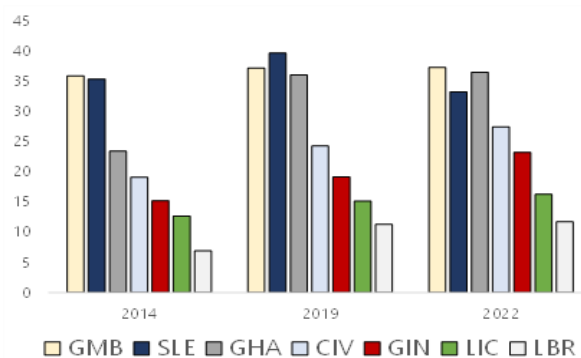
1. Banks' exposure to sovereign risk in Guinea has been on an increasing trend since 2014.

Even though the banking sector remains liquid, the banks' exposure to the public sector (central government, local governments, SOEs, and the central bank), from 15.2 percent in 2014, accounted for 29.6 percent of banks' total assets at end- 2023, which remains high compared to Low-Income Countries (LICs). However, the sovereign-bank nexus in some West Africa countries is persistently above 30 percent since 2014 (Text Figure 1).

2. This increase in exposure has been driven by:

- *Conjectural factors*—mainly pandemic-related spending, exceptional bonds issued by the Government in September-October 2023,² and the securitization of government domestic arrears;
- *Structural factors*—particularly the narrow investor base in the government bond market, limited monetary financing, and appetite of commercial banks for lower-risk assets; and
- *Regulatory and supervisory factors*—the prudential regulation on large exposures excludes limits on own sovereign exposures. Liquidity standards, including the eligibility of government securities to

Text Figure 1. Guinea: Banks' Exposure to the Public Sector in West Africa and LICs*
(Percent of Banks' Assets)



Source: IMF Sovereign-Bank Nexus Tool; and IMF staff calculations.

Notes: (*) Exposure by public entity including loans and debt securities. GMB=Gambia; SLE=Sierra Leone; GHA=Ghana; CIV=Cote d'Ivoire; GIN=Guinea; LIC=Low Income Countries; LBR=Liberia.

¹ Prepared by Judicael Guihy (MCM), Jean-Charles Normand (AFW), and Oumar Dissou (AFW).

² The bonds were issued in two tranches: i) GNF 2000 billion, a 4-year bond with an issued yield of 9 percent once on September 26, and ii) GNF 3000 billion, a 5-year bond with an issued yield of 13 percent on October 4. Those bonds were exceptional by way of issuance (tripartite agreement between the BCRG, the Government, and the banking sector), the size of the issue (GNF 5,000 billion or 2.8 percent of GDP), and the use of monetary tools to provide liquidity room to banks.

the BCRG’s refinancing windows, also favor sovereign debt holding. In addition, 30-day securities are one of the elements included in the calculation of the liquidity ratio. Afritac West (AFW) is providing TA for the implementation of liquidity coverage ratio (LCR), which is in line with Basel Framework.

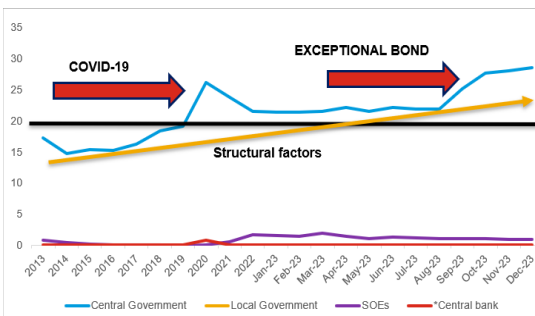
3. The sovereign-bank nexus in Guinea includes banks’ exposure to the central government, local governments, state-owned enterprises (SOEs), and the central bank. The nexus is materialized through different types of instruments available in Guinea, which are loans, government securities (T-bonds and T-bills), and guarantees denominated in Guinean Franc (GNF). Guinean banks do not provide loans or guarantees in foreign currency. They are also not exposed to securities denominated in foreign currency. Text Figure 2 illustrates the different aspects of the sovereign-bank nexus in Guinea. Banks’ exposure to public sectors other than the government securities is minor and can be omitted for the rest of the note. Only the exposure to the government securities in Guinean Franc (GNF) is material and will be the sole point of interest.

Text Figure 2. Guinea: Overview of the Banks’ Exposure to the Public Sector

Banks’ exposure to the public sector has increased over the last decade

Exposure by Public Entity

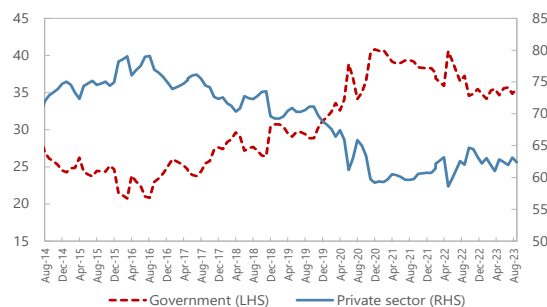
(By public entity, percent of assets)



... causing further crowding out of private-sector credit

Commercial Lending Share

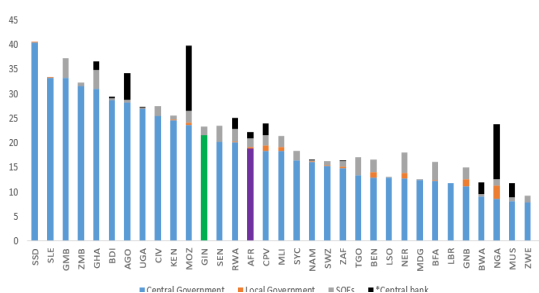
(Percent of total)



...and remains high even by regional standards, higher than the AFR and LIC averages (15.9 percent and 14.5 percent).

Exposure by Country, August 2023

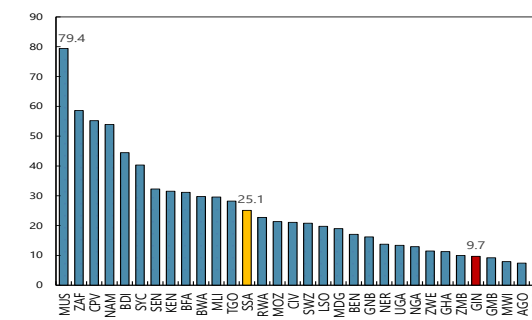
^{1/} (By public entity, including loans and debt securities, percent of banks' assets)



... with one of the lowest domestic credit to the private sector by banks amongst SSA countries.

Domestic Credit to Private Sector by Banks, 2022

(Percent of GDP)



Source: IMF Sovereign-Bank Nexus Tool; World Bank-World Development Indicators; Guinean authorities; and IMF staff calculations.

^{1/} Banks’ exposure to the central bank excludes banks’ deposits or reserves.

4. The report is structured as follows: the second section analyses risks associated with the banks' exposure to the government securities (T-Bonds and T-Bills) with their contextualized aspects. The third section focuses on policy options to mitigate the variety of risks inherent to the nexus.

B. Risks and Impacts Associated with the Sovereign-Bank Nexus in Guinea

The following risks and impacts, materialized through three transmission channels³, are inherent to banks' exposure to the Guinean public sector.

5. Concentration and credit risks. As of end-December 2023, Government securities account for 28.6 percent of banks' assets (compared to 21.5 percent in December 2022 and 14.7 percent in 2014), which is relatively high even by regional standards (Text Figure 2). This concentration risk amplifies credit risk which is mitigated by the central bank's guarantee. Since government securities are guaranteed by the BCRG, a default by the Government will not result in direct losses to banks. However, the BRCG balance sheet will be impaired.

6. The last stress test suggests a sizable interest rate risk which could be amplified the sovereign-bank nexus. Interest Rate Risk in the Banking Book (IRRBB) refers to the current or prospective risk to a bank's capital and to its earnings, arising from the impact of adverse movements in interest rates on its banking book (Basel Framework)⁴. In Guinea, according to the supervisory stress-testing of some banks, performed in 2022 by the BCRG with the technical assistance of AFRITAC West (AFW)⁵, a replication of the historical shock (600 bps decrease applied to T-bills) observed in 2014 on public debt interest rates led to a decrease in the solvency ratio by 0.5-4.2 percent. As a result, the range of the solvency ratios of the banks started from 21.8 percent to 10.3 percent. The solvency regulatory standards are 10 percent. With the increasing exposure of the banking sector to government securities, banks should identify, measure, and monitor IRRBB⁶.

7. The higher liquidity risk from the sovereign-bank nexus is primarily driven by the inexistence of a secondary government security market. The underdevelopment of the interbank and repo markets and the secondary market for government securities exposes banks to liquidity risk in case of liquidity shocks. While banks' liquidity ratios remain high, the absence of an active secondary market gives rise to liquidity risks from uncertainty over banks' ability to liquidate government securities in case of liquidity needs. Most investors, especially banks, follow a buy-and-hold strategy till maturity.

³ In the nexus, three main transmission channels convey shocks from one sector to the other and vice versa (Andrea Deghi and al. 2022): (i) the exposure of banks to sovereign debt through government debt stock (the "exposure" channel), (ii) the guarantees of the sovereign to banks (the "safety net" channel), and (iii) the indirect connection between the two sectors through non-financial firms (the "macroeconomic" channel).

⁴ Basel Committee on Banking Supervision- Supervisory review process-SRP98-Application guidance on interest rate risk in the banking book

⁵ The Technical Assistance Report on Macroprudential stress testing in Guinea (AFW 2022)

⁶ The supervisory body, the BCRG in Guinea, is accountable for the supervision of the IRRBB management framework and for setting the risk appetite level for IRRBB.

Therefore, the BCRG liquidity facilities are the primary tools for obtaining liquidity (with a 10 percent haircut) in case of liquidity shocks.

C. Policy Recommendations

8. A multi-pronged set of policy and reforms are required to tackle the risk associated with the government-bank nexus. Such policies include: (i) discouraging banks from holding significant amounts of the central government securities, (ii) promoting market development and, (iii) monitoring and managing risks associated with the nexus should be encouraged to address the increasing sovereign-bank nexus in Guinea. The following policy recommendations benefited from the contribution of AFW's experts⁷.

9. Reduce banks' exposure to sovereigns would require policies to diversify the government sources of funding and the investment base. Diversifying the government's sources of funding would require a robust Medium-Term Debt Strategy (MTDS) that would help inform the types of financing. Similarly, the government should diversify its investors' base in line with the action plan designed by AFRITAC West (AFW) in 2022 (boosting investor relations practices over the short-term, promoting the creation of investment schemes, and developing a strategy for developing a non-bank investor base over the medium term). In parallel, the authorities should develop the interbank and repo markets over the medium term.

10. An effective implementation of the Pillar 2 requirements would help improve banks' ability to face concentration and IRRBB risks. The authorities are already considering developing a methodology to introduce and calibrate a capital surcharge to discourage excessive concentration to the sovereign. Over the medium term, the authorities should also consider developing an Internal Capital Adequacy Assessment Process (ICAAP) regulatory requirement.

11. Boosting the banking sector's resilience to shocks also hinges on the enactment of the new Banking Law. The authorities have taken a step for the finalization and enactment of the banking law with its crisis management, bank resolution, and safety net components. Following the Financial Sector Stability Review (FSSR) in 2019, an IMF TA project is ongoing to revise the current Banking Law.

12. Strengthening banking supervision in Guinea would be key to address the risks associated with the increasing sovereign-bank nexus. The BCRG should imperatively address the long-standing issue of staffing constraints as recommended by AFW and several missions related to banking supervision.

13. Reducing the risks from the sovereign-bank nexus will also imply strengthening the fiscal framework. As mentioned in the GFRS⁸ Report of April 2022, chapter 2, "*better targeting of spending and strengthening of medium-term fiscal frameworks in countries with limited fiscal space and tight borrowing constraints could build resilience and mitigate the impact of an adverse shock*".

⁷ Jean-Charles Normand, Resident Advisor in Banking Regulation and Supervision and Oumar Dissou, Resident Advisor in Debt Management provided inputs to design the recommendations of this section.

⁸ Global Financial Stability Report, April 2022, Chapter 2

References

Global Financial Stability Report-GFSR- April 2022, chapter 2," The sovereign-bank nexus in emerging markets: a risky embrace."

Giovanni Dell’Ariccia, Caio Ferreira, Nigel Jenkinson, Luc Laeven, Alberto Martin, Camelia Minoiu, and Alex Popov, 2018, "Managing the Sovereign-Bank Nexus", Monetary and Capital Markets Department Research Department, No 18/16.

Andrea Deghi, Salih Fendoglu, Tara Iyer, Hamid Reza Tabarraei, Yizhi Xu and Mustafa Y. Yenice, 2022, "The Sovereign-Bank Nexus in Emerging Markets in the Wake of the COVID-19 Pandemic."

IMF Working Paper 22/223.

Heiko Hesse and Ken Miyajima, 2022, "South Africa: The Financial Sector-Sovereign Nexus."

IMF Working Paper 22/51.