Latin America (LatAm) Central Banks (CBs) environmental risk management of the international reserves: an applied framework discussion

Abstract

This is an applied framework discussion with Latin America (LatAm) Central Banks (CBs) towards the environmental risk management (ERM) of the international reserves (IRs). This study is based on a sample of LatAm CBs and the respective national exports, taking into consideration the risk of sudden stops in capital flows and the economic objectives of the IRs. Commodities are economically relevant for all analyzed countries. The specific environmental risk exposures are discussed, as well as the alternatives to ERM through strategic asset allocation (SAA) of the IRs. The framework herein discussed includes environmental risk analysis (ERA) in the traditional SAA approach of IRs. In turn, IRs investments can become more resilient to environmental and climate risk exposure.

Keywords: environmental risk management; central banks; international reserves; LatAm.

1. Introduction

Environmental factors are resulting in a range of financial risks, with implications to investments. As well known, risks need to be identified, measured, and managed. The Environmental Risk Management (ERM) is a challenge to investors, including Central Banks (CBs) when acting as managers of the International Reserves (IRs).

IRs are investments held by CBs in foreign currencies to execute the monetary and foreign exchange (FX) policies (Silva Jr, 2011; Hawkins, Rangarajan, 1970; Kohlscheen, O'Connell, 2004; Detragiache, 1996; AIzenman, Marion, 2002; Allen et al, 2002). Thus, they are classified in the policy portfolios of the CBs (NGFS, 2019). The economic objectives of the IRs include intervention in the FX market, execution of payment for goods and services, execution of payments for the government, granting of emergency liquidity assistance, underpinning of investor confidence in the country, and investment of excess reserves (Fender et al, 2019). For that, IRs totaled US$13.978 trillion in 2019 (The World Bank, 2020).

In emerging markets, as LatAm, IRs provide two important and widely accepted functions for CBs: self-insurance (Calvo, Izquierdo, and Loo-Kung, 2012) and warning signaling (Kaminsky, Lizondo, and Reinhart, 1998). Avoiding environmental risks, such as climatic ones, is compatible with these two rationales.

In this context and in the search for contributions to this knowledge gap, this is an applied framework study with Latin America (LatAm) CBs towards the ERM of the IRs. The research question was: which are the relevant environmental risk exposures of LatAm IRs, managed by CBs, taking into consideration the risk of sudden stops in capital flows, based on the respective national exports, and the economic objectives of the IRs? Also, how this ERM could be performed through Strategic Asset Allocation (SAA) of the IRs?

The methodology included literature and desk review, data analysis for ten LatAm CBs, questionnaire and meetings with discussions with selected CBs. The research findings confirmed the economical relevance of commodities for the analyzed countries and the related exposures to environmental risks.

Among the deliverables of this study, the specific LatAm environmental risk exposures are discussed, as well as the alternatives to ERM through strategic asset allocation (SAA) of the IRs. The framework herein discussed includes environmental risk analysis (ERA) in the traditional SAA approach of IRs. In turn, IRs investments can become more resilient to environmental and climate risk exposure.

This paper proceeds as follows: section 2 covers ERM of IRs through SAA, from the discussion of environmental factors as sources of financial risks up to the environmentally adjusted SAA framework for IR management. Section 3 presents the methodology of this research with LatAm CBs. Section 4 present the results and discussions of this study. The paper concludes in section 5 with an outlook for future research.

2. ERM of IRs through SAA

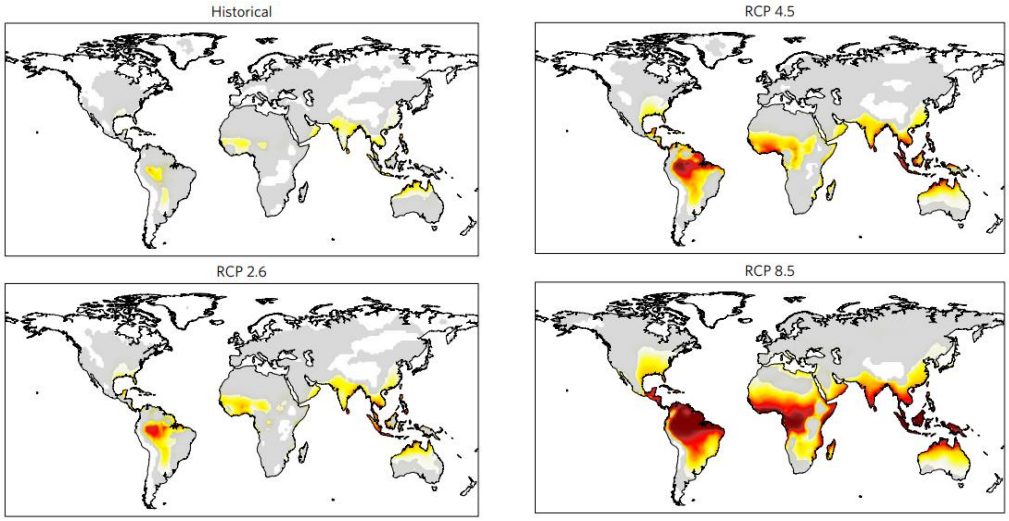
2.1 From environmental factors to financial risks

Environmental factors include climatic, geologic and ecosystem dimensions. The climatic one implies in physical and transition climate risks. Climate risks lead to financial risks through micro and macroeconomic transmission channels. Some examples are property damages and business disruptions due to extreme weather events; stranded-assets due to changes in policy or technology; shifts in prices due to supply shocks; volatility in exchange rates due to changes in capital flows, among others. Those impacts are sources of different types of financial risks, including credit, market, underwriting, operational and liquidity risks (NGFS, 2020).

The environmental physical risks and associated transition risks may increase market volatility and sector instability, driving potential financial losses (Roncoronia et al, 2021). For instance, physical shock events, such as natural catastrophes, may impact corporate financials. Also, changes in trends such as water scarcity, extreme weather events, air pollution, and natural capital degradation represent risks to corporate sectors such as agriculture and power generation.

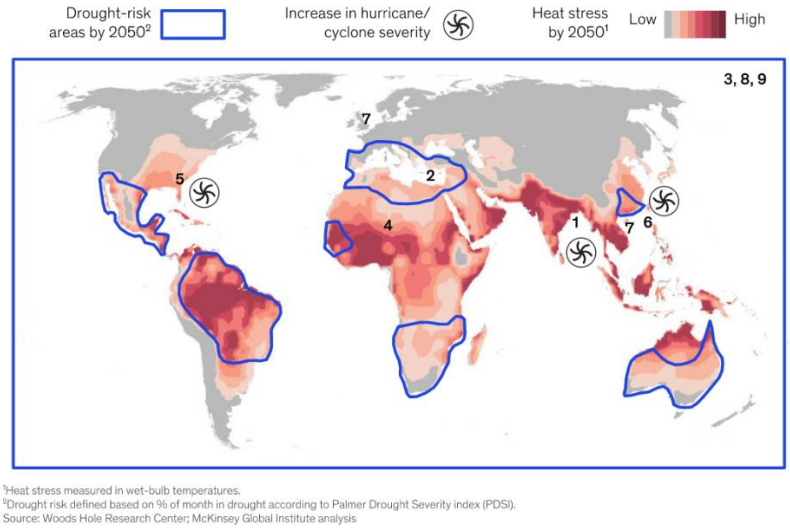
LatAm may be severely impacted by climate change, as demonstrated in figures 1, 2 and 3. Humans may have to abandon many areas, and entire regions of South America and Central America could become uninhabitable due to a mixture of high temperatures and humidity levels (Mora et al, 2017 and Bolton et al, 2020). Heat stress and a drought risk area are projected for the majority of LatAm territory (McKinsey, 2020). Finally, the change in GDP per capta by 2100 compared to a world without climate change maybe negative in 100% for LatAm (Burke, Hsiang and Miguel, 2015).

Figure 1 – Average temperature change in different IPCC global warming scenarios



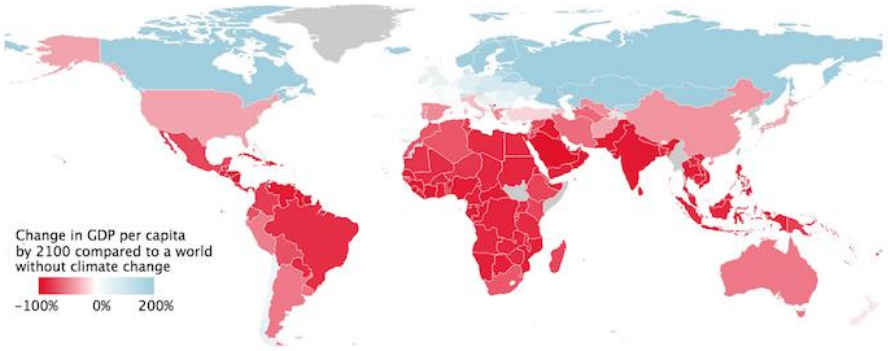
Source: Mora et al (2017) and Bolton et al (2020)

Figure 2 – Heat stress and drought-risk



Source: McKinsey (2020)

Figure 3 –change in GDP per capita by 2100 compared to a world without climate change



Source: Burke, Hsiang and Miguel (2015)

Most LatAm countries are economically based on agriculture and energy sectors. As foreseen in previous figures and in the climatic projections (IPCC, 2014), agriculture may be significantly impacted by new drought areas, changes in the precipitation patterns and consequently, in agricultural areas. Also, impacts come from policies and economic preferences towards biodiversity preservation, as well as changes in food preferences, including the vegan increase motivated by environmental global discussions.

In addition, the worldwide policy effort to achieve a low-carbon economy affects virtually all industries and sectors, in medium and long term, significantly and even disruptively (TCFD, 2017), but specially the energy one. Carbon pricing systems are already stimulating the alignment of the energy market with green public policies. Also, change in the energy matrix that is incorporating clean technologies already exemplifies potential medium-term developments and impacts. Both implies in risk of stranded-assets (Caldecott, Tilbury, and Carey, 2014), which national implications including LatAm countries.

The 2021 Leaders' Climate Summit brought together the main global leaders and registered two great signs: the concern with the physical risks associated with climate change, such as the increase in the incidence of natural disasters; and the risk that companies will have stranded assets, which are not realizable due to the transition to low carbon energy sources. Kristalina Georgieva, head of the International Monetary Fund (IMF), highlighted: "We have to make the invisible visible – the transition risks that banks are carrying because they're investing in high-carbon activities that over time are going to be phased out, and the physical risk, investments in highly vulnerable coastal areas, or in agriculture that could be affected by floods or by droughts" (Reuters, 2021).

Thus, the environmental risks, including the climatic ones, are relevant sources of financial risks with impacts in the performance of investments. As a result, the environmental risk management (ERM) of the IRs is important for CBs and includes risk identification, measurement, and control, taking into consideration environmental externalities, trends, and events (TCFD, 2017; Bank of England, UNEP and CISL, 2017; CISL, 2016; Caldecott, 2014a).

2.2 IRs management by CBs

The objectives of IR management vary among CBs and portfolios under the same investment manager. For some of them, the main objective is to hold liquid and safe foreign exchange (FX) assets for interventions within monetary policy tasks. For others, it is capital preservation as fiduciary duty. It can also be financial stability through the management of a financial buffer for interventions in financial crises, among other strategies, as inflation management.

According to the Assessing Reserve Adequacy (ARA) metrics of the International Monetary Fund (IMF, 2020), 5% to 7,5% of total exports should be covered by IR assets allocated to hedge sudden stops in capital flows.

In crises, IRs are fundamental to quickly mobilize funds in liquid portfolios (or even investment ones) to meet domestic banks or firms' foreign currency needs and support the FX value of the domestic currency (McCauley and Rigaudy, 2011). The financial stability objectives are an important constraint to IR management, short-term liquidity needs, and reputational concerns.

Environmental factors may be behind the next big crisis, possibly related to global warming, water, or biodiversity stress. For this reason and for risk–return investment management purposes, ERA should inform the IRs management process. Risk response management decisions will lead to aligning IRs' risk exposure with CB's risk tolerance and/or exploring opportunities according to the CB's risk appetite. Among possible risk responses, reweighting SAA is an option, without necessarily implying any green investment strategy.

2.3 ERM through SAA

ERA and ERM are prominently linked to strategic asset allocation (SAA) by means of a common time frame (i.e., the long-term horizon for the assessment). SAA is an investment decision made by asset owners to manage portfolio performance and risk over the long term. The tragedy of the horizon means that investors seek returns in the short run and environment risks have a long-term horizon (Carney, 2015). Central banks are long-term investors and the problem of the tragedy of the horizon should be "managed" in the SAA process.

Different portfolio types have different vulnerability and resilience to environmental and climate change-related risks. Each of the asset classes presents different risks and opportunities, demanding a multifaceted strategy across the total portfolio. In turn, the ERA comprises a financial analysis of environmental factors, including pricing and implications for an investment portfolio. Thus, ERA allows the integration of environmental data into risk management and asset allocation processes.

It is possible to mitigate environmental risks and to incorporate investment opportunities through asset, region, sector and sub-asset class allocation (PRI, 2019). ERM by investors though SAA may include, for example, increasing asset allocation to climate-sensitive assets as a climate "hedge", as well as using sustainability themed indices in passive portfolios (Mercer, 2011). According to CISL (2015), "short-term shifts in market sentiment induced by awareness of future climate risks could lead to economic shocks and losses of up to 45 per cent in an equity investment portfolio value (23 per cent loss for fixed income portfolio)". Also, "around half (53 per cent) of this decline is "hedgeable" if investments are reallocated effectively, but the other half (47 per cent) is "unhedgeable," meaning investors and asset owners are exposed unless some system-wide action is taken to address the risks".

For climate hedge, industry-sector impacts are expected to be the most significant (e.g., energy—with expressive losses in coal and gains in renewables) and asset class returns impacts could also be material. According to Mercer (2015), a 2°C scenario could imply

in better returns to emerging market equities, infrastructure, real estate, timber and agriculture. On the other hand, negative impact is expected in a 4°C scenario.

According to Mercer (2015), in the case that more stringent policy is implemented, it is expected that substantial capital would be made available to assist emerging market countries with respect to adaptation in farming methods. Also, they expect agriculture investments to benefit from technological development towards more productive and resilient crop varieties. However, agriculture is the asset class that is most negatively sensitive to resource availability, which in turn is related to long-term shifts in regional weather patterns and water stress. Finally, over 35 years, timber and agriculture were among the asset classes that have the potential for the largest additional returns or reduction in returns (Mercer, 2015).

In a risk–return analysis at the asset or portfolio level, collinearity and diversification issues should be taken into consideration at the portfolio level and across various risk profiles to reduce negative impacts. Besides the tragedy of horizons, the integration of ERA-ERM and SAA has an additional challenge, since there is no guarantee that historical correlations will work on a scenario with an environment impact. However, the investor cannot simply disregard historical information. The integration of ERA-ERM and SAA should analyze environmental factors and optimize risks and opportunities, taking into consideration both problems: the tragedy of horizons and the weaknesses and strengths of historical data. The integration of ERA into the SAA process may lead to a rebalance of investments among asset classes in a way that environment risks are considered in the investments scenarios.

It is critical for each CB to assess the level of reliability required for ERA outputs as SAA input, considering the economic objective of the reserves. One can then decide to calibrate which asset class is best suited to the investment pillars (safety, liquidity, return, or even sustainability), given the objective of each portfolio and CB in managing IRs (Fender et al, 2019).

Some SAA impacts are related to Sustainable Responsible Investing (SRI) strategies in policy/IR portfolios, which include ESG financial (risk–return) and nonfinancial (positive impact) objectives (NGFS, 2020e). ERA may be part of this as financial input in the environmental risk management process, which in turn produces input on the SAA process. “Protecting portfolios against sustainability risks” and “enhancing risk–return profile” are among the four main reasons CBs adopt SRI investment strategies, along with “mitigate reputational risk” and “set a good example” (NGFS, 2020e, p.9).

SAA is one of the possible elements of an ESG integration investment strategy (CFA UK, 2020b). In policy portfolios, there is an indication that ESG integration (including financially material ESG criteria in the investment analysis to improve the risk–return profile of the portfolio) has been considered for sovereign, supranational, and agency (SSA) bonds by four CBs, for corporate bonds by two CBs, and for equities by one CB (NGFS, 2020e).

The most prominent sustainable investment strategies adopted by CBs are green bond investments, negative screening, and ESG integration (NGFS, 2020e), which give us some information about SAA, but are not necessarily a consequence of an ERA. The NGFS survey also indicates that many CBs hold green SSA as well as corporate and covered bonds in their policy portfolios. Thus, it is not clear if the investment strategy of holding these green bonds is a result of a risk–return analysis, including ERA. Impact investment could be a reason, but it does not appear in the survey as a relevant investment strategy.

According to NGFS (2021), the selected stylized options for adjusting operational frameworks to climate-related risks, in asset purchases, include tilt purchases and negative screening. Tilt purchases means to skew asset purchases according to climate-related risks and/or criteria applied at the issuer or asset level, while negative screening exclude some assets or issuers from purchases if they fail to meet climate-related criteria.

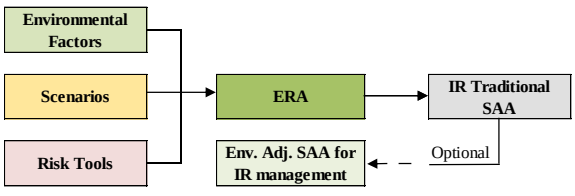
As case study, the Swedish CB divested from bonds issued by the Canadian province of Alberta and the Australian states of Queensland and Western Australia due to the large climate footprint of these issuers (Sveriges Riksbank, 2019). The main motivation behind the bank´s deputy governor's speech was a positive impact action, but this did not jeopardize eventual ERA considerations. As demonstrated by Battiston and Monasterolo (2019), sovereign bonds' portfolio alignment to a credible 2ºC trajectory can strengthen the sovereign fiscal and financial position by decreasing the climate spread, while a misalignment with a 2°C trajectory can increase it, with financial risk implications for its investors.

Finally, as Volz et al (2020) stated, CBs "need to understand their exposures to other countries' sovereign risks arising from climate change if they hold those countries' government bonds" (p. 40). Thus, ERA is critical to the SAA of IRs as IRs are mainly invested in SAA bonds, which are highly exposed to sovereign risks (Volz et al, 2020), and which are also highly impacted by climatic and other environmental factors.

2.4 Environmentally adjusted SAA framework for IR management

The environmental risks to which IRs are exposed need to be assessed to enable a proper risk management process, including eventual changes in the SAA to allow the achievement of the CB's objectives. For this purpose, a multicriteria analytical framework was developed for the evaluation of these environmental risks and incorporation in the risk management process with outputs to the IR's SAA, as outlined in figure 4:

Figure 4 - Multicriteria analytical framework for the ERA and SAA of IR management.



Source: prepared by Torinelli&SilvaJr (2021).

The output of the ERA may provide new information to the SAA framework of IRs (figure 5). **It will be considered alongside the IR's economic objectives and investment guidelines. Thus, the ERA output will be incorporated on top of other main concerns of the IR managers** as environmental risk management is not the primary concern of the IR managers. The primary concern is to adequately address the reasons that motivate the IR's existence (which may vary from CB to CB).

Hence, environmental risk exposure will be considered jointly with the concerns for currency, asset type, countercyclicality (for crisis mitigation) and the relevance of each of the three IR investment pillars: security, liquidity, and profitability. The relevance of each of the investment pillars depends on the strategic objectives of each IR manager, which ultimately reflect the reasons for which the reserves are being maintained. For example, Sovereign Wealth Funds (SWFs) can prioritize profitability instead of liquidity, while emerging countries may need to give more weight to liquidity and security. This also depends on the objective of each specific portfolio, given that the same investor can prioritize different pillars in different portfolios.

Based on the analysis of the ERA outputs considered in the traditional IR SAA framework, CBs can evaluate the adequacy to adjust the **framework to include the environmental factor as a fourth pillar of IR management objectives, what may possibly generate diversification benefits and improve risk-adjusted returns.**

Figure 5 - Environmentally adjusted SAA framework for IR management.

IR economic objectives (Fender et al, 2019)	Investment Guidelines	Four pillars of investment:	IRs focus (main exposure):	SAA model approaches:	Concern for crises mitigation:
Intervention in the FX markets; Execution of payments for goods and services; Execution of payments for the government; Granting of emergency liquidity assistance; Support of domestic monetary policy; Underpinning of investor confidence in the country; Investment of excess reserves	Investment Policy; Investment Strategy; Investment Driver; Investment Objectives	Enviromental Sustainability Profitability Liquidity Security	**Asset:** mainly Treasury Bonds, Supranationals, Sovereign Eurobonds, US Agencies, Inflation Protected Bonds, Corporates, MBS/ABS, Covered Bonds, Banks Debt and Green Bonds. **Currency:** mainly USD, EUR, CNY, JPY, GBP.	Mean-variance optimization (MVO), Factor risk allocation, Total Portfolio Analysis, Dynamic asset allocation, Liability driven asset allocation and Regime Switching	Countercyclicality

Source: Torinelli&SilvaJr (2021), based on Fender et al (2019) and other references.

In the above context, environmental risk and opportunities are considered without undermining the perspectives of other CBs. To better clarify, the purpose of an ERA is to quantify the financial risk exposure related to environmental factors in an IR's assets and portfolios. The purpose of SAA is to identify the best risk-return profile for IR allocation according to IR objectives (liquidity, safety, return). The combined assessment of financial and environmental risks as an input on the SAA may guide an asset allocation for IR which is sound from these two risk viewpoints. The decision is supported by the CB's risk tolerance and appetite.

Traditional SAA is adjusted to incorporate environmental considerations alongside the traditional investment guidance of IRs as asset classes, currencies, issuers, regions or countries, asset maturity, liquidity (bid-ask spread, turnover), and market depth (outstanding). On the top of that, specific environmental variables would be included to achieve an efficient investment portfolio, which may require a multi-objective

optimization. **This investment guidance may direct the partial allocation of the IRs in green assets or indicate a rebalancing among existing assets. Thus, the ERA could measure risks and contribute to reweighting in SAA without necessarily implying any green strategy**. Although, there is growing pressure to net-zero CBs (Robins, Dikau and Volz, 2021), what is strongly associated to positive impact strategies.

The practical possible ERA impacts on IR´s SAA would be: 1) Inclusion of new asset alternatives, as 1.1) Inclusion of Green Asset Classes (e.g.: Green Bonds, Green Funds, Green Indexes in passive portfolios etc.); and 1.2) Inclusion of other asset alternatives, as unlisted funds, if appropriate for the environmentally adjusted SAA framework; 2) Rebalance among existing asset classes, regions/countries, sectors and sub asset classes, as 2.1) Divestments from high carbon footprint and/or high temperature alternatives; 2.2) Investments to explore opportunities towards lower carbon footprint and/or lower temperature; and 2.3) Migration to assets less correlated with the environmental risks to be mitigated; and/or 3) Inclusion of environmental risk management considerations in the selection of asset managers, fund managers and companies.

3 The methodology

This study is based on a sample of ten LatAm CBs. The focus in LatAm is based on the relevance of environmental physical and transition risks to the region and the relevance of IRs to regional monetary and foreign exchange policies by CBs. The analysis was also part of a common project with CEMLA, the Center for Latin American Monetary Studies.

For the analysis, the sample of ten LatAm countries was selected based on the criteria of GDP higher than US$50 billion for YE2019 and/or percentage of IR on GDP of 10% or more. Ecuador and Panama were excluded due to due to lower IRs/GDP (0% and 5%, respectively) and lower IR amount (US$0.29 and US$3.42 billions).

Thus, the selected countries are: México, Brazil, Argentina, Colombia, Chile, Peru, Jamaica, Costa Rica, Guatemala and Dominican Republic.

Economic data from the respective countries were gathered in the World Bank public database. IR figures were collected in the public reports of the related CBs. Horizontal and vertical analysis were performed.

Meetings organized by CEMLA were held on Feb2021 to discuss the framework with representants of four out of ten CBs. One of the four CBs answered a detailed questionnaire (see Appendix 1), and a second meeting was held in May2021 to analyze the application of the framework according to its perception and to its reality. The results are detailed in the following section.

4 Results and discussion

A specific exercise was performed with LatAm CBs in the sample detailed on figure 6. LatAm IRs for the selected sample totaled US$782.4 billion in 2019, representing 17%

of the national GDP and 84% of total annual merchandise exports. Food & agriculture represented 23% of exports, fuel accounted for 9% and ores represented other 8%.

According to the Assessing Reserve Adequacy (ARA) metrics of the International Monetary Fund (IMF, 2020), 5% to 7,5% of total exports should be covered by IR assets allocated to hedge sudden stops in capital flows. In the LatAm case, this would account for US$46.50 to US$69.76 billion. Thus, considering the 5% totaling US$46.50 billion, the portion to hedge for food & agriculture on total exports would account for US$10.83 billion (23.29%), US$4.17 billion (9%) for fuel and US$3.53 billion for ores & metals.

Figure 6- Applied framework discussion for the analyzed LatAm CBs.

US$ billion in 2019	Mexico	Brazil	Peru	Colombia	Argentina	Chile	Guatemala	Costa Rica	Dominican Republic	Jamaica	Total
IR	183,06	356,89	67,71	52,65	45,22	40,66	14,78	8,94	8,87	3,63	782,40
GDP	1.258,30	1.839,80	226,80	323,80	449,70	282,30	76,70	61,80	88,90	16,50	4.624,60
% IRs/GDP	15%	19%	30%	16%	10%	14%	19%	14%	9,98%	22%	17%
Total merchandise exports	461,12	222,64	47,77	39,46	65,12	69,68	11,19	11,80	1,14	0,17	930,08
% IRs/Exports	40%	160%	142%	133%	69%	58%	132%	76%	781%	2201%	84%
Food & agriculture raw material exports	35,51	88,83	11,23	7,38	39,98	22,58	5,71	5,09	0,33	0,04	216,66
% food & agriculture on total exports	8%	40%	24%	19%	61%	32%	51%	43%	29%	23%	23%
Fuel exports	24,44	30,50	3,30	21,58	2,41	0,63	0,51	0,00	0,00	0,03	83,41
% fuel on total exports	5%	14%	7%	55%	4%	1%	5%	0%	0%	19%	9%
Ores & Metals	8,30	2,89	21,73	0,39	0,33	36,65	0,09	0,17	0,02	0,09	70,67
% ores & metals on total exports	2%	1%	46%	1%	1%	53%	1%	1%	2%	55%	8%
Manufactures exports	354,60	74,36	4,54	8,33	11,33	9,83	4,88	6,54	0,79	0,01	475,19
% manufactures on total exports	77%	33%	10%	21%	17%	14%	44%	55%	69%	3%	51%
Total merchandise imports	467,34	184,10	42,26	52,70	49,12	69,59	19,88	16,15	20,49	6,41	928,06
% IRs/Imports	39%	194%	160%	100%	92%	58%	74%	55%	43%	57%	84%
Food & agriculture raw material imports	25,70	12,70	5,41	7,11	3,68	7,52	3,44	2,26	3,40	1,22	72,45
% food & agriculture on total imports	6%	7%	13%	14%	8%	11%	17%	14%	17%	19%	8%
Fuel imports	39,26	25,96	6,76	3,64	4,22	11,34	3,28	1,63	3,40	1,69	101,18
% fuel on total imports	8%	14%	16%	7%	9%	16%	17%	10%	17%	26%	11%
Ores & Metals	8,88	6,44	0,51	0,90	1,23	0,90	0,24	0,31	0,20	0,02	19,63
% ores & metals on total imports	2%	4%	1%	2%	3%	1%	1%	2%	1%	0%	2%
Manufactures imports	346,30	139,00	29,58	40,58	39,40	49,90	12,88	11,95	13,49	3,48	686,56
% manufactures on total imports	74%	76%	70%	77%	80%	72%	65%	74%	66%	54%	74%
% IR assets allocated to hedge sudden stops in capital flows (ARA*)	**5%**	**5%**	**5%**	**5%**	**5%**	**5%**	**5%**	**5%**	**5%**	**5%**	**5%**
Total IR assets allocated to hedge of the external liabilities related to exports	23,06	11,13	2,39	1,97	3,26	3,48	0,56	0,59	0,06	0,01	46,50
Hedge for food & agriculture on total exports (e.g.: 40% BR)	**1,78**	**4,44**	**0,56**	**0,37**	**2,00**	**1,13**	**0,29**	**0,25**	**0,02**	**0,00**	**10,83**
Hedge for fuel on total exports (e.g.: 14% BR)	1,22	1,53	0,16	1,08	0,12	0,03	0,03	-	0,00	0,00	4,17
Hedge for ores & metals on total exports	0,42	0,14	1,09	0,02	0,02	1,83	0,00	0,01	0,00	0,00	3,53
Hedge for manufactures exports	17,73	3,72	0,23	0,42	0,57	0,49	0,24	0,33	0,04	0,00	23,76
%Hedge for food & agriculture / IRs	1,0%	1,2%	0,8%	0,7%	4,4%	2,8%	1,9%	2,8%	0,2%	0,1%	1,4%
%Hedge for fuel / IRs	0,7%	0,4%	0,2%	2,0%	0,3%	0,1%	0,2%	0,0%	0,0%	0,0%	0,5%
%Hedge for ores & metals / IRs	0,2%	0,0%	1,6%	0,0%	0,0%	4,5%	0,0%	0,1%	0,0%	0,1%	0,5%
%Hedge for manufactures / IRs	9,7%	1,0%	0,3%	0,8%	1,3%	1,2%	1,6%	3,7%	0,4%	0,0%	3,0%

* ARA: Assessing Reserve Adequacy - International Monetary Fund (IMF)

Source: prepared by the authors based on data from World Bank (2021)

The sectors of food & agriculture, fuel and ores & metals are significantly exposed to environmental risks, including the physical and transition climate ones. This exposure has implications on exports, capital flows and, in this perspective, an indirect impact on IRs. The IRs would be affected in its economic objectives of the execution of payments, intervention in forex markets and underpinning investors' confidence in the country.

In an ERA for the IRs of the LatAm sample the economic sectors on spot would be food & agriculture, fuel and ores & metals. The environmental factors could be climatic transition (avoidance of GHG emissions), in policy, technology & sentiment/ reputational dimensions, besides the physical climatic impacts (temperature and precipitation, with extreme events).

The relevant scenarios may contemplate *climate-change transition risk* and *climate-change physical risk,* considering NGFS climate scenarios for central banks and supervisors (2020a), for example. The related environmental risks, with potential financial impacts in some specific time horizons, could be increased GHG emission costs, stranded-assets due to changes in policy and technology towards a more sustainable economy, as well as crop breaks due to physical climate changes.

Some expected asset-price movements in crisis scenarios would reduce country exports and have an impact on the foreign exchange rate. The impacts could also be related to stranded-assets in the O&G sector; appreciation of clean energy assets; variation in ores & metals demand due to technological changes and the transition to a low-carbon economy, as well as potential decrease in water availability and increase in energy and operational costs; increase in the price of commodities due to crop breaks; decrease on non-regenerative agriculture average asset prices; stranded-assets related to policy and regulation changes towards biodiversity conservation (e.g.: reduction in the legal deforestation zone on agricultural lands); etc. The SAA exercise may consider portfolios for the investment of the IRs that are more resilient to these scenarios.

The IRs allocation in currencies and asset classes for year end 2019 (YE2019) are detailed in figure 7:

Figure 7- IRs allocation in currencies and asset classes for YE2019.

IRs in US$ billion on 2019	BRAZIL		MEXICO		CHILE		COSTA RICA		JAMAICA		COLOMBIA		PERU		ARGENTINA		GUATEMALA		DOMINICAN REPUBLIC	
Currencies	356,89	100%	183,06	100%	40,66	100%	8,94	100%	3,63	100%	52,65	100%	67,71	100%	44,88	100%	14,78	100%	8,87	100%
U.S. dollar	309,67	87%	169,99	93%	21,05	52%	8,67	97%	3,32	92%	0,00	0%	58,91	87%	0,00	0%	0,00	0%	0,00	0%
Euro	26,23	7%	-0,11	0%	4,01	10%	0,04	1%	0,02	1%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
Pound Sterling	7,53	2%	0,23	0%	0,00	0%	0,00	0%	0,02	1%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
Japanese Yen	6,17	2%	1,19	1%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
Canadian Dollar	0,00	0%	1,47	1%	3,13	8%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
Australian Dollar	0,00	0%	0,89	0%	3,26	8%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
SDR	0,00	0%	2,73	1%	0,00	0%	0,00	0%	0,24	7%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
Singapore Dollar	0,00	0%	1,91	1%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
New Zeeland Dollar	0,00	0%	1,47	1%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
Offshore Chinese Yuan	0,00	0%	1,32	1%	0,00	0%	0,00	0%	0,02	1%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
Swiss Franc	0,00	0%	0,03	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
Other currencies	3,93	1%	0,73	0%	9,21	23%	0,13	1%	0,01	0%	0,00	0%	6,09	9%	0,00	0%	0,00	0%	0,00	0%
Gold	3,35	1%	1,22	1%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	2,71	4%	0,00	0%	0,00	0%	0,00	0%
Asset Class	356,89	100%	183,06	100%	40,66	100%	8,94	100%	3,63	100%	52,65	100%	67,71	100%	44,88	100%	14,78	100%	8,87	100%
Sovereigns	324,99	91%	0,00	0%	0,00	0%	2,77	31%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	7,31	49%	0,00	0%
Agencies	6,20	2%	0,00	0%	0,00	0%	2,23	25%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	2,42	16%	0,00	0%
Supranational	2,99	1%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,78	5%	0,00	0%
Supranationals deposits	5,70	2%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
Multilateral Entities	0,00	0%	0,00	0%	0,00	0%	0,80	9%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
Deposit in banks and currency	1,42	0%	84,30	46%	0,00	0%	2,77	31%	0,00	0%	3,07	6%	18,82	28%	36,47	81%	2,06	14%	8,65	98%
Interest bearing notes	0,00	0%	53,17	29%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
Capital Market Investments and Securities	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,32	9%	47,44	90%	46,04	68%	1,22	3%	0,00	0%	0,00	0%
Discounted instruments	0,00	0%	35,01	19%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
IMF position (Reserve Tranche, Loans)	7,54	2%	2,74	1%	0,00	0%	0,00	0%	0,00	0%	0,56	1%	1,72	3%	0,37	1%	0,00	0%	0,09	1%
Gold (and local sovereign bonds for Brazil)	3,90	1%	5,92	3%	0,00	0%	0,00	0%	0,00	0%	0,68	1%	1,69	3%	2,68	6%	0,00	0%	0,03	0%
Special Drawing Rights (SDRs)	0,00	0%	3,93	2%	0,00	0%	0,00	0%	0,27	8%	0,88	2%	0,00	0%	2,60	6%	0,00	0%	0,00	0%
Stock Indices	3,62	1%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
US MBS	0,52	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	1,53	10%	0,00	0%
Liquidity Tranche	0,00	0%	0,00	0%	0,00	0%	0,00	0%	2,03	56%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
External Funds	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,70	19%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
Emerging Latin Americans	0,00	0%	0,00	0%	0,00	0%	0,36	4%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
Working Capital Tranche	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,32	9%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
Interest Receivable from Foreign Entities an	0,00	0%	0,09	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
Deposits received with maturities of less tha	0,00	0%	-2,16	-1%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%	0,00	0%
Other	0,00	0%	0,05	0%	0,00	0%	0,00	0%	0,00	0%	0,01	0%	-0,56	-1%	1,54	3%	0,68	5%	0,10	1%

Source: prepared by the authors based on the respective IRs reports from each CB.

A hedge strategy to ERA-related asset price movements is applicable, considering also other traditional SAA relevant data, as IR economic objectives, investment guidelines and investment pillars. **An alternative to some CBs of the LatAm sample could be to migrate to assets less correlated with agricultural, metals & mining and oil commodities, as example of relevant scenario to be mitigated. Commodity indices could be considered.**

Also, the SAA could drive the choice of currencies in the portfolio to those currencies that are less correlated to the specific LatAm economic exposure or foreign exchange rate exposure, for each country, in the relevant scenarios, to avoid procyclicality. The ERA analysis helps to quantify the size of the impact on the economy and the dimension of this impact in the investments of IRs. Furthermore, the choice of asset classes could consider those related to clean energy. **The choice of the currency is easier from a traditional perspective. On the other hand, the choice of asset classes is more difficult due to liquidity issues, since green asset classes eligible to CBs are traditionally agencies, supranationals, and some issuers of sovereigns. However, it**

would be possible to search for small amounts of investments in these kinds of asset classes.

4.1 Results per country

For Jamaica, IRs totaled US$3.63 billion in 2019, representing 22% of the national GDP and 2201% of total annual merchandise exports.Thus, exports would not be as relevant in the discussion of the ERA for the IRs, as detailed in figure 8. However, ERA analysis is strongly recommended since Jamaica is the third worldwide country at high economic risk from multiple hazards (World Bank, 2010). Jamaica is located in a "hurricane alley", also with geophysical hazards. Tropical storms and floods join the hurricanes among the disasters that have had the greatest impact in Jamaica. Between 1980 and 2008, Jamaica suffered 27 natural disaster events, with total economic damages around US$2.6 billion. In this context, as hypotheses to be tested, an ERA-IRs-SAA strategy could focus on hedge for variances on the local currency, with assets less correlated or negatively correlated to JMD, the Jamaican dollar, and/or with lower exposure to common physical climate risks (e.g.: different geographical area and condition).

Dominican Republic is in a similar condition, as Jamaica. IRs totaled US$8.87 billion in 2019, representing 10% of the national GDP and 781% of total annual merchandise exports. Although exports are not expressive in relation to IRs volume, ERA analysis is strongly recommended since the country is the second worldwide country at high economic risk from multiple hazards (World Bank, 2010).

For Mexico, based on total manufactures exports, 85% of sales are to USA. Manufactures are 78% Machinery/transport equipment, 33% road vehicles, 13% electrical equipment, 9% Office/data proc machines, 9% Telecoms equipment, 6% Industrial equipment and 8% Others.

In an ERA-SAA integration analysis for IRs, environmental factors could be ecosystemic physical risk (e.g: industrial water scarcity), as well as technological (e.g.: electric vehicles) and policy transition risk (e.g.: regulation towards CO2 emissions). Key economic sectors would be industry (road vehicles, electrical&telecom equip., office/dat proc machines). Scenarios could include water future availability and NGFS climate scenarios for central banks and supervisors. Environmental risks with financial impacts include increased water costs (or even unavailability) and increased CO2 emission costs.

For Costa Rica, based on total manufactures exports, 42% of sales are to USA, 6% Netherlands, 6% Belgium, 5% Guatemala, 5% Panama and 4% Nicaragua. Manufactures are 23% Fruits & Vegetables, 23% Medical instruments, 8% Chemicals and related products, 7% Machinery (mainly electrical) and 6% Orthopedic appliances.

In an ERA-SAA integration analysis for IRs, environmental factors could be ecosystemic physical risk (e.g: industrial water/energy scarcity and extreme weather events) and policy transition risk (e.g.: regulation towards CO2 emissions). Key economic sectors are fruits; medical instruments; chemicals and related products; machinery (mainly electrical); and orthopedic appliances. Scenarios could include water future availability

and NGFS climate scenarios for central banks and supervisors. Environmental risks with financial impacts include increased water costs (or even unavailability), increased CO2 emission costs and crop break due to physical climate impact.

For Chile, based on total merchandise exports, sales are 32% to China; 14% USA; 9% Japan; 7% Canada; 7% Korea; 5% Brazil. The merchandises are 48% Copper, 11% vegetables & fruits, 9% fish & similar.

In an ERA-SAA integration analysis for IRs, environmental factors could be transition- future copper demand (metals for renewable energy); ecosystemic physical risk (e.g.: industrial water/energy scarcity and extreme weather events); policy transition risk (e.g.: regulation towards CO2 emissions and sustainable mining). Key economic sectors are copper, fruits and fish. Scenarios could include water future availability and NGFS climate scenarios for central banks and supervisors. Environmental risks with financial impacts could include transition- higher cooper prices due to higher demand based on electronics, electric vehicles (EVs), renewable energy sources and energy efficiency; increased water costs (or even unavailability), increased CO2 emission costs, with impacts on energy prices, breaks in cooper production due to extreme weather events (e.g.: quakes), with impacts on cooper volumes and prices; crop and fish break due to physical climate impact, with impacts on fruits & fish volumes and prices etc.

For Brazil, IRs totaled US$356.89 billion in 2019, representing 19% of the national GDP and 160% of total annual merchandise exports. Food & agriculture represented 40% of exports and fuel accounted for other 14% (11% crude oil). According to the Assessing Reserve Adequacy (ARA) metrics of the International Monetary Fund (IMF, 2020), 5% of total exports should be covered by IR assets allocated to hedge sudden stops in capital flows. In the Brazilian case, this would account for US$11.13 billion. Thus, 40% hedge for food & agriculture on total exports would accounts for US$4.44 billion (1,2% of IRs) and 14% hedge for fuel on total exports totaling US$1,53 billion (0,4% of IRs). Environmental risks have direct impact on exports, capital flows and, in this perspective, indirect impact on IRs, considering the economic objectives of execution of payments, besides intervention in forex markets. In an ERA for the SAA of the IRs, the environmental factors would be mainly food & agriculture and energy. The related environmental risks, with financial percentage impacts in some specific time horizons could be “increased CO2 emission cost” as well as “crop break due to physical climate impacts”. Some expected asset price movements due to the crises scenarios would reduce country exports and would have impact in the foreign exchange rate.

In all cases, SAA could focus on hedge to ERA-related asset price movements as detailed in figure 8, considering also other traditional SAA relevant data (e.g.: IR economic objectives; investment guidelines and investment pillars).

Figure 8- ERA- IRs- SAA: focus to be considered for hedge purposes.

US$ billion in 2019	Mexico	Brazil	Peru	Colombia	Argentina	Chile	Guatemala	Costa Rica	Dominican Republic	Jamaica	Total
IR	183,06	356,89	67,71	52,65	45,22	40,66	14,78	8,94	8,87	3,63	782,40
GDP	1.258,30	1.839,80	226,80	323,80	449,70	282,30	76,70	61,80	88,90	16,50	
% IRs/GDP	15%	19%	30%	16%	10%	14%	19%	14%	10%	22%	
Total merchandise exports	461,12	222,64	47,77	39,46	65,12	69,68	11,19	11,80	1,14	0,17	930,08
% IRs/Exports	40%	160%	142%	133%	69%	58%	132%	76%	781%	2201%	
% IR assets allocated to hedge sudden stops in capital flows (ARA*)	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Total IR assets allocated to hedge of the external liabilities related to exports	23,06	11,13	2,39	1,97	3,26	3,48	0,56	0,59	0,06	0,01	46,50
Hedge for food & agriculture on total exports (e.g.: 40% BR)	1,78	4,44	0,56	0,37	2,00	1,13	0,29	0,25	0,02	0,00	10,83
Hedge for fuel on total exports (e.g.: 14% BR)	1,22	1,53	0,16	1,08	0,12	0,03	0,03	-	0,00	0,00	4,17
Hedge for ores & metals on total exports	0,42	0,14	1,09	0,02	0,02	1,83	0,00	0,01	0,00	0,00	3,53
Hedge for manufactures exports	17,73	3,72	0,23	0,42	0,57	0,49	0,24	0,33	0,04	0,00	23,76
%Hedge for food & agriculture / IRs	**1,0%**	**1,2%**	**0,8%**	**0,7%**	**4,4%**	**2,8%**	**1,9%**	**2,8%**	0,2%	0,1%	1,4%
%Hedge for fuel / IRs	**0,7%**	**0,4%**	**0,2%**	**2,0%**	**0,3%**	**0,1%**	**0,2%**	**0,0%**	0,0%	0,0%	0,5%
%Hedge for ores & metals / IRs	**0,2%**	**0,0%**	**1,6%**	**0,0%**	**0,0%**	**4,5%**	**0,0%**	**0,1%**	0,0%	0,1%	0,5%
%Hedge for manufactures / IRs	**9,7%**	**1,0%**	**0,3%**	**0,8%**	**1,3%**	**1,2%**	**1,6%**	**3,7%**	0,4%	0,0%	3,0%
ERA- IR- SAA: focus to be considered for hedge purposes											
Exports/Commodities	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	
Currency	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	

Source: prepared by the authors based on data from World Bank (2021).

5 Conclusion

This study discussed the specific environmental risk exposures of ten LatAm CBs and respective IRs, including hedge alternatives. The study is relevant to the LatAm construction of the investment portfolio of the IRs. It takes into consideration the national exposures, the economic objectives of the IRs and the different angles that must be contemplated in the allocation of the investment portfolio among countries and instruments.

The framework herein discussed includes environmental risk analysis (ERA) in the traditional SAA approach of IRs. As result, the ERM can be performed. The main argument is that ERA should be included in the traditional approach for SAA by CBs due to the relevance of environmental risks to which the IR are exposed. In this LatAm sample, commodities are in focus due to IRs economic objectives. The environmental risk exposures on food & agriculture, fuel and ores & metal sectors are identified, besides relevant exposures to physical climate risks in both countries located in Caribbean.

For IRs management, each viable portfolio should also be evaluated based on an environment risk analysis. A hedge strategy to ERA-related asset price movements is applicable, considering also other traditional SAA relevant data, as IR economic objectives, investment guidelines and investment pillars. An alternative to some CBs of the LatAm sample could be to migrate to assets less correlated with commodities and currencies, as example of relevant scenario to be mitigated.

This study only addresses the Environmental aspects of the ESG factors. Further studies could focus on social and governance factors under the management perspective of IR. Also, besides the initial meetings with the sample of LatAm CBs, only one of them answered the questionnaire, what limits the applicable discussion of the framework. Next article of these authors will focus on the risk/return analysis of the applied framework, with specific asset alternatives and portfolios.

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Appendix 1- Questionnaire

Framework validation questionnaire: Environmental Risk Analysis (ERA) in the Strategic Asset Allocation (SAA) of the International Reserves (IRs) managed by CBs (CBs).

Link w/ Torinelli&SilvaJr Framework

For questions of group 1 (environemntal factors) and 4 (SAA), please consider the scale 1 to 7, where 1 means lower and 7 means higher. Please use 8 if you do not feel confortable to express an opinion. Please also sign de direction of the impact, if Positive (P) or Negative (N). Probability of ocurrence will reflet exposure in time (e.g.: one incident in 10 years). Impact of the ocurrence will reflect the size of the expected event.

1 Environmental factors

1,1 Environmental physical factors

1.1.1 Environmental physical climatic factors

1.1.1

In your personal understanding, how exposed to the following physical climatic factors is/are

	the economy of your country?			the exports and imports of your country?			the IRs of your country?		
	Probability of ocurrence	Impact of ocurrence	(P) or (N) impact	Probability of ocurrence	Impact of ocurrence	(P) or (N) impact	Probability of ocurrence	Impact of ocurrence	(P) or (N) impact
1.1.1.1 CO_2 levels;									
1.1.1.2 Global temperature;									
1.1.1.3 Global precipitation;									
1.1.1.4 Ice level and snow cover;									
1.1.1.5 Ocean temperature, level and ph.									

1.1.2 Environmental physical geologic factors

In your personal understanding, how exposed to the radiative forcing, which is the difference between the sunlight aborved by the Earth and the energy radiated back to space (the scientific basis for the greenhouse effect), is/are

	the economy of your country?			the exports of your country?			the IRs of your country?		
	Probability of ocurrence	Impact of ocurrence	(P) or (N) impact	Probability of ocurrence	Impact of ocurrence	(P) or (N) impact	Probability of ocurrence	Impact of ocurrence	(P) or (N) impact
1.1.2.1 Radiative forcing;									

1.1.3 Environmental physical ecosystemic factors

In your personal understanding, how exposed to the following physical ecosystemic factors is/are

	the economy of your country?			the exports of your country?			the IRs of your country?		
	Probability of ocurrence	Impact of ocurrence	(P) or (N) impact	Probability of ocurrence	Impact of ocurrence	(P) or (N) impact	Probability of ocurrence	Impact of ocurrence	(P) or (N) impact
1.1.3.1 Biodiversity;									
1.1.3.2 Resource usage;									
1.1.3.3 Ecosystem services.									

1,2 Environmental transition factors

In your personal understanding, how exposed to the following enviromental transition factors is/are

	the economy of your country?			the exports of your country?			the IRs of your country?		
	Probability of ocurrence	Impact of ocurrence	(P) or (N) impact	Probability of ocurrence	Impact of ocurrence	(P) or (N) impact	Probability of ocurrence	Impact of ocurrence	(P) or (N) impact
1.2.1 Policy and legal;									
1.2.2 Technology;									
1.2.3 Sentiment/Reputation;									

1,3 Environmental physical and transition factors

1.3.1 In your personal understanding, how exposed to the environmental physical and transition factors is the economy of your country? What are the main sectors at risk?

1.3.2 In your personal understanding, how exposed to the environmental physical and transition factors are the exports of your country? What are the main sectors at risk?

1.3.3 In your personal understanding, how exposed to the environmental physical and transition factors is the IR portfolio of your country? What is the main exposure: currency, country, instrument?

1.3.4 In your opinion, is the IR of your country exposed to the environmental risks or to the global actions taken in order to mitigate and to adapt to the environmental risks (e.g.: changes in the energy matrix with impact in the national economies)? Why/How?

1.3.5 In your opinion, which instruments and measures may mitigate the exposure of the IRs management to the environmental risks?

2 Assessment of environmental risk in time

1.1.2

	Yes	No
2.1 In the context of the IR management, does the CB you represent feed, monitor or query any historical database of environmentally related events with financial impacts? If yes, could you detail it? Thank you!		
2.2 In the context of the IR management, does the CB you represent assess environmental risk exposure in time?		

	Scenario Analysis	Stress Test
2.2.1 If Yes was the answer to question 2.2, how do you assess the environmental risk exposure of the IRs portfolios in time? If "scenario analysis" or "stress test" are used, please detail which scenarios are considered. If "other technique" is used, please detail it.		

2.2.2 If Yes was the answer to question 2.2, which risk metrics do you consider in your analysis (e.g.: Weighted Average Carbon Intensity; Total Carbon Emissions; Carbon Footprint; Carbon Intensity; Exposure to Carbon Related Assets; Decline in revenues; Increase in costs; Impact on exports etc)?

3 Translation of environmental exposures into measured financial risks

1.1.3

3.1 Business Risk

In the management of IRs, do you translate enviromental fators into business risk? If yes, how?

3.2 Market Risk

In the management of IRs, do you translate enviromental fators into market risk? If yes, how?

3.3 Credit Risk

In the management of IRs, do you translate enviromental fators into credit risk? If yes, how?

3.4 Systemic Risk

In the management of IRs, do you translate enviromental fators into systemic risk? If yes, how?

3.5 ERA methodology - Investment Portfolio

3.5.1 Do you consider any methodology for evaluating environmental risk exposure in an investment portfolio? If so, which one? If not, why?

3.5.2 Do you use or know any methodology for contemplating environmental risk in choosing an efficient investment portfolio (eg: multi-objective optimization)? What methodology?

1,2

4 International Reserves (IRs) & Strategic Asset Allocation (SAA)

4.1 What are the economic objectives of the IRs managed by the CB you represent?

4.2 What are the investment guidelines of the IRs managed by the CB you represent?

4.3 What is the character of the IRs management in the CB you represent? E.g: priorities among the three pillars of investment (profitability, liquidity,safety); counterciclicality and market neutrality concerns etc.

4.4 What are the top 5 asset classes of the IRs portfolios in the CB you represent, and which is the percentage allocated in each of them?

4.5 What are the top 5 currencies of the IRs portfolios in the CB you represent, and which is the percentage allocated in each of them?

4.6 What are the SAA model approaches used for IR management by the CB you represent?

2 & 3

5 Environmental Risk Analysis (ERA) & SAA

5.1 Economic objectives

In your perspective, how exposed to environmental risks are the following typical IR economic objectives?

	Probability of ocurrence	Impact of ocurrence	(P) or (N) impact
5.1.1 Intervention in the FX markets;			
5.1.2 Execution of payments for goods and services;			
5.1.3 Execution of payments for the government;			
5.1.4 Granting of emergency liquidity assistance;			
5.1.5 Support of domestic monetary policy;			
5.1.6 Underpinning of investor confidence in the country;			
5.1.7 Investment of excess reserves.			

5.2 Assets

In your perspective, how exposed to environmental risks are your IRs portfolios due to the following asset classes?

	Probability of ocurrence	Impact of ocurrence	(P) or (N) impact
5.2.1 Treasury Bonds;			
5.2.2 Supranationals;			
5.2.3 Sovereign Eurobonds;			
5.2.4 US Agencies;			
5.2.5 Inflation Protected Bonds;			
5.2.6 Corporate and covered bonds;			
5.2.7 MBS/ABS			
5.2.8 Equities;			
5.2.9 Banks Debt;			
5.2.10 Green Bonds;			
5.2.11 Other- which?_____			

5.3 Currencies

In your perspective, how exposed to environmental risks are your IRs portfolios due to the following currencies?

	Probability of ocurrence	Impact of ocurrence	(P) or (N) impact
5.3.1 USD;			
5.3.2 EUR;			
5.3.3 CNY			
5.3.4 JPY;			
5.3.5 GBP;			
5.3.6 Other- which?_____			

5.4 How do you understand that the Environmental Risk Management may impact the IR Economic Objectives and the IR Investment Guidelines?

5.5 How do you understand that the Environmental Risk Management may impact the IR Strategic Asset Allocation?

5.6 In your opinion, what would be the effect on the short term and long term financial returns of the IRs due to a partial reallocation of its portfolio to green investment alternatives that suit the investor profile of CBs and mitigate their exposure to environmental risks (and/or their exposure to global actions taken in order to mitigate and to adapt to the environmental risks)? For example: would it be most probably negative in the short term and positive in the long term? Why?

5.7 In your opinion, how an incremental performance of the International Reserves, managed by the Central Banks, in the Green Finance market would impact this market segment, as well as the Green Economy? Do you believe it would significantly modify the depth and liquidity of the Green Finance market, impacting the Green Economy*? Why/How?

6.1 Does the CB you represent has any ESG investment strategy? If yes, how would you define it? Reference: http://www.eurosif.org/responsible-investment-strategies/

Best-in-class		Engagement & Voting	
Impact Investing		ESG Integration	
Norms-based screening		Exclusions	
Sustainability-themed		Other - Please specify: _____	
No ESG investment strategy.			

6.2 What are (or would be) your drivers for considering alternatives of ESG investments?

Management based on ERA		Support the Green Market Growth	
Diversification		Climate risk mitigation	
Institutional reputation		Other - Please specify: _____	
Superior returns		No driver for ESG investments.	

6.3 Which of the following green asset classes does the CB you represent consider for investments with the IR:

Green Bonds	☐	Green Index	☐
Green Investment Funds	☐	Green Exchange Traded Funds-ETFs	☐
Green Investment Trusts	☐	Unlabeled Green Assets	☐
Green Equities	☐	Other - Please specify: _____	☐

6.4 Which currencies you think may better support a strategy of mitigating climate risks in IR management?

USD	☐	GBP	☐
EUR	☐	JPY	☐
Other - Please specify: _____	☐		

6.5 Does the CB you represent has investments allocated in any Green Asset? If Yes, please select in which assets you actually invest (if No, please jump to question 6.11):

Green Bonds	☐	Green Index	☐
Green Investment Funds	☐	Green Exchange Traded Funds-ETFs	☐
Green Investment Trusts	☐	Unlabeled Green Assets	☐
None Green investments	☐	Other - Please specify: _____	☐

6.6 If Yes was the answer to question 6.7, please indicate which is your average percentage of investments in green assets, considering the total amount of investments of the CB (0% up to 100%):_____

6.7 Please indicate which categories of green bond issuers is the CB you represent interested in?

Sovereign	☐	Supranational	☐
Corporate	☐	Agencies	☐
Financial Institutions	☐	Municipals	☐

6.8 Does the CB you represent has any plan to adopt the analysis of ESG (Environmental, Social and Governance) factors in its balance sheet management, besides the management of the IRs (or is already doing so)?

Yes - Please specify how: _____	☐
No	☐
I cannot inform	☐

6.9 Please indicate the most probable proportion that the Green Assets will represent in the total investment portfolio of the CB you represent, in ten years from now (2030) (0% up to 100%): _____

For the purpose of the management of the investment portfolio, for questions 6.13 to 6.24 please consider the scale 1 to 7, where 1 means less probable and 7 means more probable:

6.10' Does the CB you represent would avoid investing in Green Assets due to low liquidity (high Bid-Ask Spread, low Turnover)?

1-No	2	3	4	5	6	7-Yes
☐	☐	☐	☐	☐	☐	☐

6.11 Does the CB you represent would take into consideration to invest in Green Assets with an objective to explore the higher Yeld due to lower liquidity (with higher liquidy risk, in case of assets been sold previously to the due date)?

1-No	2	3	4	5	6	7-Yes
☐	☐	☐	☐	☐	☐	☐

6.12 Does the CB you represent see Green Assets as a market with low depth (Outstanding)?

1-No	2	3	4	5	6	7-Yes
☐	☐	☐	☐	☐	☐	☐

6.13 Does the CB you represent would take into consideration to invest in Green Assets despite of a low depth (Outstanding)?

1-No	2	3	4	5	6	7-Yes
☐	☐	☐	☐	☐	☐	☐

6.14 Does the CB you represent would take into consideration to invest in Green Assets as protection strategy (e.g.: not losing money)?

1-No	2	3	4	5	6	7-Yes
☐	☐	☐	☐	☐	☐	☐

6.15 Does the CB you represent would avoid investing in Green Assets due to safety issues, as increased default risk?

1-No	2	3	4	5	6	7-Yes
☐	☐	☐	☐	☐	☐	☐

6.16 Does the CB you represent would avoid investing in Green Assets due to reputational risk?

1-No	2	3	4	5	6	7-Yes
☐	☐	☐	☐	☐	☐	☐

6.17 Does the CB you represent would take into consideration to invest in Green Assets as a strategy to support the Green Finance and the Green Economy?

1-No	2	3	4	5	6	7-Yes
☐	☐	☐	☐	☐	☐	☐

6.18 Does the CB you represent would take into consideration to invest in Green Assets as a strategy to mitigate the potential economic risks due to global actions taken in order to mitigate and to adapt to environmental risks (e.g.: changes in the energy matrix with impact in the national economies)?

1-No	2	3	4	5	6	7-Yes
☐	☐	☐	☐	☐	☐	☐

6.19 Does the CB you represent is concerned about green washing associated with the green assets available in the market?

1-No	2	3	4	5	6	7-Yes
☐	☐	☐	☐	☐	☐	☐

6.20' Does the CB you represent is concerned about lack of standardization of the the green assets available in the market?

1-No	2	3	4	5	6	7-Yes
☐	☐	☐	☐	☐	☐	☐