Central bank governance and reserve portfolio investment policies: an empirical analysis[1]

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Abstract

This paper uses a unique survey data set of 105 central banks to investigate whether investment policies for central bank foreign reserve portfolios are linked to the governance arrangements for reserve management. The paper evaluates whether a central bank's investment decision-making structure impacts how much risk institutions take in their reserve management operations and the level of diversity in their reserve portfolios. Additionally, it explores the implications of the broader governance environment on reserve management. The analysis yields four key findings. First, internal governance arrangements matter for foreign reserve portfolio investment policy; the empirical results indicate that reserve portfolios are more diversified in central banks where the middle office reports directly to the board. Second, controlling for the level of reserves, the macro environment and the broader governance environment, reserve portfolios are more diversified in central banks where the back, middle and front offices are separated. Third, the regression analysis also reveals that central banks in countries where the ministry of finance has an obligation to cover negative equity have fewer eligible currencies and are, therefore, less diversified. Fourth, central banks where boards actively exercise portfolio oversight usually have portfolios with more risk and diversification. Portfolios with longer investment horizons, more currencies and a broader set of asset classes have performed better historically while limiting downside risk. Given that the analysis controls for the broader governance environment, the data indicate that any central bank can improve its internal governance regardless of the external governance environment. This paper contributes to the literature on central bank foreign reserve management and on understanding the importance of governance arrangements in investment policy.

JEL classification(s): E5, G11, D81.

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1. Introduction

Governance is crucial for central banks. According to Bossu and Rossi (2019), the concept of central bank governance is multifaceted. They contend that a clearly defined central bank mandate and decision-making structure are essential to support accountability and legitimacy. Such a mandate should elaborate on objectives, functions and powers, specifying the legal tools available for a central bank to implement its functions. Clear decision-making structures are also necessary to ensure adequate implementation of the mandate. Given the complexity of central banks and their multiple responsibilities, it is crucial to define what to decide, who must decide, and how decisions must be made (Bossu and Rossi (2019)).

Our empirical analysis focuses on the governance of reserve management, a crucial part of central bank governance overall. As foreign currency reserves have significantly increased and represent an essential part of central bank assets, the process for making investment decisions and overseeing results has become more relevant. We aim to contribute to the reserve management governance discussion with data-driven analysis using a unique survey data set on central bank reserve management practices. Most previous publications on the topic are prescriptive and qualitative. Notably, our research shows that governance arrangements do matter for the foreign reserve portfolio investment policy.

As the first step in this analysis, we briefly review the literature on central bank governance, focusing on reserve management operations. We then describe the data that we use for empirical research. We use a unique data set collected by the World Bank's Reserve Advisory and Management Partnership (RAMP) using two surveys conducted across 99 central banks in 2018 and 105 central banks in 2019.[6] The surveys collected data on central banks' reserve management activities, including their governance structures, components of their investment policies and asset allocations, and their accounting and profit-sharing methodologies. We also deploy data that describe the broader institutional and macro environment in which these central banks operate and proxies for reserve adequacies. We use this data set to address novel research questions to find links between specific governance arrangements and reserve management investment policies. Finally, we conclude and discuss the possible implications of our key findings for the management of reserves.

2. Literature review

Central banks have various roles and are responsible for a broad list of functions, which have grown significantly over time. While central banks vary substantially in structure and purpose globally, most institutions have critical responsibility for monetary policy, financial system stability and safeguarding the financial infrastructure's core elements. Managing foreign reserves is typically another essential central bank function (Anasashvili et al (2020)). This section briefly summarises the literature on central bank legal frameworks, functions and governance arrangements, focusing on reserve management.

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[6]   We considered the set of respondents that participated in both surveys, a total of 93 central banks. The set of respondents common to both surveys varies depending on the variable.

2.1   Legal framework

The legal frameworks of central banks differ widely from country to country. For example, most common-law countries do not have constitutional provisions for the central bank. Countries with these provisions often differ in the rules and authorities concerning central bank functions and mandates that are built into their constitutions (Ortiz (2009)). Most central bank laws, however, explicitly define independence, prescribe the central bank's policy goals, and provide discretion and autonomy to achieve those goals through policies and operations (Khan (2017)).[7] For many central banks, price stability, monetary policy, financial supervision and reserve management are part of a legislative mandate (Appendix III briefly reviews the relationships between financial supervision functions and the broader governance environment and reserve management). In other cases, central banks' objectives are implicit in more general economic goals. For example, price stability is critical for achieving stable economic growth. Following the 2008–09 global financial crisis, the objectives and powers delegated to central banks increased significantly to allow for unconventional responses to halt a worldwide financial meltdown (Balls et al (2018)). Building on this expansion during the global financial crisis, central bank actions in response to the Covid-19 pandemic have been unprecedented in speed, scope and scale.[8] Observers of central banks have raised questions about the rapid expansion of new instruments and unconventional monetary policies and the implications of these for central bank independence (de Haan and Eijffinger (2016)).

2.2   Reserve management function

Holding and managing a country's official foreign reserves are among a central bank's core functions (Bossu and Rossi (2019)). Central banks' reserve management operations have always been part and parcel of their monetary policy function. Initially, most central banks had gold-backed currencies, and their reserves primarily consisted of gold bullion. With the abolition of the gold standard in 1971, central banks started diversifying their reserves into foreign asset pools.
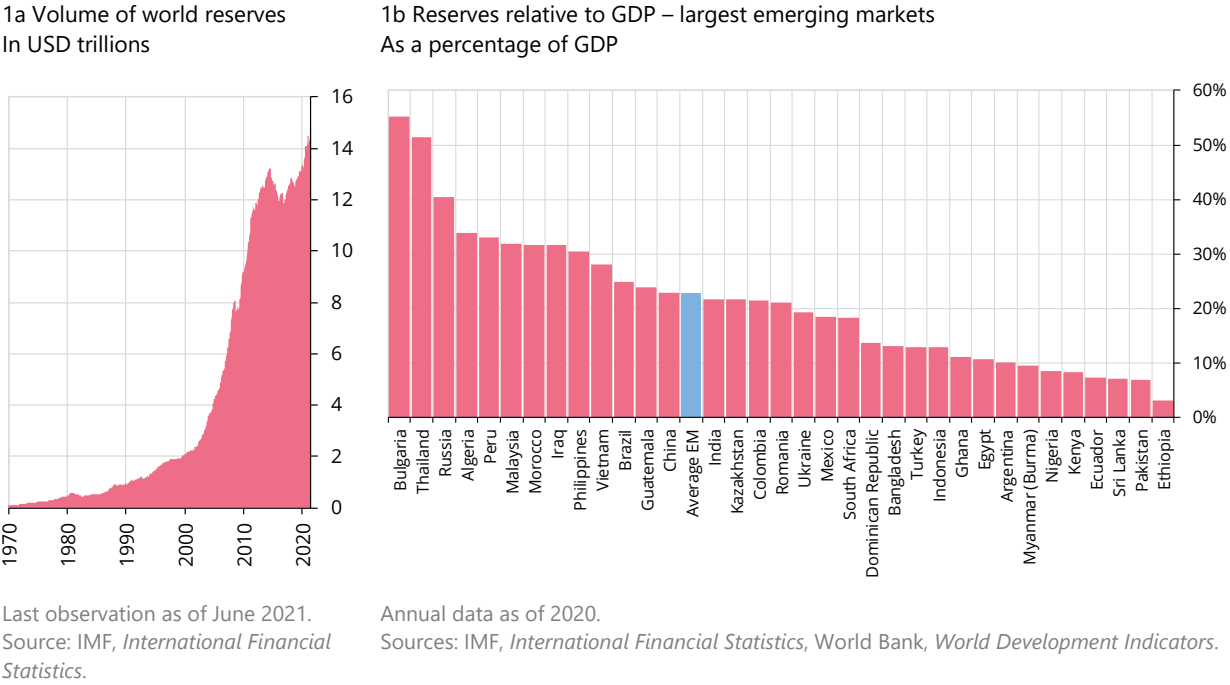
Holding foreign reserves has various purposes. Most notable are self-insurance for balance of payments crises and support of exchange rate policies. In some countries, reserves also support financial stability by providing lender of last resort functions in foreign currency. As a result, reserves protect the country against disruptions and volatility in international capital markets. Over the past two decades, successive financial crises have solidified and validated this approach. Recent research indicates that emerging market central banks holding relatively higher foreign reserves have experienced less currency depreciation, smoother credit growth and more stable credit ratings. Countries with higher levels of reserves also had better access to external funding during the global financial crisis of 2008 (Arslan and Cantú (2019)). Furthermore, empirical research identifies a relationship between political instability and weak institutions in emerging markets. This results in central banks accumulating international reserves as a risk mitigation method to deal with broader economic uncertainties (Ortega de la Rosa (2015)).

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[7]   For a compendium of such legislation globally, see Khan (2017), which provides an analysis.
[8]   See IMF (2020) for a global accounting of the monetary and fiscal policy actions taken by governments worldwide.

Foreign reserves have grown significantly over the past four decades and are now at record highs (Figure 1a). Emerging market economies, notably China, have led this trend. Economic development and higher commodity prices have encouraged capital inflows and higher exports in emerging market economies. As a result, central banks have intervened in foreign exchange markets and accumulated foreign reserves to curb the appreciation of their exchange rates. As Figure 1 shows, this build-up has been a worldwide phenomenon. On average, emerging market central banks[9] have accumulated foreign reserve levels at or above 23% of GDP (Figure 1b).[10] Many countries hold reserves far above traditional benchmarks, such as three months of import cover, 20% of broad money, or 100% cover of short-term external debt repayments. In addition, according to the Assessing Reserve Adequacy (ARA) metric[11] of the International Monetary Fund (IMF), approximately half of the reported countries have reserves above the adequate level.

Figure 1

1a Volume of world reserves
In USD trillions

1b Reserves relative to GDP – largest emerging markets
As a percentage of GDP

Last observation as of June 2021.
Source: IMF, *International Financial Statistics.*

Annual data as of 2020.
Sources: IMF, *International Financial Statistics*, World Bank, *World Development Indicators*.

The build-up of reserves has transformed the way central banks manage these funds. Although they remain invested primarily in government bonds and other conservative instruments, adopting non-traditional asset classes, such as mortgage-backed securities, corporate bonds and equities, is on the rise (Anasashvili et al (2020)).

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[9] This conclusion draws on the World Bank current country classification. Emerging markets are countries classified as being those with low, lower-middle and upper-middle incomes.

[10] This figure is based on available data for emerging markets for 2020 and refers to the GDP-weighted average of official reserve assets.

[11] The IMF publishes the ARA metric for 65 countries. This metric combines some traditional reserve adequacy variables, like broad money, short-term debt and imports, to provide a more robust estimate of reserve adequacy. The data and methodology are available at www.imf.org/external/datamapper/Reserves_ARA@ARA/CHN/IND/BRA/RUS/ZAFtt.

2.3   Reserve management governance

Reserve management governance refers to the institutional arrangements and processes for policy development and investment of foreign exchange assets. According to de Abreau Faria and Streit (2016), an effective governance framework ensures clear delegation and separation of responsibilities. Governance arrangements typically establish the policymaking structure; in other words, they determine who is responsible for each type of decision. In addition, these arrangements include reporting lines and oversight mechanisms. Figure 2 depicts a stylised structure of governance arrangements.

Reserve management governance reflects country-specific institutional, social and regulatory considerations like other central bank arrangements. Central bank laws are generally not specific and prescriptive about the reserve management function. This allows flexibility to define and adjust governance as markets evolve, asset classes change and portfolio practices modernise over time.

Despite the importance of country-specific factors, there is agreement on the most relevant principles for reserve management. The IMF Guidelines for Foreign Exchange Reserve Management are an excellent example of generally agreed reserve management principles. The IMF developed this document in consultation with various central banks and international organisations, including the World Bank. According to the Guidelines, the "internal governance structure of the reserve management entity should be guided by and reflect the principles of clear allocation and separation of responsibilities. Sound management of internal operations and risks requires appropriately qualified and well-trained staff, following sound business practices" ((Al-Hassan et al (2014)). The guidelines further suggest that central bank boards should make decisions at a strategic level and delegate decisions concerning strategy implementation to the investment committees. The operational units implement the decisions made by the board and investment committee. Such a division of responsibilities results in a three-tier decision-making structure for reserve management operations.

A clear definition of roles and policies is considered critical. The investment policy statement for reserve management is the most suitable place to define eligible asset classes, investment instruments and transactions (Johnson-Calari and Strauss-Khan (2020)). The board's involvement in the investment policy definition is deemed the most effective structure to ensure robust oversight and informed decision-making. Furthermore, the role of every person who participates in the investment process must be defined clearly, along with well defined documentation of processes, to allow continuous decision-making (Ruiz (2020)).

The RAMP survey (see Anasashvili et al (2020)) collects data on how central banks organise their reserve management operations. The survey findings indicate that reserve governance arrangements vary across central banks. Most of the 105 respondents to the 2019 RAMP survey follow a three-tier governance structure. Ninety-two per cent of central banks reported that their respective boards approved the reserve management policy, including high-level decisions such as reserve management objectives, risk tolerance, investment horizon and strategic asset allocation. Moreover, the survey also showed that central banks' boards frequently approve the investment management guidelines; that is, the specific investment rules for managing the portfolio, indicating that many central bank investment committees have limited decision-making power. Many boards are also responsible for hiring
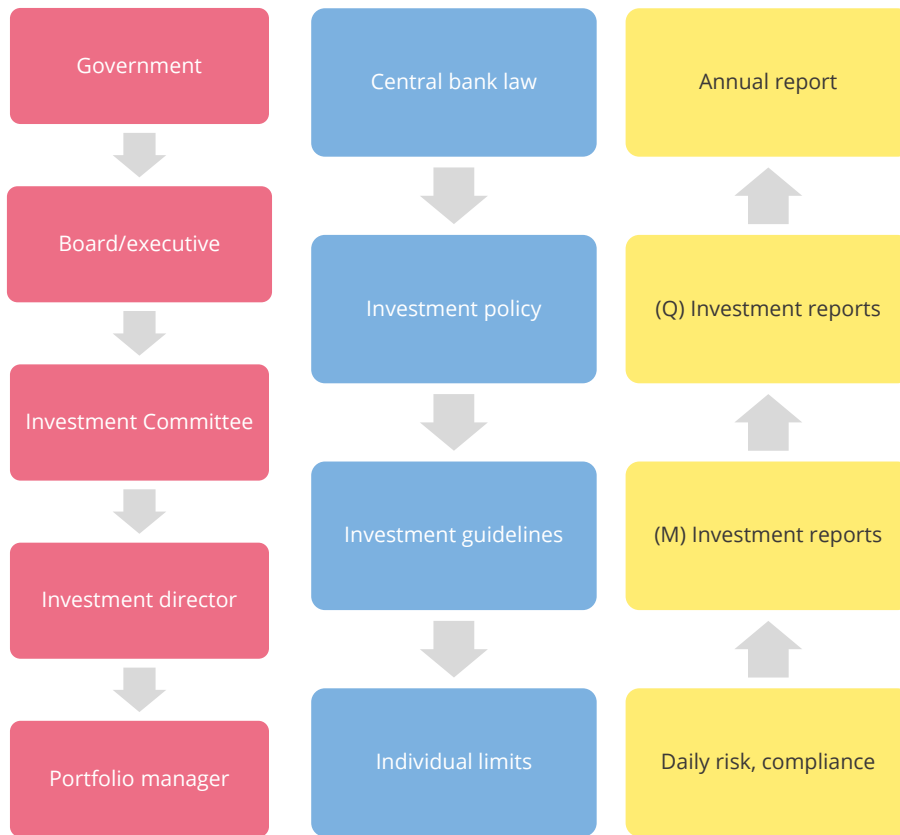
Source: Johnson-Calari and Strauss-Khan (2020).

external managers. Finally, the survey showed that middle office reporting on risk and return information to the board varies across central banks.

Apart from the specific governance arrangements for reserve management operations, the RAMP survey investigates how central banks organise their operational units. Typically, central banks separate the reserve management function into three different operational units. The first is the front office, which plans and executes trades. The second is the middle office, responsible for measuring risks and producing reports. The third oversees the trade settlement and accounting of reserve operations. Even though these operational units have differentiated roles and responsibilities, the location of these individual units in the organisational structure varies, as the RAMP survey shows. Approximately a third of central banks have the front, middle and back office in the same department, while another third of institutions place them in completely separate departments. The remaining central banks opt for a hybrid approach (Anasashvili et al (2020)).

3. Approach and objectives

Little quantitative research is available on the link between overall central bank governance and reserve management, despite the critical role that sound reserve

management plays in helping, supporting and maintaining confidence in monetary management (Al-Hassan et al (2014)). As shown above, most publications on reserve management governance are prescriptive and qualitative. Therefore, we contribute to the reserve management governance discussion with data-driven analysis using RAMP's unique survey data on governance and organisational arrangements of central banks and asset allocation and risk measures. Specifically, we investigate whether governance arrangements impact investment policies and central bank risk-taking and, if so, precisely which arrangements matter. We also analyse whether organisational arrangements impact central banks' investment policies and whether reporting structures influence their investment policies and risk-taking in their reserve management operations. This paper empirically analyses the relationships between a central bank's governance structure for its reserve management operations and investment policies and risk-taking.

4. Methodology and data

We use correlations and regression analysis to find links between specific governance arrangements and variables related to central banks' reserve investment policies. We start by analysing correlations between the above-mentioned variables and testing for their statistical significance. We then use regression analysis to explore whether some correlation results hold when adjusting for reserve adequacy and indicators that describe the macro environment.

We use data groups that capture the governance arrangement, investment policies and measures of risk-taking of individual central banks to test whether governance affects investment policies. First, we use data on governance arrangements for central banks' reserve management operations as an independent variable collected by combining the first (2018) and the second (2019) RAMP surveys. We use data for the central banks participating in both surveys for the relevant variables. Second, we utilise the most recent data from the second RAMP survey on the composition and risk of reserve portfolios as dependent variables describing a central bank's investment policy. We then deploy three types of control variables to empirically isolate the impact of the governance structure and investment policies.

4.1 Governance and macroeconomic variables

We compiled governance variables from multiple sources, collected at the national level, to assess the broader governance environment as a control variable to isolate the effect of the governance arrangements at the central bank level. We also use macroeconomic variables and data on reserve adequacy to isolate the effects further (see Table 1 for a summary).

Governance environment, macroeconomic and reserve adequacy variables					Table 1
Variable	Obs	Mean	Std dev	Min	Max
Governance environment variables					
Government effectiveness	204	0.0	1.0	−2.4	2.2
Central bank independence	144	2.8	1.2	0	4
Corruption Perceptions Index	179	43.3	18.9	9	87
Governance Pillar Score	143	5.7	2.1	1.1	9.2
Macroeconomic variables					
Country risk score	121	46.6	16.3	13	89
Number of currency crises (1971–2017)	164	1.5	1.5	0	7
Current account balance (% of GDP)	212	−3.0	9.0	−34	34.8
Reserve adequacy variables					
Reserves to GDP (%)	162	0.2	0.2	0.6	2.0
Reserves to M2 (%)	126	0.4	0.3	0.0	1.9

Sources: IMF, *World Economic Indicators*, *Official Foreign Exchange Reserves* (COFER); World Bank; French Treasury; Transparency International; Bloomberg; Economist Intelligence Unit (EIU); MSCI.

1. **Governance environment variables**: We use various indices to measure the broader governance environment in which a central bank operates. First, we use the government effectiveness index, compiled by the World Bank. This index measures the "perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies".[12] The scale runs from −2.5 (lowest) to 2.5 (highest) and covers 204 countries. The index is developed by compiling and summarising information from over 30 existing data sources that report the views and experiences of citizens, entrepreneurs and experts in the public, private, and non-governmental sectors. The rationale for using this variable is that countries with strong governance and effective public sectors usually have well implemented laws for their central banks. We also use data on central bank independence from the French Treasury. This variable measures the degree of central bank independence in each country. Central banks with no independence are assigned a value of zero, while those with substantial autonomy are assigned a value of 4.[13] The Directorate General of the French Treasury surveys this and other institutional characteristics for 144 countries. The survey is based on perception data. The study's results are captured in the Institutional Profiles Database and were last updated in 2016. In addition, clear accountability frameworks and low corruption increase public confidence in the central bank. To measure these elements, we use the Corruption Perceptions Index, which scores 180 countries based on experts' and business executives' perceptions of corruption in a country's public sector. It is a composite index combining 13 surveys and assessments of corruption collected by various institutions. The index has a scale of 0–100, where zero represents the highest level of perceived

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[12] See https://info.worldbank.org/governance/wgi/Home/Documents.
[13] See www.cepii.fr/institutions/EN/ipd.asp.

corruption, and 100 the lowest level.[14] Finally, we use the Governance Pillar Score (MSCI). This index covers 198 countries to "assess the extent to which a country's long-term competitiveness is affected by its institutional capacity to support long-term stability and functioning of its financial, judicial, and political systems, and capacity to address the environmental and social risks".[15] The Governance Pillar Score is included in the MSCI assessment of sovereign countries' environment, social and governance (ESG) risk. The best score is zero; the worst is 10. The index is derived from third-party sources and focuses on political rights and civil liberties, stability and peace, control of corruption and public financial management.

2. **Macroeconomic variables**: We then use the country risk score from the Economist Intelligence Unit's Country Risk Model to control for the macro environment. This score rates country risk from zero (no risk) to 100 (maximum risk), taking a simple average of a country's sovereign, currency and banking sector risk scores.[16] We included this variable in the analysis to assess the macro environment in which central banks operate. Alternatively, we use the number of currency crises and the current account balance as a percentage of GDP to describe the macro environment in which the central bank operates.

3. **Reserve adequacy variables**: Finally, a central bank's risk tolerance and investment policy (number of eligible assets and currencies, portfolio duration, allocation to non-traditional asset classes) are linked to reserve adequacy. All else being equal, a central bank with higher reserve adequacy typically has a higher risk tolerance and can deploy a broader range of asset classes and currencies and longer duration. Therefore, we use reserve adequacy measures to control for differences in reserve adequacy across central banks. We include two reserve adequacy metrics as control variables: reserves to GDP and M2. Separately, we also control for GDP per capita and other macroeconomic variables, such as short-term external debt stocks as a percentage of total reserves.

4.2   RAMP survey variables

RAMP's global surveys on reserve management practices are the source of information on central banks' governance arrangements, investment policies and risk-taking measures. RAMP conducted two surveys in 2018 and 2019 with responses from 99 and 105 central banks, respectively.[17] The RAMP survey data are unique, systematically collecting data on governance arrangements of reserve management investment operations across central banks globally for the first time. In addition to questions on governance arrangements and investment policies, the surveys included questions on asset allocation, portfolio management, risk management, performance and risk reporting, and transparency. Table 2 lists the survey variables we used to test our questions empirically.

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[14]   See www.transparency.org/en/cpi and https://images.transparencycdn.org/images/2019_CPI_SourceDescription_EN-converted-merged.pdf.

[15]   See www.msci.com/documents/10199/e092c439-34e1-4055-8491-86fb0799c38f.

[16]   See www.eiu.com/n/solutions/country-risk-model/.

[17]   Anasashvili et al (2020); see https://openknowledge.worldbank.org/bitstream/handle/10986/33657/K880541.pdf?sequence=1&isAllowed=y.

Summary statistics of RAMP survey variables					Table 2
Variable	Obs	Mean	Std dev	Min	Max
Governance – discrete variables					
Independent investment committee	105	0.2	0.4	0	1
Middle office reports to the board	105	0.9	0.3	0	1
Middle office reports to the investment committee	105	0.8	0.4	0	1
Back office, middle office and front office are in the same department	105	0.3	0.5	0	1
Back office, middle office and front office are in separate departments	105	0.3	0.5	0	1
Obligation to cover negative equity	93	0.6	0.5	0	1
Governance – continuous variables					
Transparency of reserve management policies	95	0.4	0.3	0	1
Composition of reserve portfolio – continuous variables					
Number of eligible currencies	100	7.9	4.3	1	20
Number of eligible assets	97	6.8	2.8	1	14
Allocation to non-traditional assets (%)	71	10.1	17.0	0	72
Estimated risk of the portfolio	71	1.0	0.3	0.8	2.9
Investment horizon – total portfolio (months)	57	35.3	30.7	1	126
Duration – total tranched portfolio (months)	52	22.4	18.9	1	84
Duration – liquidity tranche (months)	64	7.8	12.6	1	76
Duration – investment tranche (months)	62	32.1	31.5	3	180

The survey specifically asked whether the middle office reports to the board on performance and risk metrics and compliance with the investment management guidelines.

Source: RAMP Survey on the Reserve Management Practices of Central Banks (World Bank Treasury).

Concerning governance arrangements, we consider as independent variables those indicated in the RAMP survey results as differing across central banks, which could therefore influence central bank investment policies and risk-taking. We use dummy variables for the following governance arrangements:

1. We consider an investment committee independent if it approves the investment management guidelines; that is, the specific investment rules for managing the portfolio.

2. We explore whether the middle office reports directly to the board.

3. We also consider whether the middle office reports performance and risk metrics to the investment committee.

4. We test whether a central bank organises its reserve management operations in one department.

5. We further assess whether the reserve management operations are arranged in separate departments.

6. Finally, we probe the impact of the ministry of finance's obligation to cover the central bank's negative equity.

Relatedly, we further probe transparency on the risks and returns of reserve management operations to the board as a continuous variable. The variable represents the central banks' degree of transparency, ranging from zero to one, based on the public disclosure of their currency composition, investment guidelines and benchmark selection.

We use RAMP survey data collected as continuous data on the number of eligible currencies and asset classes and the allocation to non-traditional asset classes as dependent variables to reflect a central bank's investment policies. We also deploy RAMP data to compute the measures of risk as reflected in a central bank's current asset allocation: (1) estimated risk of the portfolio;[18] (2) investment horizon (measured at the total portfolio level for both tranched and untranched portfolios); and (3) duration (measured at the total portfolio level and the liquidity or investment tranche level).

5. Descriptive statistical results

We run simple correlations for the various independent governance variables to identify patterns in the data. The correlations are run to develop context and show empirical relationships between critical elements of reserve management. The full results of the correlation analysis are found in Appendix I.

1. **Independent investment committee and investment policies**. We test whether a positive statistical correlation exists between the investment committee's independence and the investment guidelines' characteristics. As explained above, we define an investment committee as independent if it is responsible for approving the investment guidelines. Table 3 indicates that an independent investment committee negatively correlates with the number of eligible currencies and asset classes. Similarly, duration is negatively correlated with an independent investment committee.

Independence of the investment committee and investment policies   Table 3

Variables	Estimated risk of the portfolio	Non-traditional assets (%)	Number of eligible currencies	Number of eligible assets	Investment horizon – total portfolio (months)	Duration – total portfolio (months)	Duration – liquidity tranche (months)	Duration – investment tranche (months)
Independent investment committee	−0.179	−0.233*	−0.102	−0.148	−0.036	−0.282**	−0.108	−0.14

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

2. **Middle office reporting directly to the board and investment policies**. Additionally, we find a statistically positive correlation between the middle office's reporting and a central bank's risk-taking and investment policies (Table 4). When

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[18]   We estimate the implied annual volatility of the portfolio (ie absolute risk measure) based on the respondents' actual asset allocation using data from the benchmark's performance, assuming they follow a passive investment strategy and replicate the underlying benchmark.

the middle office reports directly to the board, we observe a higher allocation to non-traditional assets and more diversified reserve portfolios as the number of currencies and asset classes increases (see Figure 3).
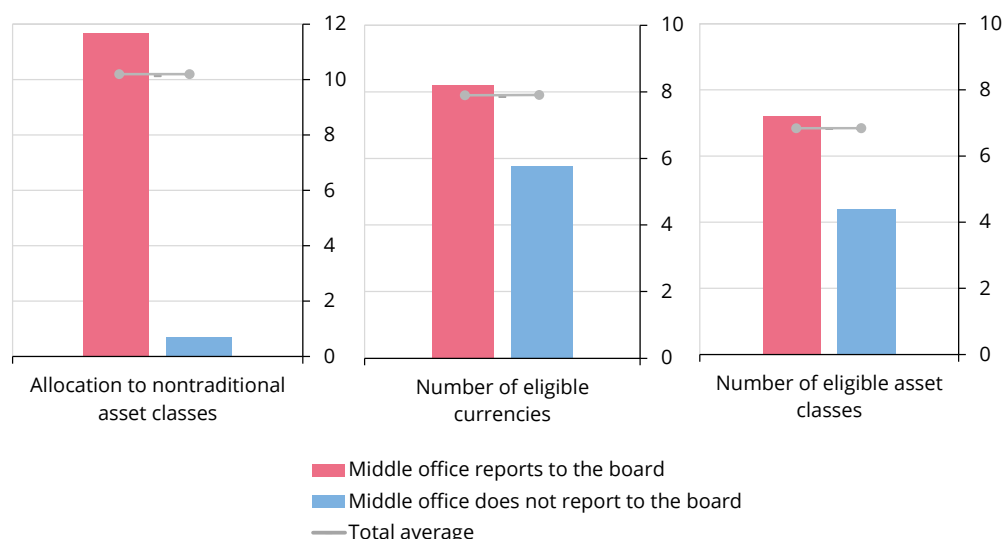
Reporting to the board and investment policies Table 4

Variables	Estimated risk of the portfolio	Non-traditional assets (%)	Number of eligible currencies	Number of eligible assets	Investment horizon – total portfolio (months)	Duration – total portfolio (months)	Duration – liquidity tranche (months)	Duration – investment tranche (months)
Middle office reports to the board	0.123	0.227*	0.193*	0.345***	−0.1	0.114	0.153	−0.006

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

Reporting to the board and investment policies Figure 3

Middle office reports to the board
Middle office does not report to the board
Total average

Number of respondents: 71, 100 and 97, respectively.

Source: RAMP Survey on the Reserve Management Practices of Central Banks (World Bank Treasury).

3. **Organisation of operational units and investment policies**. We find a statistically significant correlation between the organisation of the operational units and the diversification of reserve management portfolios. Central banks with the back, middle and front offices in the same department have less diversified portfolios and shorter investment horizons (see Table 5). As discussed earlier, the RAMP surveys show that one third of central banks have their front, middle and back office functions together.

Organisation of operational units and investment policies — Table 5

Variables	Estimated risk of the portfolio	Non-traditional assets (%)	Number of eligible currencies	Number of eligible assets	Investment horizon – total portfolio (months)	Duration – total portfolio (months)	Duration – liquidity tranche (months)	Duration – investment tranche (months)
Back office, middle office and front office are in the same department	−0.178	−0.234**	−0.073	−0.204**	−0.264**	−0.088	−0.045	0.114

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

4. **Obligation to cover negative equity and investment policies**. Our empirical analysis shows that central banks that do not receive financial support from the government tend to have a more diversified strategic asset allocation with lower overall portfolio risk, even when controlling for distribution policies (see Table 6). Countries in which finance ministries have an obligation to cover central banks' negative equity also have riskier macro environments. This observation is consistent with the result that the obligation to cover negative equity is more common in countries with weaker governance. It also may indicate that the necessity of government support for the central bank may be higher in such environments as the economy is less stable and prone to unforeseen shocks that the central bank is not well prepared to manage with existing resources.

Obligation to cover negative equity and investment policies — Table 6

Variables	Estimated risk of the portfolio	Non-traditional assets (%)	Number of eligible currencies	Number of eligible assets	Investment horizon – total portfolio (months)	Duration – total portfolio (months)	Duration – liquidity tranche (months)	Duration – investment tranche (months)
Obligation to cover negative equity	−0.264**	−0.200*	−0.201*	−0.251**	−0.322**	−0.172	−0.309**	−0.067
No obligation to cover negative equity **and** transfer of realised income	0.251**	0.221*	0.063	0.211**	0.246*	−0.004	0.193	0.06
Obligation to cover negative equity **and** transfer of realised income	−0.244**	−0.201*	−0.217**	−0.230**	−0.287**	−0.153	−0.202	0.011

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

5. **The broader institutional environments and investment policies**. Our analysis finds that the broader governance environment in which central banks operate correlates with certain investment policy types (see Table 7). As the table indicates, the government effectiveness index has a strong, statistically significant positive correlation with duration risk and portfolio diversification, measured as the number of eligible asset classes and the allocation to non-traditional asset classes (see Figure 4). Because of these findings, we will use indices that describe the broader institutional environment as control variables in our regressions.

## Government effectiveness and investment policies — Table 7

Variables	Independence of central bank	Corruption Perceptions Index	Governance Pillar Score	Government effectiveness
Estimated risk of the portfolio	0.275**	0.268**	0.253*	0.265**
Non-traditional assets (%)	0.162	0.114	0.177	0.239**
Number of eligible currencies	0.06	0.076	0.041	0.146
Number of eligible assets	−0.032	0.091	0.204*	0.217**
Investment horizon – total portfolio (months)	0.347**	0.348***	0.182	0.237*
Duration – total portfolio (months)	0.219	0.346**	0.087	0.308**
Duration – liquidity tranche (months)	0.349**	0.451***	0.225*	0.433***
Duration – investment tranche (months)	0.250*	0.124	0.185	−0.008

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

Investment policies and government effectiveness — Figure 4
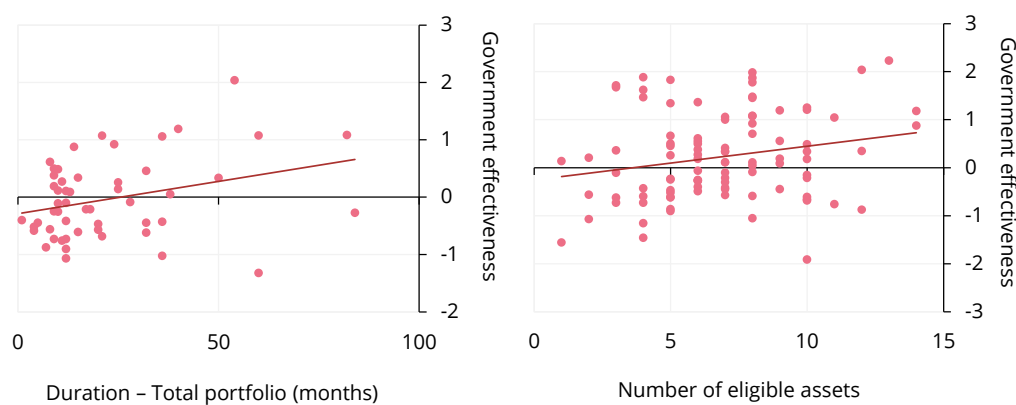
Number of respondents: 52 and 97, respectively.

Sources: RAMP Survey (World Bank Treasury); Transparency International.

6. Multivariate regression results

We use regression analysis to delve into the correlation analyses on central bank governance and risk. We test the extent to which governance arrangements matter for risk-taking and diversification in foreign reserve portfolios while controlling for the broader governance environment in which central banks operate, the level of

reserve adequacy, the macro environment, or country risk.[19] Additional regression results are found in Appendix II.

1. **Independent investment committee**. We examine if approving the investment guidelines at the board or investment committee level makes any difference for reserve management operations. In most central banks, either can have this role. The most significant advantage of leaving this decision to the board is that it has more authority. However, central bank board members may not be financial experts and may have less time to focus on reserve management policy. By contrast, the investment committee has less authority, but it can meet more often, and the members usually understand operational nuances and have financial expertise. We test whether the independence of an investment committee influences central bank investment policies, as suggested in our correlation exercise. As explained, we control for reserve adequacy, the general macro environment and government effectiveness, which may influence a central bank's risk-taking as expressed in its investment policy. We do not find with any statistical significance that having the investment committee approve guidelines matters, even when different control variables are used to describe the macro environment (see Table 8).

Measuring the impact of an independent investment committee on investment policies				Table 8
	(1)	(2)	(3)	(4)
Independent variable	Number of eligible assets	Number of eligible currencies	Estimated risk of the portfolio	Investment horizon – total portfolio (months)
Independent investment committee	−0.544	−1.668	−0.270	4.038
	(0.810)	(1.297)	(0.239)	(11.305)
Government effectiveness	0.380	0.971	0.211	14.590**
	(0.435)	(0.728)	(0.148)	(7.062)
Reserves to GDP (%)	4.129**	5.223*	−0.789	−5.334
	(1.669)	(2.808)	(0.760)	(24.260)
Short-term external debt stocks, % of reserves	0.000	−0.000	−0.000	0.019**
	(0.000)	(0.000)	(0.000)	(0.009)
Current account balance (% of GDP)	0.064	−0.069	−0.008	−0.533
	(0.044)	(0.072)	(0.014)	(0.615)
Number of currency crises (1971–2017)	0.141	0.653	−0.062	0.621
	(0.234)	(0.394)	(0.074)	(3.841)
Constant	5.932***	5.877***	2.007***	22.020**
	(0.709)	(1.194)	(0.268)	(10.539)
Observations	83	85	63	48
R-squared	0.172	0.112	0.102	0.305

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each column in this table refers to a different regression with the column name as the dependent variable.

Source: Authors' calculations.

[19] This choice of variables was influenced by a general-to-specific regression (GETS) run as a way of selecting the most relevant variables out of a relatively large sample of variables when fitting a regression model.

2. **Middle office reporting directly to the board**. We find evidence that reporting lines impact investment policies. Our regression analysis confirms the importance of direct communication between the board and the middle office. We observe that reserve portfolios are more diversified in terms of eligible assets and currencies in central banks where the middle office reports to the board. This finding is significant, considering that we control for reserve adequacy, a country's macro environment and the broader governance environment (see Table 9). These results are robust when using different specifications for macro risks (see Appendix II), and the results also hold when subsampling the data by income level and level of reserves.[20] However, there does not seem to be a significant difference between the groups.

Measuring the impact of the middle office directly reporting to the board on investment policies

Table 9

Independent variable	(1) Number of eligible assets	(2) Number of eligible currencies	(3) Estimated risk of the portfolio	(4) Investment horizon – total portfolio (months)
Middle office reports to the board	2.854***	3.098**	−0.045	1.304
	(0.797)	(1.373)	(0.262)	(12.801)
Government effectiveness	0.421	1.043	0.229	14.347**
	(0.403)	(0.710)	(0.150)	(7.044)
Reserves to GDP (%)	4.065**	5.072*	−0.765	−5.020
	(1.547)	(2.748)	(0.772)	(24.300)
Short-term external debt stocks, % of reserves	0.000	−0.000	−0.000	0.019*
	(0.000)	(0.000)	(0.000)	(0.010)
Current account balance (% of GDP)	0.059	−0.055	−0.003	−0.616
	(0.039)	(0.068)	(0.013)	(0.585)
Number of currency crises (1971–2017)	0.255	0.774*	−0.065	0.564
	(0.219)	(0.390)	(0.076)	(3.843)
Constant	3.182***	2.745	2.005***	21.414
	(0.995)	(1.732)	(0.384)	(16.198)
Observations	83	85	63	48
R-squared	0.287	0.149	0.082	0.303

Standard errors are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Each column in this table refers to a different regression with the column name as the dependent variable.

Source: Authors' calculations.

3. **Organisation of reserve management operations and investment policy**. We find support for the hypothesis that how institutions organise their reserve management operations matters for the investment policy of central banks. Central banks in which the front, middle and back offices are in the same department have, on average, significantly shorter investment horizons. As macro volatility, levels of reserves and the broader governance environment may influence the investment horizon of central banks' reserve

[20] The data were divided into high-income and low-income countries, on the one hand, and by level of reserves (above and below US$ 15 billion) on the other.

operations, we include these in the regression as control variables (see Table 10).

Measuring the impact of the organisational structure of reserve management operations on investment policies

Table 10

Independent variable	(1) Number of eligible assets	(2) Number of eligible currencies	(3) Estimated risk of the portfolio	(4) Investment horizon – total portfolio (months)
Back office, middle office and front office are in the same department	−0.842	−1.532	−0.243	−15.575*
	(0.603)	(1.010)	(0.194)	(8.952)
Government effectiveness	0.388	1.019	0.220	17.076**
	(0.431)	(0.723)	(0.147)	(6.974)
Reserves to GDP (%)	4.110**	5.188*	−0.702	−6.832
	(1.651)	(2.796)	(0.758)	(23.460)
Short-term external debt stocks (% of reserves)	0.000	−0.000	−0.000	0.016*
	(0.000)	(0.000)	(0.000)	(0.009)
Current account balance (% of GDP)	0.066	−0.054	−0.006	−0.885
	(0.041)	(0.069)	(0.013)	(0.581)
Number of currency crises (1971–2017)	0.153	0.661*	−0.048	1.374
	(0.232)	(0.392)	(0.074)	(3.738)
Constant	6.122***	6.111***	2.012***	25.570**
	(0.719)	(1.215)	(0.267)	(10.165)
Observations	83	85	63	48
R-squared	0.188	0.120	0.106	0.350

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each column in this table refers to a different regression with the column name as the dependent variable.

Source: Authors' calculations.

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4. **Obligation of the ministry of finance to cover central bank negative equity**. The distribution of profits and losses within the government is a sensitive issue for central banks. Although central banks commonly share their earnings with ministries of finance, there are questions regarding the source of those profits (ie foreign exchange revaluation or changes in market prices) and the timing (ie realised versus unrealised). Despite significant variation in their practices, central banks tend to distribute realised profits partially. Our regression analysis confirms that the obligation of the ministry of finance to cover central banks' negative equity influences investment policy. Reserve portfolios in countries where finance ministries must cover negative equity are less diversified in terms of eligible currencies, even when controlling for reserve adequacy and the macro and broader governance environment. On average, central banks operating in countries where the ministry of finance had an obligation to cover negative equity held 2.4 to 2.7 fewer eligible currencies across the various regression specifications (see Table 11). It appears that this obligation narrowly impacts investment policies, as we cannot find robust results for asset diversification, level of risks, or the investment horizon.

Measuring the impact of the obligation of the ministry of finance to cover   Table 11
central bank negative equity on investment policies

Independent variable	(1) Number of eligible assets	(2) Number of eligible currencies	(3) Estimated risk of the portfolio	(4) Investment horizon – total portfolio (months)
Obligation to cover negative equity	−0.414	−2.728**	−0.063	−7.680
	(0.756)	(1.280)	(0.235)	(10.882)
Government effectiveness	0.171	0.260	0.170	8.933
	(0.492)	(0.841)	(0.168)	(8.211)
Reserves to GDP (%)	4.516**	5.292*	−0.298	9.021
	(1.709)	(2.926)	(0.791)	(26.845)
Short-term external debt stocks (% of reserves)	0.000	−0.000	−0.000	0.039**
	(0.000)	(0.000)	(0.000)	(0.018)
Current account balance (% of GDP)	0.065	−0.084	−0.004	−0.840
	(0.043)	(0.072)	(0.013)	(0.606)
Number of currency crises (1971–2017)	0.134	0.511	−0.032	0.324
	(0.235)	(0.404)	(0.073)	(4.122)
Constant	5.930***	7.401***	1.797***	21.772
	(0.834)	(1.432)	(0.307)	(14.276)
Observations	77	78	58	43
R-squared	0.178	0.141	0.055	0.321

Standard errors are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Each column in this table refers to a different regression with the column name as the dependent variable.

Source: Authors' calculations.

7. Conclusion and policy implications

Effective governance is essential for central banks and their reserve management function. Multiple authors have analysed central bank governance arrangements around the world. These publications conclude that governance practices vary from country to country, but some principles seem broadly relevant for achieving positive outcomes. Empirical evidence points to the importance of central bank independence and transparency for monetary policy. Different publications agree that a proper governance structure is the cornerstone of a successful investment operation in reserve management. However, most publications on reserve management governance are prescriptive and qualitative.

We contribute to the discussion on reserve management governance with data-driven analysis. Our novel empirical study indicates that specific governance arrangements impact investment policy and risk-taking in central banks' reserve management operations, controlling for the macroeconomic environment, reserve levels and the broader governance environment.

We find that three types of governance factors relate to diversification and risk in foreign reserve portfolios. First, direct communication between the board and the middle office often coincides with more diversified reserve operations. Notably, the result holds when controlling for reserve adequacy, and country risk indicates that anchoring risk-taking at the board level allows reserve managers to have more

diversified portfolios in terms of eligible assets and eligible currencies, everything else equal. Second, we find that the organisational structure for reserve operations may impact investment policy. Having all three units responsible for managing reserve operations in the same department, with the same reporting line, affects central banks' ability to take risks, as reflected in the investment horizon. Controlling for the macro and governance environment and reserve adequacy, central banks with the same reporting lines for the front, middle and back offices, on average, have a significantly shorter investment horizon. We also find that this result is robust across different specifications. Third, countries where the ministry of finance is obligated to cover negative equity have, on average, investment policies with fewer eligible currencies than countries where the ministry of finance does not have such obligations.

The most important policy implication of our analysis is the board's critical role in reserve management. Central banks where boards actively exercise portfolio oversight (ie the middle office reports directly to the board) usually have portfolios with more risk and diversification. While ability and tolerance for risk-taking vary across central banks, portfolios with longer investment horizons, more currencies and more asset classes have performed better historically while limiting downside risk. Given that we control for the broader governance environment, our data indicate that any central bank can improve its internal governance regardless of the external governance environment. Several central banks in our database have implemented robust reserve management practices even without optimal external governance environments.

8. Appendix I: Correlation results

Central bank independence and the broader governance environment   Table 8.1

Variables	Independence of central bank	Corruption Perceptions Index	Governance Pillar Score	Government effectiveness
Independence of central bank	1			
Corruption Perceptions Index	0.472***	1		
Governance Pillar Score	0.346***	0.690***	1	
Government effectiveness	0.440***	0.928***	0.720***	1
GDP per capita	0.383***	0.803***	0.609***	0.784***

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

Country risk and the broader governance environment   Table 8.2

Variables	Independence of central bank	Corruption Perceptions Index	Governance Pillar Score	Government effectiveness
Country risk score	−0.484***	−0.828***	−0.638***	−0.880***

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

Transparency of reserve management policies and the broader governance environment   Table 8.3

Variables	Independence of central bank	Corruption Perceptions Index	Governance Pillar Score	Government effectiveness
Transparency of reserve management policies	0.298***	0.117	0.082	0.084

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

Transparency of reserve management policies and country risk

Table 8.4

Variables	Country risk score
Transparency of reserve management policies	−0.222*

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

Investment policies and the broader governance environment

Table 8.5

Variables	Independence of central bank	Corruption Perceptions Index	Governance Pillar Score	Government effectiveness
Estimated risk of the portfolio	0.275**	0.268**	0.253*	0.265**
Non-traditional assets (%)	0.162	0.114	0.177	0.239**
Number of eligible currencies	0.06	0.076	0.041	0.146
Number of eligible assets	−0.032	0.091	0.204*	0.217**
Investment horizon – total portfolio (months)	0.347**	0.348***	0.182	0.237*
Duration – total portfolio (months)	0.219	0.346**	0.087	0.308**
Duration – liquidity tranche (months)	0.349**	0.451***	0.225*	0.433***
Duration – investment tranche (months)	0.250*	0.124	0.185	−0.008

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

Country risk and investment policies · Table 8.6

Variables	Country risk score
Estimated risk of the portfolio	−0.408***
Non-traditional assets (%)	−0.423***
Number of eligible currencies	−0.041
Number of eligible assets	−0.157
Investment horizon – total tranched and untranched portfolio (months)	−0.404***
Duration – total portfolio (months)	−0.384**
Duration – liquidity tranche (months)	−0.521***
Duration – investment tranche (months)	−0.296**

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

Independence of the investment committee and the broader governance environment · Table 8.7

Variables	Independence of central bank	Corruption Perceptions Index	Governance Pillar Score	Government effectiveness
Independent investment committee	−0.018	−0.186*	−0.180*	−0.204**

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

Independence of the investment committee and investment policies · Table 8.8

Variables	Estimated risk of the portfolio	Non-traditional assets (%)	Number of eligible currencies	Number of eligible assets	Investment horizon – total portfolio (months)	Duration – total portfolio (months)	Duration – liquidity tranche (months)	Duration – investment tranche (months)
Independent investment committee	−0.179	−0.233*	−0.102	−0.148	−0.036	−0.282**	−0.108	−0.14

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

Reporting to the board and investment policies

Table 8.9

Variables	Estimated risk of the portfolio	Non-traditional assets (%)	Number of eligible currencies	Number of eligible assets	Investment horizon – total portfolio (months)	Duration – total portfolio (months)	Duration – liquidity tranche (months)	Duration – investment tranche (months)
Middle office reports to the board	0.123	0.227*	0.193*	0.345***	–0.1	0.114	0.153	–0.006

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

Obligation to cover negative equity and the broader governance environment

Table 8.10

Variables	Independence of central bank	Corruption Perceptions Index	Governance Pillar Score	Government effectiveness
Obligation to cover negative equity	–0.194*	–0.479***	–0.357***	–0.483***

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

Obligation to cover negative equity and investment policies

Table 8.11

Variables	Estimated risk of the portfolio	Non-traditional assets (%)	Number of eligible currencies	Number of eligible assets	Investment horizon – total portfolio (months)	Duration – total portfolio (months)	Duration – liquidity tranche (months)	Duration – investment tranche (months)
Obligation to cover negative equity	–0.264**	–0.200*	–0.201*	–0.251**	–0.322**	–0.172	–0.309**	–0.067
No obligation to cover negative equity **and** transfer of realised income	0.251**	0.221*	0.063	0.211**	0.246*	–0.004	0.193	0.06
Obligation to cover negative equity **and** transfer of realised income	–0.244**	–0.201*	–0.217**	–0.230**	–0.287**	–0.153	–0.202	0.011

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

9. Appendix II: Additional regression results

Measuring the impact of organisational structure on investment policies

Table 9.1

Independent variable	(1) Number of eligible assets	(2) Number of eligible currencies	(3) Estimated risk of the portfolio	(4) Investment horizon – total portfolio (months)
Middle office reports to the board	2.544***	2.262*	0.0365	−8.061
	(0.757)	(1.263)	(0.251)	(11.46)
Reserves to GDP (%)	2.375	3.755	−0.330	−18.82
	(1.445)	(2.479)	(0.668)	(19.93)
Government effectiveness	0.625**	0.322	0.254**	14.07***
	(0.306)	(0.512)	(0.117)	(4.892)
Constant	3.865***	5.050***	1.736***	41.58***
	(0.756)	(1.254)	(0.267)	(11.00)
Observations	91	94	66	53
R-squared	0.201	0.073	0.076	0.156

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each column in this table refers to a different regression with the column name as the dependent variable.

Source: Authors' calculations.

Measuring the impact of organisational structure on investment policies

Table 9.2

Independent variable	(1) Number of eligible assets	(2) Number of eligible currencies	(3) Estimated risk of the portfolio	(4) Investment horizon – total portfolio (months)
Back office, middle office and front office are in the same department	−0.834	−0.869	−0.247	−14.83*
	(0.584)	(0.954)	(0.189)	(8.311)
Government effectiveness	0.701**	0.401	0.222*	14.53***
	(0.321)	(0.516)	(0.118)	(4.768)
Reserves to GDP (%)	2.700*	4.102	−0.273	−19.35
	(1.518)	(2.508)	(0.659)	(19.20)
Constant	6.231***	7.169***	1.848***	38.74***
	(0.492)	(0.801)	(0.181)	(6.111)
Observations	91	94	66	53
R-squared	0.118	0.049	0.101	0.200

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each column in this table refers to a different regression with the column name as the dependent variable.

Source: Authors' calculations.

Measuring the impact of requiring the ministry of finance to cover negative equity   Table 9.3

Independent variable	(1) Number of eligible assets	(2) Number of eligible currencies	(3) Estimated risk of the portfolio	(4) Investment horizon – total portfolio (months)
Obligation to cover negative equity	−0.977	−2.403**	0.0702	−7.063
	(0.703)	(1.179)	(0.223)	(10.02)
Reserves to GDP (%)	3.562**	4.414	−0.151	−19.22
	(1.637)	(2.755)	(0.684)	(22.62)
Government effectiveness	0.345	−0.317	0.258*	11.14*
	(0.403)	(0.666)	(0.139)	(6.363)
Constant	6.327***	8.437***	1.655***	39.26***
	(0.622)	(1.047)	(0.203)	(8.733)
Observations	82	84	61	46
R-squared	0.122	0.079	0.067	0.143

Standard errors are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Each column in this table refers to a different regression with the column name as the dependent variable.

Source: Authors' calculations.

10. Appendix III: Central bank governance and financial supervision

Central banks often have mandates regarding financial stability and supervision, but central bank legislation is often less specific about central banks' clear functions and responsibilities in this regard (Ortiz (2009)). Nonetheless, elements of this task, such as the lender of last resort function or oversight of the payment system, have long been central bank functions (Freixas et al (2000)).[21] Although the trend since the 1990s has been toward consolidation of financial supervisory functions, these changes have primarily focused on consolidating functions in an agency separate from the central bank. Despite those developments, according to a survey of 160 countries completed in 2019, approximately 68% of central banks still have banking supervisory responsibilities (Anginer et al (2019)).

Empirical evidence on the link between central bank independence and financial supervisory responsibilities remains limited. Some research has shown that central bank independence positively impacts bank soundness and that bank involvement in banking supervision mitigates the adverse effects of financial crises (Doumpos et al (2015)). However, this more extensive mandate can impact the central bank's autonomy, decision-making and transparency. Initial findings from the research explored in this report indicate that countries with better overall governance environments and lower country risk usually have an entity different from the central bank for financial supervision, as seen in Table 10.1. The variables used here are

[21]   Henry Thornton (1802) and Walter Bagehot (1873) developed the classic doctrine of lender of last resort. According to Bagehot, in a panic situation monetary authorities should lend unsparingly but at a penalty rate to illiquid but solvent banks. See Freixas et al (2000) for further background.

described earlier in the paper. As a measure of whether central banks also have supervisory responsibilities, we use the World Bank's regulation and supervision survey.[22] This comprehensive survey covers multiple subjects on banking regulation and supervision practices in 160 jurisdictions. We use this survey to establish whether the central bank or a separate entity is responsible for financial supervision. This variable aims to analyse whether reserve management differs in central banks with more responsibilities and more complex governance structures. The survey's last edition was in 2019.

Financial supervision and the broader governance environment				Table 10.1
Variables	Independence of central bank	Corruption Perceptions Index	Governance Pillar Score	Government effectiveness
Central bank is financial supervisor	−0.086	−0.268***	−0.281***	−0.291***

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant). 2

Source: Authors' calculations.

Regarding the impact on reserve management, the correlations suggest that countries where the central bank is also a financial supervisor tend to have an independent investment committee to which the middle office reports (see Table 10.2). This arrangement may result in a lower risk appetite in managing reserves and imply that the central bank accounts for and manages the risks of a more volatile governance environment in which it operates. As other findings of this paper show, in deficient overall governance environments, central banks tend to have independent investment committees because they can help safeguard decisions made by a weak and/or politically influenced board. However, the literature and data are scant on whether a central bank with supervisory functions impacts reserve management and policy decision-making. This question may be another line of future inquiry and research.

Financial supervision and the governance of reserve management			Table 10.2
Variables	Independent investment committee	Middle office reports to the investment committee	Obligation to cover negative equity
Central bank is financial supervisor	0.255**	0.243**	0.277**

The significance level of the pairwise correlations is displayed with asterisks, where *** stands for a p-value below 0.01 (ie extremely significant), ** stands for a p-value below 0.05 (ie very significant) and * stands for a p-value below 0.1 (ie significant).

Source: Authors' calculations.

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[22]   www.worldbank.org/en/research/brief/BRSS.

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