

The challenges of managing large FX reserves: the case of Israel

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Abstract

This paper describes the Bank of Israel's investment philosophy and policy. The paper focuses on the strategic asset allocation framework and the role of the Monetary Policy Committee in setting the investment strategy. The abundant FX reserves in recent years, and falling yields on traditional reserve assets, called for reform in reserves management. Institutional changes – the enactment of a new central bank law – made reform possible. The result was a dramatic shift in the BOI's investment policy. In seven years, the BOI moved from a classic reserves portfolio to a multi-asset diversified portfolio that includes a sizeable allocation of equities and corporate bonds. These riskier assets significantly increased the returns on reserves in recent years. For example, between 2012 and 2017, investment in equities was the source of 64% of the total return, which was 9.2%. The contribution of equities to total return allowed the BOI to preserve the purchasing power of reserves at times when traditional reserve assets yielded negative real returns.

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1. Introduction

The Bank of Israel (BOI) manages a sizeable foreign exchange reserves portfolio, which stands today at approximately \$115 billion as of November 2018, or about 31% of GDP. It has grown threefold in a decade, mainly due to FX purchases that totalled \$85 billion. While the BOI was accumulating reserves above and beyond the adequate level associated with precautionary purposes, the yields on traditional reserve assets dropped to near zero levels and even to negative territory. These changes called for a revised approach to reserve management.

The first step was to change the legislative framework defining the management of the foreign exchange reserves. Within the new BOI law that was legislated in 2010, the BOI's potential investment universe was expanded to include for the first time not only the traditional reserve assets, such as high-grade government bonds, but also equities and corporate bonds. In addition, the law induced a major institutional change with the establishment of a Monetary Policy Committee (MPC), while previously decision-making was solely in the hands of the BOI's governor. The motivation for establishing the MPC was to improve the quality and consistency of monetary policy, the major role it still fulfils. In addition, it has come to be over time the high-level investment committee of the BOI.

These two processes, ie the institutional changes at the BOI and the rapid growth in FX reserves, led to a shift in the BOI's investment policy, which although implemented gradually, facilitated a radical change in hindsight. While a decade ago reserves included "classic" reserve assets only, nowadays the BOI manages a diversified, multi-asset portfolio of which about 20% is allocated to other assets.

This paper describes the BOI's current investment policy and the driving forces behind it. We start by describing the background conditions – the level of reserves and the fall in yields on traditional reserve assets. Next, we lay out our investment philosophy – our attitude to financial markets' behaviour and idiosyncratic attributes as an investor in those markets, with the implications for our investment strategy. Next, we describe the diversification process from the perspective of the MPC, and its impact on the process of moving toward a reserves portfolio with a higher expected return and a higher risk. We conclude with remarks on the contribution from a broader asset class and our capacity to bear reputational risks in case of a loss.

2. Managing abundant reserves when the risk-free real rate is negative

The assets of a central bank are typically managed according to the priorities of (1) safety, (2) liquidity and (3) return. The implications of these preferences are strict: many assets are entirely excluded from a central bank's investment universe when the first two preferences are dominant. Therefore, when the level of reserves is relatively low, return is not only the least important goal of a central bank, it is also one which is hard to achieve, as many of the assets that could potentially generate higher returns are not eligible for investment.

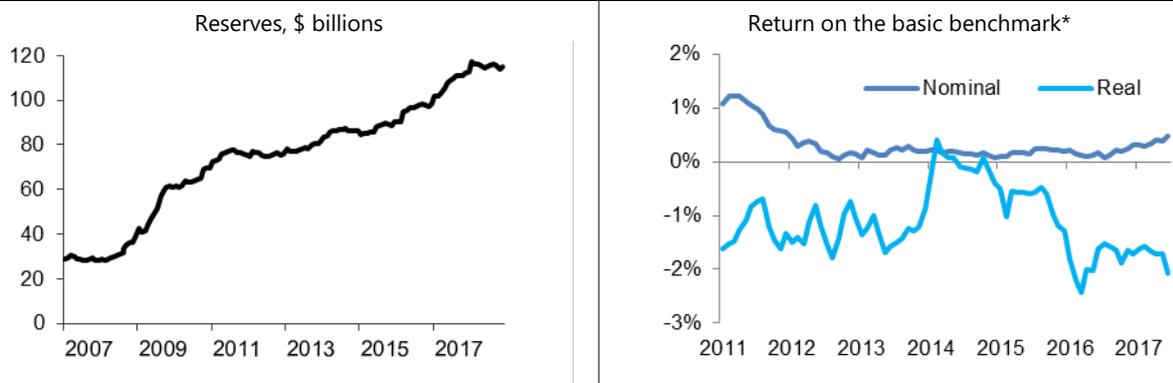
These considerations change with the level of reserves. When reserves are below the adequate level which is a function of the precautionary needs, the central bank cannot

afford sharp fluctuations and therefore has to mitigate the risk associated with reserves management. This is typically done by adhering to a basic, “risk-free” benchmark, which depends on the structure and exposures of the economy.

The most important factor behind the behavioural change of the BOI as a reserves manager is probably the accumulation of reserves up to and beyond a level that ensures the first target of reserve management – safety. The systematic, preannounced FX purchases that were conducted between March 2008 and August 2009 (see the left-hand side of Graph 1) brought the reserves to a level that was deemed sufficient at the time. As FX discretionary purchases continued, the BOI started to assign a higher and increasing weight to the next and last goal in its priority list – rate of return.

The BOI’s reserves and the return on the BOI’s basic benchmark

Graph 1



* The basic benchmark of the BOI, the numéraire, is defined as a six-month duration portfolio comprising US government bonds (67%), euro area bonds (30%) and UK government bonds (3%). The figure presents the annual minimal rolling returns. Real return is adjusted for inflation in numeraire countries.

Amid the reserves accumulation process, the yield on the BOI’s basic benchmark, which is composed of short-duration US and European countries treasuries, fell to a near zero level.² The outcome of these two developments, which are not mutually exclusive,³ is that the *real* yield on the BOI’s basic benchmark fell into negative territory. This means that sticking to the benchmark portfolio would have eroded the purchasing power of reserves and hence would have violated the major objective of reserve management – safety.

The extent and persistence of a negative real rate of return is shown on the right-hand side of Graph 1. Note that the BOI did not stick exactly to the basic benchmark even before equities and corporate bonds were introduced to the portfolio. Some risk was taken – either in the form of a longer maturity than the benchmark or by allocating a fraction of the portfolio to various “spread products” – assets that can be classified as close substitutes for the benchmark “risk-free” assets, but generate some excess returns, usually due to their lower liquidity. However, such an investment

² The BOI’s basic benchmark reflects the fundamental exposures of the economy to various real and financial shocks that might require a draw of reserves. For the composition of this benchmark see Graph 1.

³ The drop of the yield on the basic benchmark reflects the ultra-expansionary monetary policies of the Fed, the ECB and the BOE, which contributed to capital inflows and a continuous upward pressure on the NIS. This exchange rate overvaluation has been the main driver for the BOI’s discretionary FX purchases since August 2009.

strategy can only partially mitigate the erosion of purchasing power, while expanding the asset universe to alternative assets has at least the *potential* of addressing this problem in full.

3. The BOI's investment philosophy and strategy

A coherent set of investment principles that reflect the investor's preferences and beliefs regarding financial markets behaviour, is always useful, and even more so in the case of a central bank, which invests in a broader asset universe and adheres to the general principles of sound public policy. We refer to these principles as our *investment philosophy*.⁴

As investors, central banks have several distinct attributes: first and foremost, modern central banks hold reserves mainly for precautionary reasons, specifically to be able to supply the demand for foreign currency if necessary so as to fulfil their mandates and ensure financial stability and the smooth functioning of the FX market. This is the motivation for the preference structure previously mentioned. Second, central banks are exposed to a unique reputational risk: the risk that a large loss on reserves will damage their institutional credibility, which could have repercussions for the entire economy. Indeed, the independence of the central bank is a direct function of its credibility in fulfilling its mandates. In Israel, the BOI is an independent institution operating under an inflation targeting regime, for which credibility is key. Thus any reputational damage could have far-reaching macroeconomic consequences.

An additional problem that magnifies the BOI's reputational risks is that the reserves portfolio's basic benchmark – the numéraire – comprises a synthetic currency (see the note below Graph 1 for details). The BOI's annual financial report is published in local currency; and to add confusion, the level of reserves is also reported on a monthly basis in US dollars, and as a percentage of GDP.

These several indicators on reserves are rarely aligned and thus present a challenge for managing communication on that front. These challenges depend not only on the inclusion of riskier assets in the portfolio, but might be exacerbated when the level of risk in numéraire terms increases.

The importance of the precautionary motive and the reputational risk was translated into a clear measure of risk appetite, which can then be used to define the set of appropriate portfolio allocations, as will be described below.

Under these limitations, and given the abundant level of reserves, the BOI chose two asset classes so as to extract premia over time: equities and investment-grade corporate bonds, in both cases those of developed economies. Equities were chosen for their excess return over long horizons, their negative correlation with government bonds and their relatively high liquidity, and corporate bonds for their risk-return ratio and the fact that, given the current level of reserves, the BOI is in the position to extract a liquidity premium.

⁴ Some of these principles below were officially adopted by the BOI while others simply reflect its prevailing preference.

A central question in formulating an investment philosophy, and especially when equity investment is considered, is whether the investor believes in market efficiency. In an efficient market, asset prices should reflect all available information, including historical data, public and private information. In this case, one cannot exploit any such information to achieve abnormal returns, systematically. This in turn implies that an investor who believes in market efficiency has no reason to attempt to time the market, as prices follow a random walk. This also implies that such an investor has no reason to engage in security selection, as all information is already reflected in the securities' prices.

The BOI's general attitude is that financial markets are close to being efficient, and this attitude *dominates* the BOI's investment strategy. Hence, when allocating funds to alternative assets, the BOI is guided by a market-cap approach, and invests in global benchmarks such as the MSCI-developed market stock index,⁵ the Barclay's US Corp IG etc. The actual allocation to these assets is determined through an annual strategic asset allocation process, in which efficient diversification is an important consideration, and is vetted by the MPC. The result is an "MPC benchmark", which the actual portfolio tracks relatively closely. This is not to say that only strategic considerations affect the actual portfolio. Tactical decisions, for example in the form of long/short positions vs the MPC benchmark, are regularly taken by the department of market operations; however the relative size of these positions is usually small.⁶ In the equity market, selection is applied at a country level only, ie not on at the individual security level. As to corporate bonds, some deviation from the benchmark is allowed at the individual security level, with a limited degree of tracking error.

Holding claims on corporates rather than on other sovereigns is a big conceptual change for a central bank. In order to develop the necessary competence, and especially to test the risk management framework, the diversification process has been applied gradually over several years, during which the total allocation to the new asset classes was augmented continuously and the assets were allocated to additional markets.⁷

The overall results of this diversification process are shown in Graph 2, where the "before and after" 2010 vs 2017 breakdowns of reserves are presented. The green shades, which denote riskier assets, make up almost 20% of the reserves portfolio today. These assets were added at the expense of government bonds, while the allocation to cash, money market, and other assets has remained almost unchanged.

The risk framework to monitor and control the risks associated with investment in alternative assets contains several layers. The guidelines set constraints on the maximum allocation to equities (15%), and to corporate bonds (15%), while the total allocation to these assets, combined, is limited to 25%. Investment in corporate bonds is limited to investment grade bonds, and is allowed in US and European bonds only. The risk appetite of the MPC was translated as follows: the total risk of the portfolio

⁵ This benchmark was slightly modified due to several adjustments that were done because not all the assets that are included in the index are investible according to the BOI's guidelines. For example, the BOI does not invest in Israeli companies that are included in this benchmark.

⁶ For example, a typical position in equities is of the size of 0.5% of total reserves, while the allocation to equities in the end of 2017 was 13.3%. In addition to tactical positions, strategic allocation changes create timing issues that cannot be completely avoided.

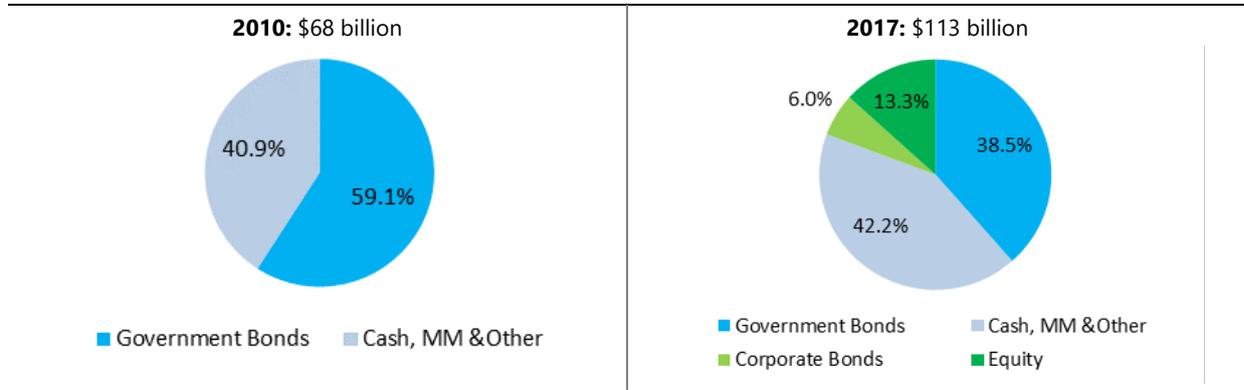
⁷ See Abir and Benita (2018) for a fuller account of the adjustment process and the considerations behind it.

is constrained by a maximum expected tail loss of 400 bp in the worst 5% of the outcomes. This measure, aka the conditional value-at-risk (CVaR), provides a useful instrument for evaluating the risk in real time.

From a classic to a contemporary reserve portfolio

The composition and level of foreign reserves, year end

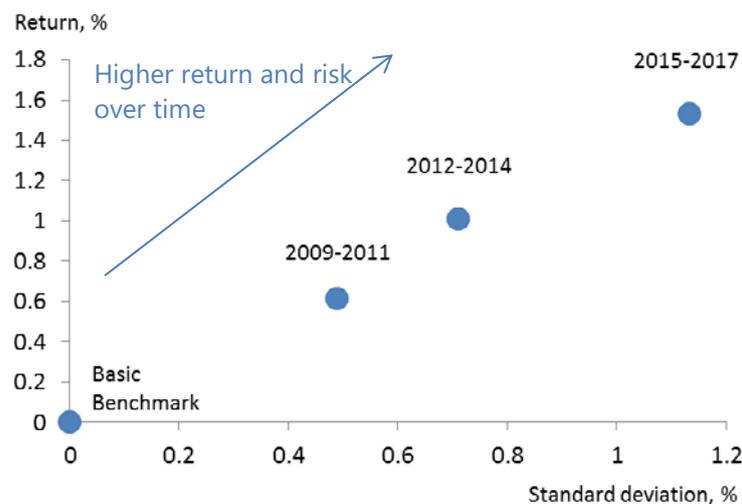
Graph 2



The gradual increase in the share of riskier assets within the portfolio is expected to yield higher returns over time. However, over short periods of time – even up to one year – the ex post results are not always associated with higher returns. Thus the horizon used to evaluate the risk-return trade-offs is crucial for measuring the CVaR: for instance, with the same level of CVaR, a longer horizon will allow for a larger proportion of riskier assets in the portfolio than it would for a shorter time horizon. This reflects the fact that the prices of riskier assets tend to recover over a longer period of time. Graph 3 presents the risk-return space over a three-year moving average compared with the basic benchmark (which is defined as the risk-free asset, and hence located at the origin of the axes in the graph). The results show the steady increase in actual returns and risks since the BOI has started to invest in riskier assets.

The contribution of adding new asset classes to risk and return* (%)

Graph 3



* The figure presents three-year averages of excess return and volatility relative to the basic benchmark. Volatility is measured by the standard deviation of weekly returns in annual terms.

Although the risks have definitely risen, our experience in equity investment implies that it is less risky than meets the eye. Due to the negative equity-bond correlation, drops in equity prices are usually compensated by price increases for fixed income assets and vice versa. The counterintuitive result is that adding a small allocation of equities to a fixed income portfolio reduces rather than increases the volatility of the portfolio while increasing its expected return. In other words, the traditional reserve portfolio that contains fixed income assets only is simply inefficient, at least over a one-year horizon.⁸

4. The strategic asset allocation process

In recent years, the BOI has developed a well structured strategic asset allocation (SAA) process, which aims at achieving efficient diversification of the reserves portfolio, as well as robustness under different market outcomes. Our SAA process starts by assessing the global macroeconomic environment; next, we outline a central-tendency base scenario, and also optimistic and pessimistic scenarios, focusing on growth, inflation and monetary policy. In each scenario, we forecast the expected returns on the assets that are part of our investment universe set. Given our forecast for the assets' expected returns, we derive the efficient frontier using the mean-variance (MV) approach. This is a useful starting point, but is very sensitive to the assumptions made about the distribution of assets' returns, and it tends to generate optimal portfolios with a small number of assets.⁹

To address these limitations we use two analytical tools, which have been developed internally. The first analyses the portfolios that are located near the efficient frontier, and the second maps the risks to the optimal portfolio within a range of expected returns. These tools enable us to have a more productive and robust investment decision process.

4.1 The portfolios near the efficient frontier

Generally, the reserves portfolio is exposed to four main risk factors: currency risk, duration risk, credit risk and equity risk. Similar portfolios in risk-return terms can sometimes be obtained by using different combinations of risk factors. For instance, there may be two portfolios with a similar expected performance under the baseline scenario where the risk in one is mainly due to its allocation to equities, while in the other it is mainly due to its duration exposure. However, these portfolios may have substantially different performance under the alternative scenarios. In such cases, we would prefer to invest in a portfolio which is slightly below the efficient frontier, if by doing so we can obtain a higher degree of robustness to different scenarios. This is the reason why it is important to also assess "near-optimal" portfolios – that is, portfolios that are close to the efficient frontier.

For example, we present the efficient frontier for 2017 based on the BOI's forecast as of December 2016 (the red line on the left-hand side of Graph 4). The portfolios

⁸ Many central banks refrain from equity investment, yet at the same time invest in gold, which is at least as volatile as equities. Historical, cultural and political explanations are probably behind this phenomenon.

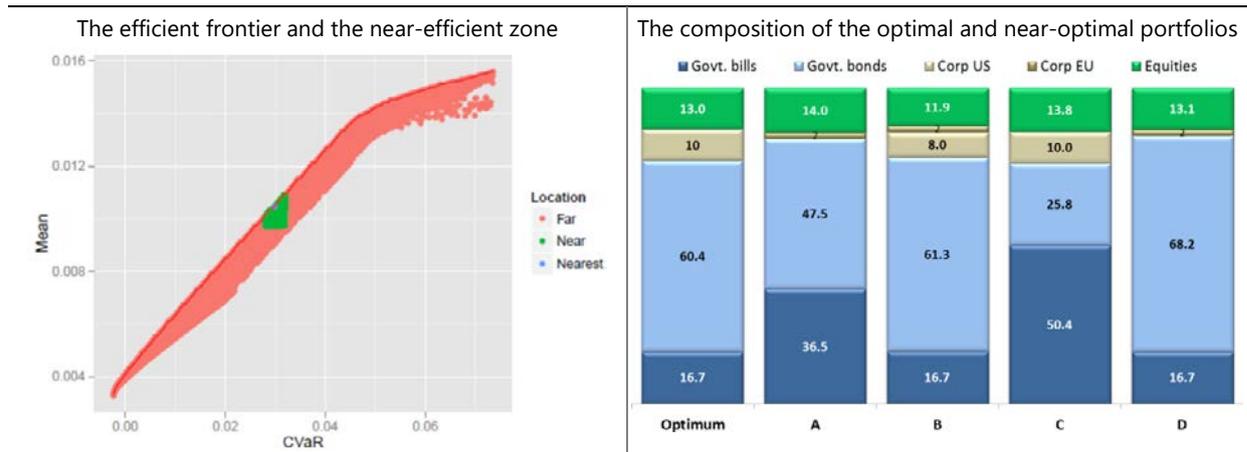
⁹ Mainly as a result of imposing a "no-short-sales" constraint on the optimisation process.

close to the target risk (in green), which was set by the MPC to a CVaR of 3%, represent about 1,000 different but similar portfolios in terms of risk and expected return. Within this set, we inspect those portfolios that are most different in their composition from one another and from the optimal portfolio. These portfolios are shown on the right-hand side of Graph 4.

The portfolios presented in Graph 4 have very similar expected performance under the base scenario, but they have very different compositions. This means that their performance under the alternative scenarios can be substantially different.

Optimal asset allocation for 2017

Graph 4



¹ The portfolios A–D are near-optimal, and are compared to the optimal portfolio. The different composition of bonds vs bills in between the portfolios reflects different maturities. The investment in equities follows closely (but not identically) an MSCI-DM-like index.

4.2 Sensitivity analysis

After setting the risk level, the next main three strategic decisions to be taken by the MPC are the weight of equities, the weight of corporate bonds, and the portfolio's duration. We examine the robustness of these decisions for a range of outcomes around our base scenario. Specifically, we check deviations from (1) the expected structure of the yield curves; (2) the expected return on equity; and (3) the expected change in credit spreads. These deviations can be associated with two risk factors – a curve risk and a business cycle risk, where the later reflects the correlated performance of equities and corporate bonds.¹⁰

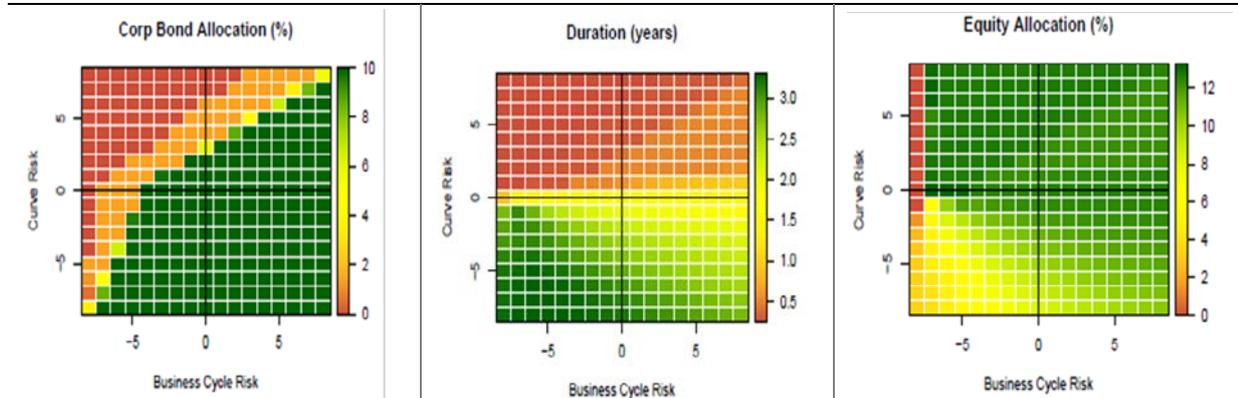
The heat maps in Graph 5 show the sensitivity of the three main strategic decisions to the main risk factors. Each portfolio is represented by its portfolio duration, its allocation to corporate bonds and its equity allocation. The characteristics of the optimal portfolios – duration, weight of equities and weight of corporate bonds – are presented in three graphs of the space defined by curve risk (vertical dimension) and business cycle risk (horizontal dimension).

The MPC's role is to set the risk level and to select the SAA benchmark. The analysis above lets the MPC members to review a wide set of eligible portfolios. This allows them to apply judgment, to take into consideration factors such as reputation,

¹⁰ The fourth risk that we mentioned – currency risk – is not analysed through the SAA process.

and even to express personal preferences before making the strategic decisions, and facilitates a robust investment decision process.

The optimal duration and allocation to risk assets under different scenarios for 2017 Graph 5



¹ Reading the heat maps: the origin in the three heat maps above represents the optimum under the base scenario. Weak growth is represented by a negative business cycle risk, where higher interest rates are represented by a positive curve risk.

5. The impact of the Monetary Policy Committee on the BOI's risk appetite¹¹

Although the motivation behind the establishment of the MPC was primarily to improve the quality and autonomy of monetary policy, over time, it has practically turned into the BOI's investment committee. As such, nowadays, the MPC discusses and approves the major strategic decisions affecting the management of reserves. This includes, for example, adjusting the MPC benchmark composition annually, approving the inclusion of new assets, setting the level of the CVaR etc.

This involvement of the MPC was not bound to happen. The BOI law is a primary law, and as such is a high-level law that does not detail the responsibilities of the MPC regarding reserves management, beyond its duties to formulate investment guidelines and report to the government and the general public.¹²

The composition of the committee, its size, and the intensity of the interaction of its members, probably contributed to the process. The BOI's MPC comprises three internal BOI members and three external, independent members.¹³ This balanced

¹¹ This section benefited from conversations with Esti Schwartz and Eddie Azulay, who were involved in the early stages of the MPC's work, in which none of the authors took part.

¹² According to the law, the MPC is in charge of formulating the guidelines for reserve management (40.b), reporting biannually to the Minister of Finance (40.c) and reporting to the public on the composition of the reserves portfolio, annually (40.d). Initially, the intention was to leave the management of reserves within the guidelines to an internal BOI committee – an advisory committee in which the Governor was the sole decision-maker. The investment guidelines are subject to consultation with the Ministry of Finance.

¹³ In case of a tie, the Governor of the BOI, who is one of the three internal members of the MPC, can cast a decisive vote. This option, however, has never been exercised.

structure is uncommon (BIS (2009)). Unlike central banks where the MPC meets only around interest rate decisions, the BOI's MPC convenes on a weekly basis in order to discuss development in the local and international markets. These ongoing deliberations allow the MPC members to be briefed continuously on the factors that determine the performance of the reserves portfolio. The size of the BOI's MPC, according to the literature, is well within the optimal range for decision-making, and its size encourages constructive dialogues between group members,¹⁴ which are important for information-sharing given the varying degrees of expertise of different committee members of the subjects at hand.

What was the impact of the migration of strategic investment decisions from the governor of the BOI to its MPC, on the risk-return profile of reserves?

On the one hand, the interaction between the MPC and the BOI's Market Operations Department staff creates the impression that the MPC slowed the process of moving towards a riskier portfolio. The reason is that the usual dynamics of decision-making at the BOI is based on bottom-up proposals to increase the allocation to riskier assets, expand the eligible asset classes and so on. The MPC accepts, modifies or rejects the proposals, but so far the demand for higher risk has never been initiated by the MPC. In addition, it is important to note that the initial decision to break the concept of traditional reserve management and to allocate 2% of reserves to equities was in fact implemented in 2011 by the governor at the time, Stanley Fischer, before the MPC was established later on that year. It is unclear if a committee would have made such a dramatic decision.

On the other hand, it is doubtful whether 20% of reserves would have been allocated to riskier reserve assets – equities and corporate bonds – by a single decision-maker if an MPC had not existed. As reserves are currently higher than those required due to precautionary motives, the effective constraint on the BOI's risk-appetite is the reputational risk it faces in case of a loss on a potentially macroeconomic scale. The MPC in this context creates a mechanism for sharing the reputational burden, which might have been too heavy for any single decision-maker to bear. In addition, such a decision would have been probably sensitive to the identity of the specific governor in office and to regime changes.

Psychological research indicated long ago that groups tend to accept greater risk than do their individual members (Bem and Madaras (1968)). This phenomenon was also validated later in the field of experimental economics, and particularly in settings that emulate investment decisions under risk. For example, within a well known design that generates results that are in line with the myopic loss-aversion of individuals,¹⁵ it was found that decision-making by teams rather than individuals attenuates loss-aversion and yields higher risk-taking (Sutter (2007, 2009); Nieboer (2015)). Thus, keeping in mind the caveats associated with the abyss between experimental economics and real-world investment decision-making, and the impression generated by the dynamics between the MPC and staff that point to the

¹⁴ See Erhart et al (2007) for a review of the literature in economics as well as other disciplines on the optimal size of decision-making groups.

¹⁵ In this experiment, individuals have to decide repeatedly on the amount they are willing to invest (x) in a lottery that yields $-X$ on a probability of $2/3$, and $2.5X$ on a probability of $1/3$. The results show that the more frequently returns are evaluated, the more risk-averse investors will be. This phenomenon, coined "myopic loss-aversion" can also help to explain the equity premium puzzle. See Gneezy and Potters (1997).

restraining role of the MPC, it is equally possible that the MPC promoted a higher risk-return profile for the reserves portfolio.

6. Conclusions

The abundant level of FX reserves in recent years, and the falling yields on traditional reserve assets, called for reform in reserve management. The institutional changes that took place in the BOI made reform possible. The result was a dramatic shift in the BOI's investment policy. In seven years, the BOI moved from a classic reserves portfolio to a multi-asset diversified portfolio in which the allocation to equities and corporate bonds is sizeable.

This shift has materialised despite the BOI's character as inherently a conservative institution with a culture dominated by risk-aversion. The BOI's duty to preserve financial stability contributes to a cautious attitude that is usually focused on the downside rather than on the upside of risk. This sometimes creates a dissonance between the BOI's investment behaviour and its other roles.

The riskier assets significantly increased the returns on reserves in recent years. For example, between 2012 and 2017, investment in equities was the source of 64% of the total return, which was 9.2%. The contribution of equities to return allowed the BOI to preserve the purchasing power of reserves at times when traditional reserve assets yielded negative real returns. This, however, did not come for free. The short-term volatility of reserves has risen, but so far the BOI has not dealt with a major reported loss on its riskier assets.

One of the challenges of investing in riskier assets is the reputational damage a loss might inflict. The BOI is fully aware that given the range of its asset classes, such a loss, for example in a single year, is inevitable. The mostly passive investment behaviour of the BOI provides a partial hedge against reputational risks if losses were to materialise. In addition, the BOI's MPC, which functions as an investment committee, provides a mechanism for sharing the reputational burden and supports consistent investment policy during rotations in the governor's office.

In addition, the successful track record of the investment in riskier assets may have created some leeway for absorbing losses without reputational implications. The performance of the reserves portfolio in 2018 might put this expectation to a test sooner than we had hoped.

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