TASK FORCE ON CLIMATE, DEVELOPMENT AND THE INTERNATIONAL MONETARY FUND

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Climate Change and IMF Debt Sustainability Analysis

FRANCO MALDONADO AND KEVIN P. GALLAGHER

ABSTRACT

The International Monetary Fund (IMF) has pledged to align the IMF's surveillance, advice and financing to the goals of the Paris Climate Agreement. One area of crucial importance will be reforming the IMF's 'Debt Sustainability Analysis' to incorporate climate change. In this short note, we adjust the IMF Debt Sustainability Analysis methodology to incorporate climate risk and climate transition resource needs in an application to the economies of Colombia and Peru. In these two test cases, we observe that the climate shocks may significantly affect the countries' public debt trajectory, making countries' debt converge to a significantly higher level and, in some cases, increasing the countries' probability to incur a significant stress event. More importantly, however, our analysis points to the need for new methological approaches and new forms of data collection at the IMF so that more robust analyses can be conducted in order to fully incorporate climate change into Debt Sustainability Analysis and the subsequent advice the IMF gives to member states.

Keywords: International Monetary Fund, surveillance, debt sustainability analysis, climate change

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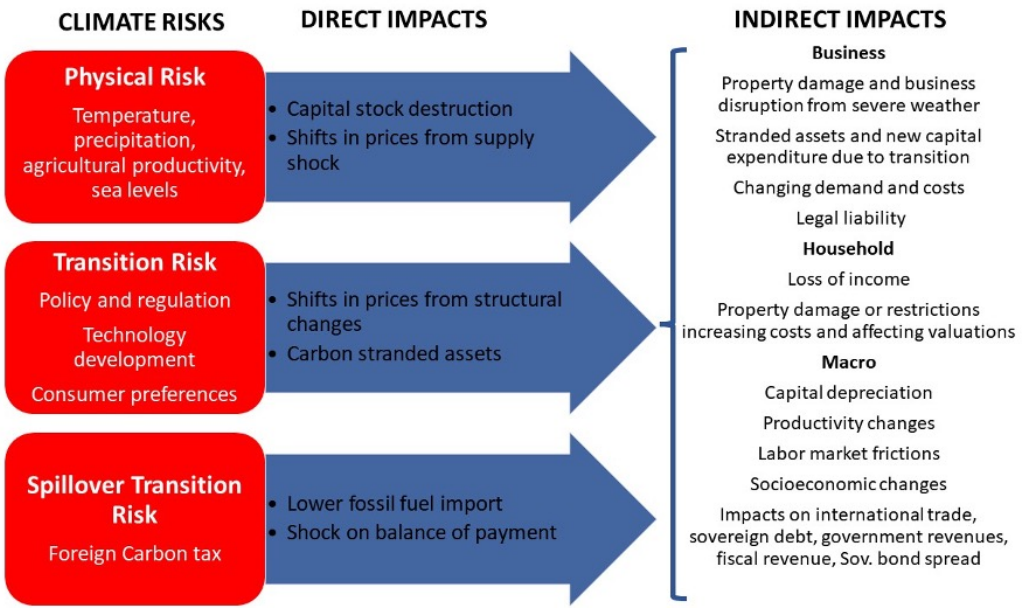
INTRODUCTION

There is now a consensus that climate change and climate change policy pose 'macro-critical risks' to national economies, and the global economy as well. The frequency of climate-related disasters has increased by an order of five, according to the World Meteorological Organization over 50 years (WMO, 2021). The cost of extreme weather events is trending toward $6 trillion in this century, and in 2020, the cost was estimated at $298 billion. In some countries, such as in Small Island Developing States (SIDS), these damages have been more than 100 percent of GDP for just one single event (Climate, Weather, and Catastrophe Insight, 2021). These 'physical climate risks' can have significant impacts on macroeconomic conditions in a country.

Physical risks occur when the material effects of climate change, such as the increased impact of floods and hurricanes, damage physical assets inducing capital stock losses in an economy (NGFS, 2019; Dunz *et al*., 2021). These losses can ripple across financial actors through changes in the value of securities and loans of impacted firms, which can lead to credit, insurance and sovereign risks (Monasterolo, 2020). Transition risks emerge from a late and uncoordinated introduction of climate policies whose impacts cannot be fully anticipated by investors, leading to sudden adjustments of asset prices, with implications on financial stability at the individual and systemic level (Battiston *et al*., 2017).

These climate risks and their macro-critical aspects are depicted in Figure 1, in addition to 'spillover transition risks' whereby physical or transition risk that happens in one country or region has cross-border macro-critical impacts on financial and fiscal systems (Gallagher *et al*., 2022).

FIGURE 1 Macro-critical Aspects of Climate Risks



Source: Gallagher *et al*. (2022)

The International Monetary Fund (IMF) has begun to build these concepts into its toolkit in order to help countries anticipate, prevent and mitigate these risks (IMF, 2021a). One important tool that will need to incorporate climate risks is the IMF's Debt Sustainability Analysis (DSA). DSAs are tools that identify an IMF member state's vulnerability to sovereign debt stress and thus form a pillar of analysis to help member states avoid such stress.

In this short viewpoint, we focus on the debt sustainability aspects of physical climate risk and the resource mobilization necessary for a transition to a more resilient and low-carbon economy. We experiment with the current IMF DSA methodology for Market Access Countries (MAC-DSA) to include estimates to physical and transition investments needed to prevent physical climate risk into the future. In so doing, we introduce two non-excludable climate-risk related pathways into a DSA. The first path considers that the country is impacted by physical climate risk—a climate-related disaster that affects the country's economy and public finances, as well as the fiscal response necessary to develop a reconstruction and recovery plan. The second path assumes focuses on the resource mobilization needed to put in place climate adaptation and resilience investments to safeguard from physical climate risk into the future and invest in climate mitigation and transformation.

We apply our methodology to two Andean countries: Colombia and Peru, both of which are affected by climate-related disasters and require significant resources to make a green transition. In these two test cases, we observe that the climate shocks might significantly affect the countries' public debt trajectory, making countries' debt converge to a significantly higher level, and in some cases, increasing the countries' probability to incur in a stress event. More importantly, however, our analysis points to the need for new forms of data collection so that more robust DSAs can be conducted to fully incorporate climate change into DSA analysis and subsequent advice.

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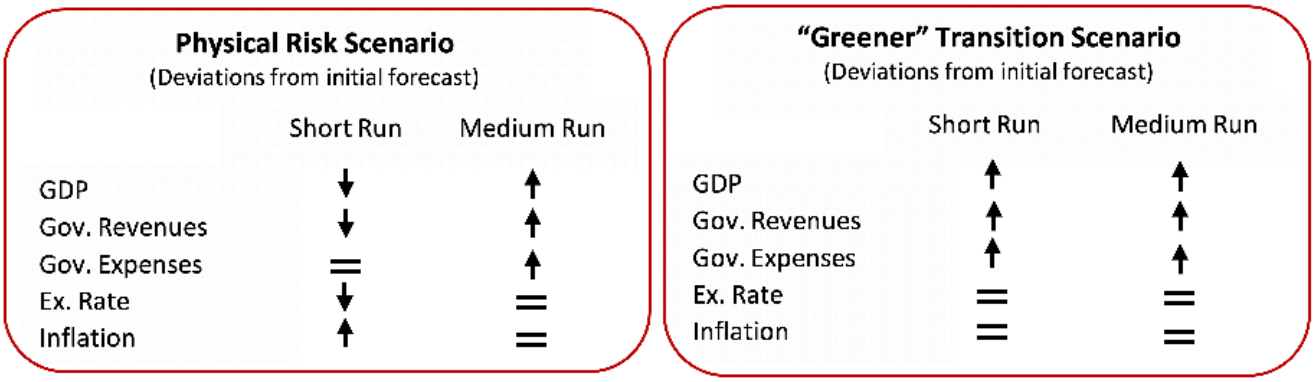
METHODOLOGY

In this section, we present our approach devised to include climate risks into the IMF's MAC-DSA. For two countries, Colombia and Peru, we develop two potential scenarios: 1) the Physical Risk Scenario and 2) the "Green" Transition Scenario. Each of these scenarios, and then a third exercise that combines the two, are introduced into those countries' existing DSA frameworks. These experiments allow us to examine the extent to which debt vulnerabilities in the two countries might change under these scenarios and help identify the kinds of methodological and data needs required for more robust analysis and advice.

The MAC-DSA is a framework tied to the IMF role of surveillance and lending and is oriented to detect, prevent and resolve a potential crisis in countries (IMF, 2021d). In particular, this framework is applied to countries to analyze their current debt situation and policy, identify vulnerabilities in their fiscal capacity to allow policy corrections and in certain cases, examine the impact of alternative debt-stabilizing policy paths. Therefore, the framework considers the possibility that the country could face a different set of shocks (internal and external) in the short and medium run that might affect the country's fiscal profile. However, the MAC-DSA does not include climate-related shocks in their analysis, leaving an important vulnerability unseen.

We introduce our two climate-related scenarios into this framework, as depicted in Figure 2. In the first scenario, we assume that the country faces one climate-related negative shock in the form of a climate disaster (e.g. floods, landslides, water scarcity, among others). This shock triggers a set of macroeconomic reactions in the short run (first year of analysis). First, the shock has a negative effect on real GDP, both from the supply and the demand side. For instance, this shock can be characterized as a flood that destroys crops for local or international markets or important infrastructure facilities crucial for internal supply chains. Similarly, this shock might also affect employment and household incomes, reducing domestic consumption. Government revenues decrease in line with the GDP reduction. Finally, as the shock might affect the exporting capabilities and volumes more than imports, the exchange rate increases temporally.

FIGURE 2 Physical Climate Risk and Green Transition Scenarios



Source: Compiled by authors

In the medium run (second year and beyond), the government reacts to the climate shock, mainly by developing a public investment and expenditure package to reinstate the infrastructure lost and adequate the infrastructure to reduce the impact of future climate shocks. This greater spending on infrastructure has a positive impact on GDP, both directly (greater public investment) and indirectly (spending multipliers), as well as in government revenues.

The second scenario assumes that the country takes a propositive action to face climate risk and decides to invest in key infrastructure to limit the climate change impacts and close the service gaps. For instance, building coastal and river protection to avoid major floods or investing in the change of the energy matrix from fossil fuels to renewable energies. In this line, as in the medium run impact the previously described scenario, this greater government expenditure has a positive impact on the real GDP and in government revenues, as a result of the new economic activity triggered by these investments.

A third scenario combines both the previous two scenarios described above. In this scenario, we assume that the country, instead of only responding to the effects of the climate shock, decides to also address other long-run climate-related challenges. In this sense, the country develops a resource mobilization strategy that includes both reconstruction and climate transitioning.

APPLICATION

We apply the scenarios mentioned before to two Andean countries: Colombia and Peru. These countries are at medium-high risk of climate change, according to the Global Climate Risk Index 2021 (Batini *et al.*, 2021) and have faced important climate shocks like "La Niña" and "El Niño" in recent years.

Data and Assumptions

In order to test in implications of our scenarios, we used the DSA for Market-Access Countries template published by the IMF.[1] We collect the main macroeconomic series (e.g. real and nominal GDP, current account balance, among others) from the countries' Central Banks online databases.[2] Public debt information is obtained from countries' Ministries of Finance;[3] in particular, we used detailed information about current and future countries' debt profiles (e.g. stock, ownership), interest and amortization. Finally, we use IMF forecast of major macroeconomic variables published in the countries' IMF Country Reports (IMF, 2021b and 2021c).

The general assumptions behind the exercises are the following:

- The non-interest public revenues, as a percentage of GDP, increase in the same magnitude as the real GDP.
- Multiplier of public expenses to real GDP is 0.1. We took a conservative assumption given the different characteristics of the expenses considered. However, according to Batini *et al.* (2021), the response to 1 percent of GDP spending in renewable clean energy is 1.2 percent of GDP in the first year of disbursement.
- Public expending is already compromised in the horizon of analysis. Therefore, the expenses considered in the scenarios are treated as additional expenses.
- New debt maintains the latest countries' debt profile.

The specific assumption for each of the exercises are the following:

- **Physical Risk Scenario**

  The magnitude of the climate shock is equal to the impact of the most recent climate-related disaster. In the case of Colombia, the 2010-11 "La Niña" phenomenon reduced the economic growth by around 0.5 percentage points (IMF, 2011); while in the case of Peru, the 2017 Coastal El Niño affected GDP growth by around 1 percentage point (MEF, 2017).

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[1] https://www.imf.org/external/pubs/ft/dsa/mac.htm

[2] Colombia, Banco de la Republica: https://totoro.banrep.gov.co/estadisticas-economicas/. Peru, Banco Central de Reserva del Peru: https://www.bcrp.gob.pe/estadisticas.html and https://www.bcrp.gob.pe/estadisticas/cuadros-de-la-nota-semanal.html.

[3] Colombia, Ministerio de Hacienda y Credito Publico: https://www.irc.gov.co/webcenter/portal/IRCEs/pages_Deuda/perfildeudapblicagnc. Peru, Ministerio de Economía y Finanzas: https://www.mef.gob.pe/es/?option=com_content&language=es-ES&Itemid=101940&lang=es-ES&view=article&id=3030.

The magnitude of the public expending increase is proportional to previous fiscal packages to respond to the climate-related shock. In the case of this exercise, the Colombian and Peruvian governments implemented a fiscal package of around 3 percent of their GPD (IMF, 2011; MEF, 2017). We assume this package is disbursed in a 3-year horizon beginning the immediate next year of the shock: 30 percent in the first year, 40 percent in the second and 30 percent in the third year.

Inflation increases 1 percentage point above the baseline forecast as a result of production, infrastructure and supply chain disruptions during the first year, and returns to its baseline scenario at the second year and beyond.

Nominal exchange depreciates 10 percent and 5 percent during the first and second year, respectively, and returns to its baseline scenario at the third year and beyond.

- **"Greener" Transition Scenario**

  To quantify the magnitude of the public spending we use the estimates for the investment needed in key infrastructure to limit the climate change impacts and close the service gaps for Latin America in a World Bank study conducted by Rozenberg and Fay (2019) to both countries. In this sense, as can be observed in detail in Table 1, we consider three alternative yearly investment levels: low, 2.2 percent of GDP; preferred, 3.7 percent of GDP; and high, 8.3 percent of GDP. The World Bank estimates are considered to be conservative, and are lower than others by the Organisation for Economic Co-operation and Development (OECD) and independent think tanks and scholars. Moreover, they do not include the broader adjustment finance needed to ensure that stranded workers and firms are buoyed throughout the transition (Bhattacharya *et al*, 2019).

- **Physical Risk and "Greener" Transition Scenario**

  Public spending considers the investment for key infrastructure to limit the climate change impacts and close the service gaps for Latin America described in the previous point, plus a third of the fiscal package to respond to the climate-related shock (1 percent of the GDP), assuming an overlapping among the investment projects in both scenarios.

TABLE 1 Yearly Transition Investment in Latin America (percent of GDP)

		Low	Moderate	High
Irrigation		0.05	0.07	0.22
Energy		0.63	1.43	1.95
	Capital	0.51	1.2	1.74
	Maintenance	0.12	0.23	0.21
Transport		1.49	1.97	4.53
	Capital	0.95	1.4	3.65
	Maintenance	0.54	0.57	0.88
Flood protection		0.07	0.27	1.62
	Capital	0.04	0.19	1.48
	Maintenance	0.03	0.08	0.14
Total		**2.24**	**3.74**	**8.32**

Table 2 summarizes the results of the underlying assumptions on the main macroeconomic variables of the baseline scenario and each of the alternative scenarios.

TABLE 2 Underlying Assumptions (percentages)

COLOMBIA

Baseline Scenario

	2021	2022	2023	2024	2025	2026
Real GDP growth	5.1	3.6	4.0	3.8	3.8	3.6
Inflation	3.0	3.1	3.2	3.3	3.4	3.5
Primary Balance	-5.5	-0.5	0.0	1.1	1.1	1.1
Effective interest rate	4.7	5.0	4.9	5.0	5.0	5.1

Physical Risk Scenario

	2021	2022	2023	2024	2025	2026
Real GDP growth	5.1	3.1	4.1	3.9	3.9	3.6
Inflation	3.0	4.1	3.2	3.3	3.4	3.5
Primary Balance	-5.5	-1.0	-0.8	0.0	0.3	1.1
Effective interest rate	4.7	5.1	4.9	5.0	5.0	5.1

"Greener" Transition Scenario - Moderate

	2021	2022	2023	2024	2025	2026
Real GDP growth	5.1	4.0	4.4	4.2	4.2	4.0
Inflation	3.0	3.1	3.2	3.3	3.4	3.5
Primary Balance	-5.5	-3.9	-3.4	-2.3	-2.3	-2.3
Effective interest rate	4.7	5.1	4.9	5.0	5.1	5.2

Physical Risk and "Greener" Transition Scenario - Moderate

	2021	2022	2023	2024	2025	2026
Real GDP growth	5.1	3.5	4.4	4.2	4.2	4.0
Inflation	3.0	4.1	3.2	3.3	3.4	3.5
Primary Balance	-5.5	-4.4	-3.6	-2.6	-2.5	-2.3
Effective interest rate	4.7	5.1	4.9	5.0	5.1	5.2

PERU

Baseline Scenario

	2021	2022	2023	2024	2025	2026
Real GDP growth	8.5	5.2	4.8	3.4	3.3	3.3
Inflation	2.0	2.0	2.0	2.0	2.0	2.0
Primary Balance	-3.3	-1.7	-1.0	-0.6	-0.4	-0.1
Effective interest rate	4.8	4.9	5.0	5.1	5.2	5.3

Physical Risk Scenario

	2021	2022	2023	2024	2025	2026
Real GDP growth	8.5	4.2	4.9	3.5	3.4	3.3
Inflation	2.0	3.0	2.0	2.0	2.0	2.0
Primary Balance	-3.3	-2.7	-1.8	-1.7	-1.2	-0.1
Effective interest rate	4.8	5.1	4.9	5.1	5.2	5.3

"Greener" Transition Scenario - Moderate

	2021	2022	2023	2024	2025	2026
Real GDP growth	8.5	5.7	5.3	3.9	3.8	3.8
Inflation	2.0	2.0	2.0	2.0	2.0	2.0
Primary Balance	-3.3	-6.0	-5.3	-4.9	-4.7	-4.4
Effective interest rate	4.8	5.1	4.9	5.1	5.3	5.4

Physical Risk and "Greener" Transition Scenario - Moderate

	2021	2022	2023	2024	2025	2026
Real GDP growth	8.5	4.6	5.2	3.8	3.7	3.7
Inflation	2.0	3.0	2.0	2.0	2.0	2.0
Primary Balance	-3.3	-6.1	-4.6	-4.3	-4.0	-3.5
Effective interest rate	4.8	5.1	4.9	5.1	5.3	5.4

Source: IMF (2021b and 2021c), and author calculations.

Results

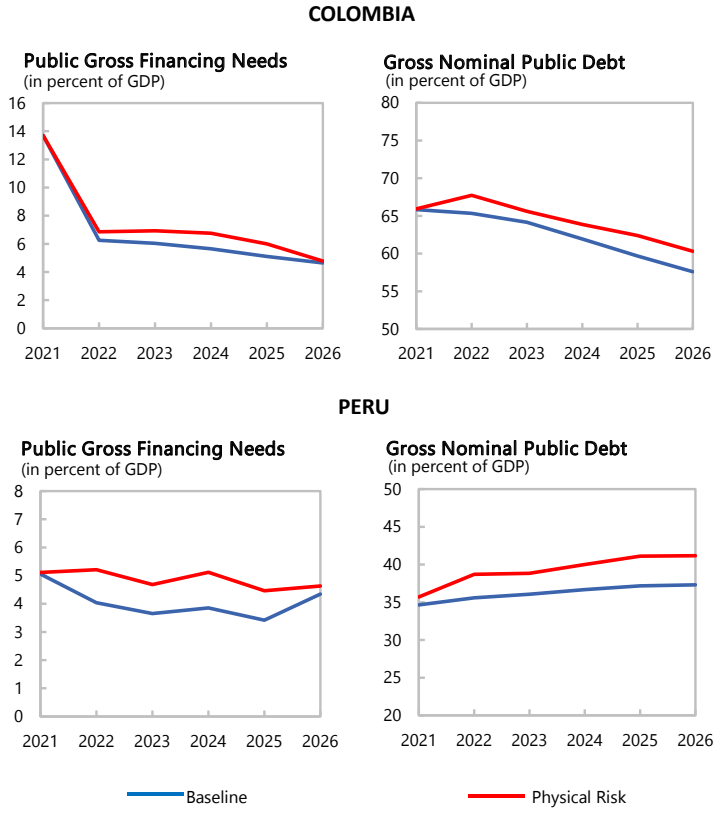
We apply the described scenarios and assumptions to both countries, and we analyze the results under the view of the previous and current MAC-DSA frameworks (IMF, 2013 and 2021d) to determine the presence of potential risks. In this sense, following the previous MAC-DSA framework (IMF, 2013) we analyze if the countries' results might be higher than the benchmarks for gross debt-to-GDP and gross financial needs-to-GDP ratios (70 percent and 15 percent, respectively, for emerging markets countries); and therefore, could incur

into a risk of debt burden. In parallel, we use the new MAC-DSA framework (IMF, 2021d) to calculate the probability that each scenario could induce the countries into a stress event or crisis.[4]

The application of the first scenario affects the countries' public debt trajectory, converging into a significantly higher level that does not imply significant risks to the countries. However, the second scenario could increase debt at a constant rate, reaching problematic levels in some cases that might require fiscal adjustments to reduce the risks.

In the Physical Risk scenario, as can be observed in Figure 3, a climate-related shock might increase countries' gross financial needs in the near term (mainly between 2022 and 2025), rising the debt stock by the end of the period of analysis. In particular, a physical shock

FIGURE 3 Physical Risk Scenario – Public Gross Financial Needs and Gross Nominal Debt



Source: IMF (2021b and 2021c), and own calculations.

[4] In order to calculate this probability, we use the coefficients of the logistic model presented in the page 19 and Annex V of IMF, 2021d. In addition, we assume the following elements:

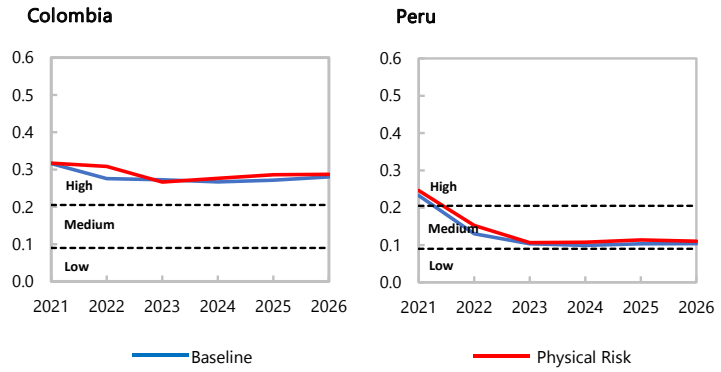
- Institutional quality, we assume each country maintains the indicators observed in 2020.
- Stress history, we assume that neither Colombia or Peru featured a debt stress in recent history and, therefore, this variable is equal to zero.
- Change in VIX index, we assume no change in the time of analysis.
- We assume a constant coefficient of -2.
- We use the IMF's forecast for the rest of the variables that does not change with the scenarios (current account, real exchange rate, credit-to-GDP gap, international reserves).

in Colombia might increase the country's financial needs by approximately 0.7 percent of its yearly GDP in comparison with the estimates in the baseline scenario. This will push Colombia's public debt to 60.3 percent of GDP by 2026, which is 2.7 percentage points above the baseline scenario. Meanwhile, Peru might demand an additional 1.0 percent of its yearly GDP of financial resources in comparison with the baseline scenario. Therefore, Peru's public debt might reach 41.2 percent of GDP by 2026, which is 3.9 percentage points higher than the initial projections.

Based on the previous MAC-DSA framework, the Physical Risk scenario does not generate substantial risks to these countries. As can be seen in Figure 4, during the period of analysis the financial needs are consistently below the 15 percent threshold. In a similar result, the public debt is consistently below the 70 percent benchmark and either decreases consistently, like in the case of Colombia, or converges to a new level below the threshold, like in the case of Peru.

Considering the new MAC-DSA framework, Figure 4 displays the calculated probabilities of a stress event that are originated due to the Physical Risk scenario. In both cases, the probabilities associated with the scenario increase temporally above the baseline scenario in certain years but converge near to the probability of the baseline scenario at the end of the period of analysis. In the situation of Colombia, the probability remains in the high-risk area, but it decreases and stabilizes into the lower part of this area. Meanwhile, in the case of Peru, the probability temporally increases into the high-risk area in the year 2022, but it decreases and converged into the lower part of the medium-risk area near the probability of the baseline scenario.

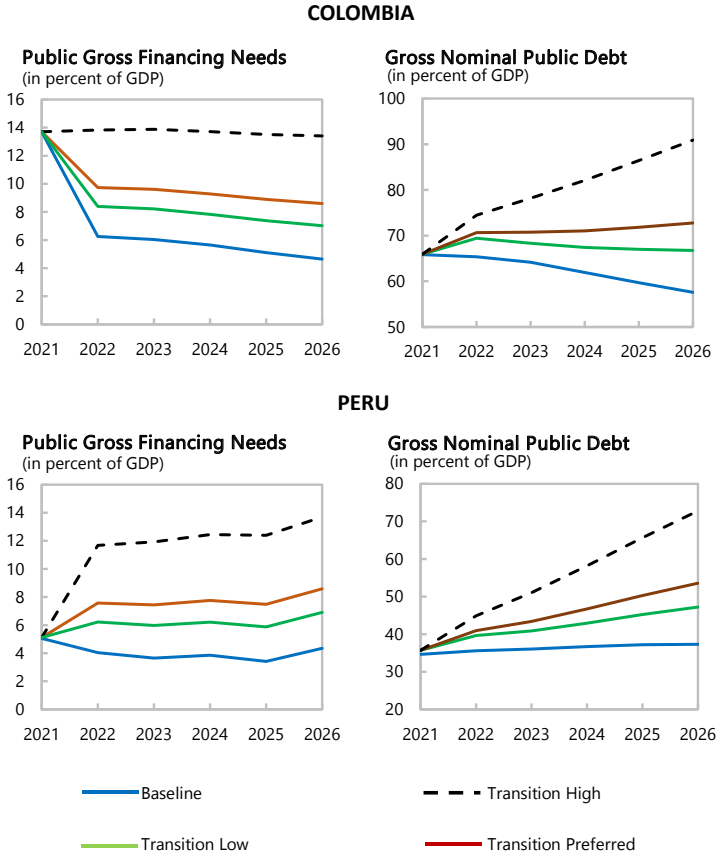
FIGURE 4 Physical Risk Scenario – Probability of Stress Event



Source: IMF (2021b, 2021c and 2021d), and author calculations.

In the "Greener" Transition scenario, as can be observed in Figure 5, both countries' financial needs are reasonably held at the same level, making the debt stock increase at a constant rate to a systematically higher level than the one in the baseline scenario. However, impacts depend on the different degrees of investment. The lower and preferable investment levels have a similar impact on debt, but the high investment level generates a substantial increase of the public debt level without a clear convergence.

FIGURE 5 "Greener" Transition Scenario – Public Gross Financial Needs and Gross Nominal Debt



Source: IMF (2021b and 2021c), and own calculations.

In specific, Colombia might need 2.2 and 3.7 percent of its yearly GDP in additional financial resources in contrast to the baseline scenario if they follow a low or a preferable investment, respectively. Colombia's public debt might reach 66.7 and 72.8 percent of the GDP by 2026 (9.1 and 15.2 percentage points more than the baseline scenario) if they conduct a low or a preferable investment, respectively.

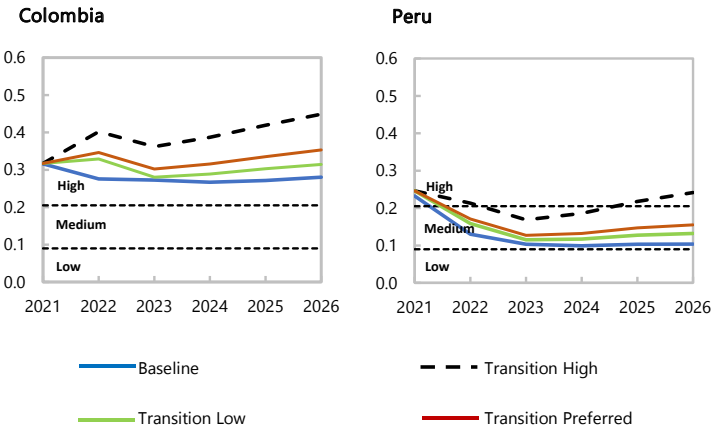
In parallel, Peru might require an additional 2.4 percent of its yearly GDP in additional financial resources above the baseline scenario if they follow a low investment, and 3.9 percent if follows the preferable investment level. The behavior might push Peru's public debt to 47.2 percent of the GDP by 2026 (9.9 percentage points more than the baseline scenario) in the low investment case, and to 53.5 percent of the GDP (16.3 percentage points more than the baseline scenario) in the preferable investment level.

If both countries follow a high investment level to transition into a "greener" economy they might require significantly higher additional financial resources, which account for around 8.1 percent of its yearly GDP in the case of Colombia, and 8.6 percent regarding Peru. In this context, public debt might move to a considerably higher level, which in the case of Colombia is 90.9 percent of GDP (33.3 percentage points above the baseline scenario), and 72.8 percent of GDP regarding Peru (35.5 percentage points above the baseline scenario).

In observance of the previous MAC-DSA framework, the application of this scenario could create significant risks in some investment profiles. In the case of Colombia, the resulting financial needs in all investment cases are not above the benchmark of 15 percent of the GDP. However, only the low investment case generated public debt levels that are below the benchmark of 70 percent of the GDP during the period of analysis. In both the desirable and high investment cases, the public debt path rises above the benchmark and does not converge during the period of analysis. Therefore, only the low investment path could generate no significant risks for Colombia, while the desirable and high investment cases might generate significant risks that could induce the country to adjust its fiscal accounts to return to a stable debt path. In the case of Peru, the financial needs in all investment cases are below the benchmark of 15 percent of the GDP during the period of analysis. Meanwhile, the stock of public debt steadily increases in all investment cases without convergence. However, the high investment is the only case in which the level of public debt is above the threshold level of 70 percent by the end of the period of analysis.

In parallel, the current MAC-DSA framework analysis based on the multivariate model, as can be observed in Figure 6, implies that this scenario could increase the countries' risks to incur into a stress event; nevertheless, the risks are significantly greater in the case of the

FIGURE 6 "Greener" Transition Scenario – Probability of Stress Event



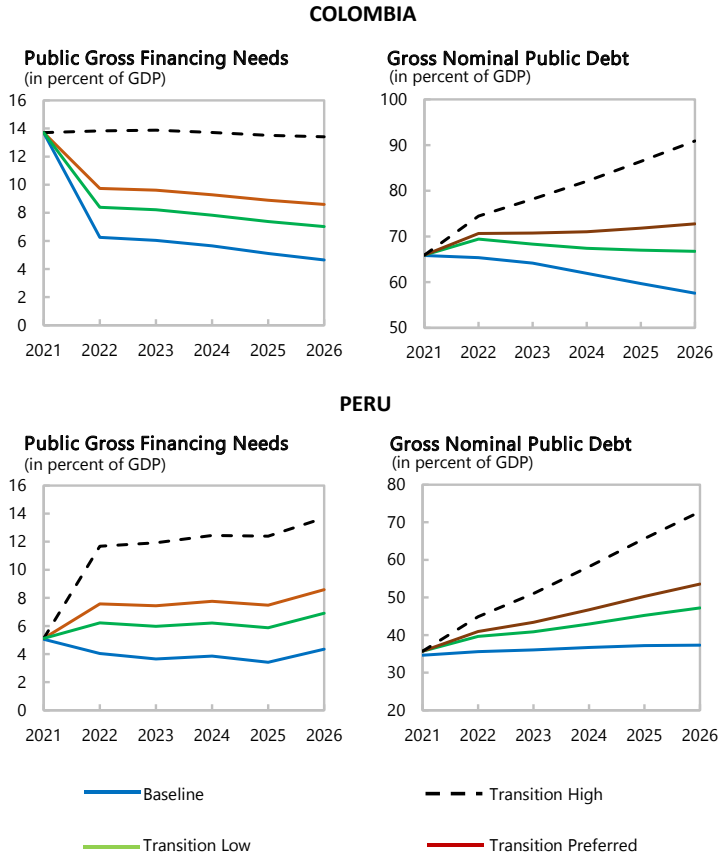
Source: IMF (2021b, 2021c and 2021d), and own calculations.

high investment level. In concern to Colombia, the probability of incurring a stress event revert the convergence path observed in the baseline scenario and increases systematically in all the investment levels and maintains in the high-risk area. It is important to highlight that in the high level of investment the probability of falling into a stress event increases 17 percentage points by 2026, in comparison with the level observed in the baseline scenario.

In the case of Peru, this scenario also creates a similar decoupling path to the baseline scenario that we observe in the case of Colombia. However, the magnitude of the increases of probabilities is lower than in the case of Colombia. Both the low and preferred investment levels generate probabilities that are in the medium-risk area, while the high investment level breaks into the high-risk area and is around 14 percentage points higher than the probability observed in the baseline scenario

Figure 7 displays the results if we consider both shocks at the same time—pursuing a climate transition strategy while withstanding physical climate shocks. In this context, Colombia's public debt might increase between 10.1 to 34.3 percentage points with respect to the baseline scenario. Meanwhile, regarding Peru's public debt, it might rise between 11.7 to 37.2 percentage points to the baseline scenario.

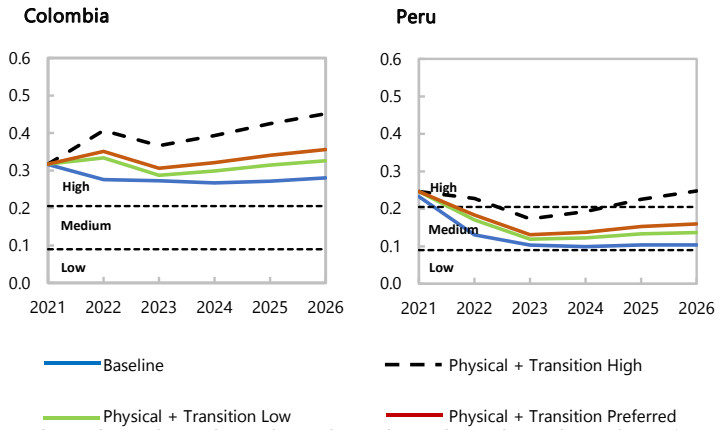
FIGURE 7 Physical Risk and "Greener" Transition Scenario – Public Gross Financial Needs and Gross Nominal Debt



Source: IMF (2021b and 2021c), and own calculations.

In this line, if we consider both shocks at the same time, the risk of incurring a stress event is exacerbated with all investment cases in both countries. Even though in all the cases the financial needs benchmarks have not been exceeded, the public debt-to-GDP levels have been surpassed in the preferred and high investment level in the case of Colombia, and in the case of the high investment level in the case of Peru. In addition, as can be observed in Figure 8, the probabilities of incurring a stress rise systematically in all the cases, but highlights the case of high investment for countries, which rise into the high-risk area. As we described before, in these cases the countries might need to adjust the financial requirements to stabilize the path of debt.

FIGURE 8 Physical Risk and "Greener" Transition Scenario – Probability of Stress Event



Source: IMF (2021b, 2021c and 2021d), and author calculations.

Sensitivity Aspects of this Exercise

Besides the common sensibilities present in the forecasts and assumptions used MAC-DSA (e.g. interest rates and debt profiles), the present exercise have the following sensitivities:

- **Severity of the climate-related shock.** As we described in the data and assumptions part, we assume that the effect of the climate-related shock on the GDP is equal in terms of magnitude to the ones observed previously in the case of the 2010-11 "La Niña" phenomenon in Colombia and the 2017 Coastal El Nino in Peru. Therefore, the public expenditure considered in this scenario is equal to the fiscal packages considered to address these disasters. However, the next climate-related disaster may have a different level of severity. Hence, the effect of the event on the GDP and the size of the financial needs required to address the situation is going to be different from the one assumed in this exercise.
- **Funding source of the expenses.** Our exercise considers that the public sector bears the financial needs entirely, without any participation of the private sector. Nevertheless, the private sector could play an important role in financing and taking care directly of a significant share of the costs and resources required in both scenarios. For instance, the private sector has developed different energy and transportation projects in Latin

America via Public-Private Partnerships. In this line, part of the public expenses considered in the "Greener" Transition scenario could be assumed by the private sector, reducing the financial needs and the debt that the public sector might have to take.

CONCLUSION

This exercise speaks to the need for the IMF to develop the necessary data and methodologies that will allow the IMF to fully incorporate climate-related risks and actions into the IMF's DSAs. The proposed methodology considers two non-excludable paths. First, we contemplate the path in which the country's impact of a climate-related disaster and its recovery path. Second, we consider the path in which the country decides to invest in adapting to a "greener" economy and making its country more resilient to climate-related risks. Finally, we combine the two to examine the full potential impact of climate risk on the debt sustainability of these two countries. We apply our methodology to two Andean countries: Colombia and Peru. The results show that, in the case of these countries, the application of the methodology may affect the countries' public debt trajectory, making countries' debt converge to a significantly higher level in most cases. In specific, the Physical Risk scenario increases the countries public debt, converging to a higher level, but does not convey a significant increase in the probability to incur a stress event. However, the "Greener" Transition scenario could increase debt at a constant rate, reaching problematic levels in some cases that might require fiscal adjustments to reduce the risks.

More important than the specific results of these exercises for Colombia and Peru is the need for more robust, country-specific data that could be used as inputs into the MAC-DSA framework used by the IMF. The Network for Greening the Financial System (NGFS) has been developing a number of physical and transition risk scenarios for global modeling efforts (NGFS, 2021). The IMF will need to adapt these to country-level applications for DSAs and beyond. What is more, improved official data estimation is needed for the magnitude of investment required for resilience and low-carbon transition pathways in IMF member countries. As in the case of the NGFS, there are a number of global estimates, but national-level estimates will be needed to properly understand the debt sustainability of member states (see NCE, 2014; OECD, 2017; Bhattacharya *et al.*, 2019; Rozenberg and Fay, 2019).

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