Sterilization in Botswana: Cost, Sustainability and Efficiency

Ita Mannathoko

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By

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Contents

List of tables

List of figures

Abstract

While Botswana has had a good governance record, it has also had its fair share of challenges. This paper investigates why monetary policy in the country failed to contain inflation in the 2000s decade, and explores corresponding concerns over the fiscal cost of monetary sterilization, low monetary policy autonomy and real exchange rate appreciation. The findings provide an explanation for Botswana's sub-optimal monetary policy outcomes that challenges the popular storyline. Accounting equations are used to estimate the net cost and sustainability of sterilization interventions and to compile a monetary policy autonomy index, while simultaneous equation estimation using two-stage least square regressions for a monetary policy reaction function and a capital flow equation provide measures of the extent of sterilization and of offsetting inflows prior to and after the great recession. The results show how a series of policy decisions from 1999 led (in the absence of appropriate counter-measures) to substantial loss of monetary policy autonomy, large offsetting inflows, unsustainable sterilization costs, high inflation and real exchange rate appreciation. In the wake of the great recession, excess liquidity pressures have now abated and offsetting inflows have tapered off, thus reducing the need for sterilization. Recent diamond import-linked (customs union) inward transfers to the current account have enabled reserve accumulation and recovery of monetary policy autonomy. However, these current conditions for enhancing monetary policy autonomy remain overly reliant on the diamond industry and may not be sustainable. A long-term solution is still needed as inflows from large trade surpluses may resume in the future.

Keywords: Monetary policy, sterilization, capital flows, autonomy, inflation, real interest rate differential, real exchange rate

1.0 Introduction

1.1 Background

Resource-rich mineral exporters face the challenge of managing large monetary inflows through the current account. For many resource-rich mineral-exporting developing countries, large inflows through the current account derive from a single sector. In such cases, the use of a managed exchange rate regime alongside sterilization interventions to avoid excessive inflation, excessive currency appreciation and loss of competitiveness is well established both in practice and in the Dutch Disease literature. [1]

By pegging or otherwise targeting the exchange rate through foreign exchange interventions, policy makers can help limit Dutch Disease tendencies and avoid placing upward (appreciation) pressure on the domestic currency, displacing domestic production with imports of tradable goods, and decreasing the competitiveness of domestic manufacturing (Corden and Neary, 1982; Corden, 1984; Wijnbergen, 1984b). At the same time, sterilization interventions[2] ensure that large foreign exchange inflows have limited effect on the domestic monetary base. Without sterilization, large current account surpluses and capital inflows could generate enough excess liquidity in the banking system to accelerate the growth of credit, cause inflation and lead to loss of monetary control; or they could pressure the real exchange rate to appreciate, affecting macroeconomic variables in a way that hampers policy objectives such as price stability, exchange rate stability, and export promotion (Fernandez-Arias and Montiel, 1995).

This paper presents a particularly interesting story about sterilization and the monetary policy experience in Botswana, a country that is widely cited as an African success story and model for prudent governance. Botswana's good record, however,

1 The term "Dutch disease" originates from a crisis in the Netherlands in the 1960s that resulted from discoveries of vast natural gas deposits in the North Sea. The vast receipts from gas exports caused the Dutch Guilder to appreciate significantly, making exports of all its non-gas products uncompetitive on the world market. Relatively recent research on resource-rich economies (Aliyev, 2012) confirms findings in the earlier literature.

2 Sterilization refers to monetary operations that reverse monetary increases in the economy. It can take various forms, such as raising reserve requirements, shifting government deposits from commercial banks to the central bank, central bank borrowing from commercial banks, or the sale of debt instruments in open-market operations.

does not mean that the country has not had its fair share of policy challenges.

This paper analyzes a period of adverse experience with monetary policy outcomes in a two-target two-instrument policy regime, providing useful lessons for Botswana and other resource-rich developing countries on the importance of well-defined transmission mechanisms and careful structuring and coordination of macroeconomic policy decisions. It also illustrates the significant influence that pension fund resources can have on monetary policy outcomes in a developing country, and shows how the treatment of these resources matters to monetary policy.

1.2 Objectives

This study is motivated by the need for a fuller understanding of Botswana's experience with sterilization during large current account surplus and large private inflow episodes, where, in addition to monetary policy's inability to meet its inflation objective, the rising intensity of sterilization over time produced fiscal cost, and sustainability and efficiency concerns. A broader understanding of this sterilization experience could help policy makers to better manage the monetary policy process in future, should large current account surpluses resume and large private inflows happen.

The objective is to determine why Botswana's sterilization policy failed to contain inflation in the 2000s, how efficient the policy was, how the fiscal cost could be mitigated under similar conditions in future, and how sterilization can be improved. The study considers questions related to fiscal cost, and sustainability and efficiency of sterilization. What has the annual fiscal cost of sterilization been since 1991 when open market operations commenced and Bank of Botswana Certificates (BoBCs) were introduced as sterilization instruments? When was the fiscal cost highest and why? Was the cost sustainable? Was monetary policy autonomy affected? Did offsetting capital inflows to Botswana hamper the efficiency of sterilization interventions? Why were policy outcomes in the period prior to the great (global) recession of 2008-09 so different from those seen in the wake of the great recession?

To address these issues, the approach of this paper is to:

(i.) measure and track the net fiscal cost of sterilization over time both prior to and after the great recession of 2008-09, covering the period 1991 to 2014, and determine when sterilization was sustainable and when it was not;

(ii.) track the evolution of monetary policy autonomy (constructing an index) for the above period and consider its relationship to the real exchange rate – to consider the hypothesis that sterilization was constrained in preventing real currency appreciation over the medium term because monetary policy autonomy was short-lived; and

(iii.) investigate the relationship between sterilization, inflows and monetary policy

efficiency for the period 2002 to 2015, considering the sub-periods before and after the great recession. This will entail econometric estimation of the degree of sterilization (sterilization coefficient) and the offset coefficient from capital inflows.

1.3 Potential Contribution

As far as the author has been able to determine, the approach and methodologies adopted in this paper have not been used before in published studies of monetary policy and excess liquidity management in Botswana. Neither have other published studies provided this paper's interpretation of monetary policy outcomes in the country. In addition to measuring the net fiscal cost and sustainability of past sterilization, this study assesses the efficiency of the sterilization process alongside the impact it had on monetary policy autonomy. It measures the degree to which current account receipts and other inflows were sterilized and estimates the extent to which off-setting capital inflows may have restricted the ability of sterilization measures to remain effective. This is an important consideration because temporary impact would explain the failure to contain inflation; it would have necessitated repeated sterilization resulting in a larger fiscal cost and higher interest rates. The analysis will help to inform future sterilization measures in Botswana.

While most of the literature concentrates on sterilization necessitated by large capital inflows, this study also looks at sterilization of the mineral export receipts that fuelled current account surpluses. It contributes to the debate on the cost and efficiency of sterilization by considering whether sterilized intervention can serve as a fully independent policy tool in an economy driven by large mining export receipts. It uses Botswana as a case study to analyze its experience in sterilizing mineral receipts through the current account and capital inflows, applying both accounting equations and econometric modelling to the sterilization question.

The rest of the paper is structured as follows: Section 2 provides an overview of the pertinent literature; Section 3 describes Botswana's experience with sterilization; Section 4 gives the accounting calculations and the monetary autonomy index used. Section 5 provides the framework and model specification. Section 6 lays out the data and descriptive statistics and presents the results and their interpretation. Section 7 summarizes the conclusions and policy implications from the study.

2.0 Overview of the Literature

2.1 Literature on Sterilization in Botswana

Though little, if any, published work has been done on sterilization policy in Botswana, there are a couple of papers alluding to the effectiveness of the Bank of Botswana Certificates (BoBCs) used for sterilization. While investigating the efficacy of auction systems used in the sale of BoBCs, Kone (1996) reviewed the performance of BoBCs in mopping up excess liquidity from 1991 to 1996, given the objectives of attaining price stability and positive real interest rates comparable to those in world financial markets. He surmised that BoBCs had been effective in mopping up excess liquidity, re-establishing positive real interest rates, and cutting down credit growth in Botswana. The desired outcome was to have real interest rates at an equilibrium level that would keep the economy at its production potential over time, such that real rates below this equilibrium could be deemed inflationary, while real rates above the equilibrium would be associated with stagnation and disinflation.

In 2001, Masalila and Phetwe also described how the volume of BoBCs auctioned by Bank of Botswana was based on an estimate of excess liquidity where the excess liquidity to be absorbed was "specified by the central bank relative to a given level of real interest rates", with the focus on keeping real interest rates positive at levels comparable to those in major international financial markets. In more recent years, the Bank of Botswana has indicated that its liquidity management is determined in the context of an inflation forecasting framework that estimates an output gap to represent aggregate demand pressures (Bank of Botswana, 2015a).

With respect to the effectiveness of monetary policy, several monetary policy reaction function (MFR) studies have been conducted. Bleaney and Lisenda (2001) used a MFR for interest rates to study monetary policy in Botswana in the post-liberalization era after 1990 and found a countercyclical response of the Bank of Botswana's Bank Rate to both real private sector credit and inflation. Setlhare (2004) specified a modified version of the MFR in Setlhare (2002) and used OLS regressions to estimate the function for the Bank of Botswana over the period 1977-2000, finding that monetary authorities had been systematic in conducting policy and that inflation (directly and indirectly through the real exchange rate) was an important variable of policy interest. Setlhare (2013) investigated the monetary policy transmission mechanism in Botswana, including over the period 2005-2011 when the crawling

exchange rate peg regime was in place, using a structural identification scheme to allow for simultaneous interaction between monetary policy and exchange rate variables. There was evidence of simultaneity between monetary policy and real exchange rate. The results showed only weak transmission of monetary policy to inflation, through both interest rate and exchange rate variables.

2.2 Sterilization Cost and Sustainability, and Monetary Policy Autonomy

Beyond Botswana, the cost and efficacy of sterilization has been debated both in the literature and by policy makers. Frenkel (2010) discusses the notion of the impossible "trilemma", referring to the inability of monetary authorities to influence both the exchange rate and interest rate, given an open capital account. He shows that the trilemma holds only if the exchange rate is over-valued. In the case of under-valued exchange rates, the corresponding monetary policy space comes into play; this is pertinent to developing countries that target real exchange rates to generate export-led growth, but still need flexibility regarding the domestic interest rate. Frenkel (2007) shows that given free capital flows, the "trilemma" will hold in a country with an overvalued exchange rate because, in this scenario, policy makers must draw on limited foreign exchange reserves to support the exchange rate at a given level. Once the reserves run out, policy makers can no longer support the currency and influence interest rates. However, the trilemma does not hold in the short to medium term with an undervalued exchange rate as the country accumulates foreign exchange reserves (rather than drawing on them) to maintain the lower exchange rate level. In this case, the sustainability question does not concern the adequacy of foreign reserves, but rather is determined by how much domestic interest (paid on domestic liabilities) can exceed foreign interest (earned on assets) adjusted for the exchange rate, and still be maintainable. This difference between domestic and foreign (adjusted) interest rates (cost and earnings, respectively) helps to define how much monetary policy autonomy the central bank has. Frenkel's analysis suggests that the closer the currency is to over-valuation, the less monetary autonomy and efficiency the authorities' sterilization policies will achieve.[3] The analysis by Frenkel (2010) enables this paper to construct a monetary policy autonomy index A, which tracks the evolution of monetary autonomy over time.

Sterilization policy has its challenges. Intensifying this intervention can sometimes generate new hurdles in the guise of rising fiscal costs and concerns regarding sustainability. The interest cost paid by policy makers on the domestic liabilities

3 In the Botswana context, there has been periodic ongoing debate over whether the currency is over-valued – especially relative to the non-mining economy. If over-valued, during such periods, this could have negative implications for the efficiency of monetary policy and for relative prices faced by industry.

used to sterilize will tend to exceed interest earned on an equivalent value of foreign assets. The cost of sterilization arises from this difference between high-yielding domestic debt and low-yielding foreign assets (Calvo, 1991). The extent of the fiscal burden of sterilization incurred in the form of interest paid on government bonds or central bank certificates issued will depend on this interest differential. The interest cost of the sterilization intervention must be manageable for the intervention to be sustainable. In some countries, the fiscal cost of ongoing sterilization (issuing more and more domestic liabilities such as certificates or bonds) can become prohibitive as the market becomes saturated with certificates or bonds, and higher interest rates are required to persuade commercial banks or investors to hold new certificates or bonds.

It can also happen that new speculative capital inflows occur in response to the interest rate differential as the domestic rate rises further above foreign rates, and this in turn necessitates more sterilization and exacerbates the sterilization cost problem. Reinhart and Reinhart (1998) documented sterilization experiences through open market operations which showed that domestic interest rates rose when sterilization began, and that short-term flows as a share of total capital flows also rose as a result of an increase in the short-term interest rate. Ishii et al (2006) work on sterilizing countries showed that to effectively sterilize, domestic debt issued and corresponding foreign assets must be imperfect substitutes. Kawai and Takagi (2008) found that the interest rate differential (and sterilization cost) rises as substitutability declines, and vice versa; therefore greater effectiveness from low substitution can also mean more limited sustainability as cost rises. Masson (1995) describes the United Kingdom case in 1992 where policy makers had over time allowed the level of domestic interest rates to so far exceed target rates (close to international rates) that eventually the extent of output contraction forced the government to abandon its exchange rate target. Some countries are able to contain the interest rate differential between domestic debt and foreign assets and limit the volume of debt instruments issued in order to sterilize. This then helps to contain the cost and enables the sustainability of monetary operations.

Notwithstanding the monetary management challenges, some Dutch Disease literature advises that mineral dependent economies should limit spending of mineral export receipts (fiscal expansion) based on absorptive capacity and save corresponding resource revenues through reserve accumulation. Others, however, posit that developing countries should use mineral receipts to expand absorptive capacity and help establish a base for long-run growth (Fundanga, 2012). As seen earlier, Botswana is an example of an African country that chose to pursue this latter path, only saving the residual from mineral receipts after budgetary allocations were made (informed by absorptive capacity).

2.3 Efficiency of Sterilization

The literature on the efficiency of sterilization and whether it can be sustained under an open capital account considers two channels that are often used to explain instances of temporary (unsustainable) effectiveness of sterilization policy:

(i.) The theory of interest rate parity – where capital inflows respond to and negate interest rate differentials caused by higher domestic interest rates in the wake of sterilization interventions, or

(ii.) The presence of a trade-off between monetary policy autonomy (control of bank reserves) and control of foreign exchange reserves, in sterilization.[4]

More generally, sterilization policy efficiency can be gauged by considering whether its objectives were attained and by reviewing its effect in terms of possible challenges to policy objectives:

(i.) If inflation is not contained by sterilization, this calls the effectiveness of the monetary policy into question.

(ii.) If sterilization raises the level of interest rates to the extent of encouraging further capital inflows under an open capital account, as was observed in several emerging market economies such as Indonesia and Malaysia in the 1990s (Reinhart and Reinhart, 1998), the sterilization can become ineffectual.

(iii.) There are also country examples where sterilization was constrained in preventing real currency appreciation over the medium term, because monetary policy autonomy was short-lived (as domestic and foreign interest rates moved towards parity with capital inflows), or because inflation rose over time (IMF, 2007; Schadler, 2008).

(iv.) If sterilization tightens monetary conditions despite a genuine demand for credit, apart from raising fiscal costs (through excessive bond or certificate issuance), it can suppress private sector growth as seen in the UK case (Masson, 1995) or else create further incentive for locals to borrow from abroad, adding unintended exchange rate risk to the domestic loan portfolio. Reinhart and Reinhart (1998) found in some cases that interest rates increased if the demand for money rose and deduced that by sterilizing, the monetary authorities were not accommodating the increased demand for money, and were forcing the money market to clear at a higher interest rate.[5]

(v.) A final ancillary effect of sustained, sizeable sterilization interventions can occur through commercial bank balance sheets, distorting banks' incentive to lend. Empirical studies examining the role of bank net worth in loan supply using

4 Herring and Marston (1977) derived an expression that described the trade-off between the control of foreign exchange reserves and the control of bank reserves (monetary autonomy) in Germany. Their investigation used a structural model that analyzed international capital flow offsets to monetary policy and sterilization behaviour by the monetary authorities. Brissimis, Gibson and Tsakalotos (2002) presented a unifying theoretical framework for analyzing offsetting capital flows and sterilization using the experience of Germany and the ERM in the 1980s.

5 In Botswana's case, this points to the importance of accurate estimates of the output gap by the Bank of Botswana, as it determines the appropriate extent of sterilization.

aggregate data show that bank liquidity or capital can have a significant effect on lending, and that these effects are stronger when monetary policy is tight (Romer and Romer, 1990; Bernanke and Blinder, 1992; Kashyap et al., 1993; Hoshi et al., 1993; Ueda, 1993; and Ramey, 1993). In some cases, when banks are left with little liquidity, they may tend initially to decrease loans (Hosono and Miyakawa, 2014; Stein 1998). Jayaratne and Morgan (2000) used bank-level data to study the relationship between bank liquidity and loans, while Bernanke and Lown (1991), Peek and Rosengren (1997), Woo (1999), and Ito and Sasaki (2002) used bank-level data to examine the relationship between bank capital and loans. Kashyap and Stein (2000), Favero et al. (1999), and Hosono (2006) also used bank-level data to investigate the bank lending channel of monetary policy.[6]

Governments in both fixed and flexible exchange rate regimes frequently resort to sterilized intervention policy. It is the most commonly used instrument to manage large capital (or current) account inflows (Reinhart and Reinhart, 1998). Empirical studies on the efficacy of these interventions in developed countries suggest that they have often been successful, though the issue of whether or not sterilized intervention can serve as a fully independent policy tool continues to be debated. In developing countries, where there is less empirical evidence available, success has been mixed (Dominguez, 2009). On the other hand, some economies have been successful in the sustained and intense sterilization needed for sizeable foreign exchange reserve accumulation. Asian countries, in particular, have had success with sterilization over extended periods (Reisen, 1993). At the global level, various studies confirmed a rising accumulation of foreign reserves following the Asian crisis in the years prior to the recent global crisis and great recession, reflecting a greater intensity of sterilization by developing countries in Asia and Latin America (Aizenman and Glick, 2009). Saxegaard's (2006) empirical work on African countries noted the importance of sterilization, finding that excess liquidity[7] weakened the monetary policy transmission mechanism and thus the ability of monetary authorities to influence demand conditions in the economy.

There is also a lot of literature on exchange rate interventions where there are central bank operations in the foreign exchange market - affecting the exchange rate. Literature from the 1980s on sterilized exchange rate interventions using the portfolio-balance approach, by Kouri and others, considered how sterilized intervention affected the exchange rate through changes in the asset composition of portfolios and risk premium. Backus and Kehoe (1989) using a general equilibrium monetary model showed that some sterilized interventions had no effect on private sector decisions

6 For the open market operations (OMO) channel that was discussed for Botswana, the implication is that when Bank of Botswana sells BoBCs to banks through OMOs, this decreases the banks' reserves; the banks then have to decrease their loans unless they choose to make up for any shortfall in deposits by selling security holdings or by issuing non-reservable debt. In Botswana, the cost of issuing new debt to augment loan supply is likely to discourage this route.

7 Portion of commercial bank funds that is not on-lent to clients or used to maintain required reserves (actual liquid assets in excess of what is used and required.

and that it was interventions associated with changes in fiscal and monetary policy that had real effects. Kumhof (2010) showed that, in theory, it was possible to have imperfect substitutability between various kinds of public sector assets in a general equilibrium setting, helping to make these sterilized interventions work.

For emerging markets and developing countries, foreign exchange interventions can be effective (BIS, 2005; Neely, 2008 and Canales-Kirilenko, 2003). In cases where there are some forms of partial capital controls, along with under-developed asset markets, partial asset substitutability is possible. Thus, sterilized intervention may impact on real and nominal outcomes in such cases (more monetary autonomy and policy influence). In those countries that are just beginning to enter global capital markets, it is likely that assets are still imperfect substitutes and that domestic financial markets are relatively "thin", and therefore changes in supply can have large relative price effects. Various event studies on advanced or more developed economies have also found that interventions had a significant but short-lasting effect on exchange rates (Cavusoglu, 2010). Dominguez and Frankel (1993) found that deviations from uncovered interest parity between the US dollar and selected European currencies depended significantly on intervention variables.[8]

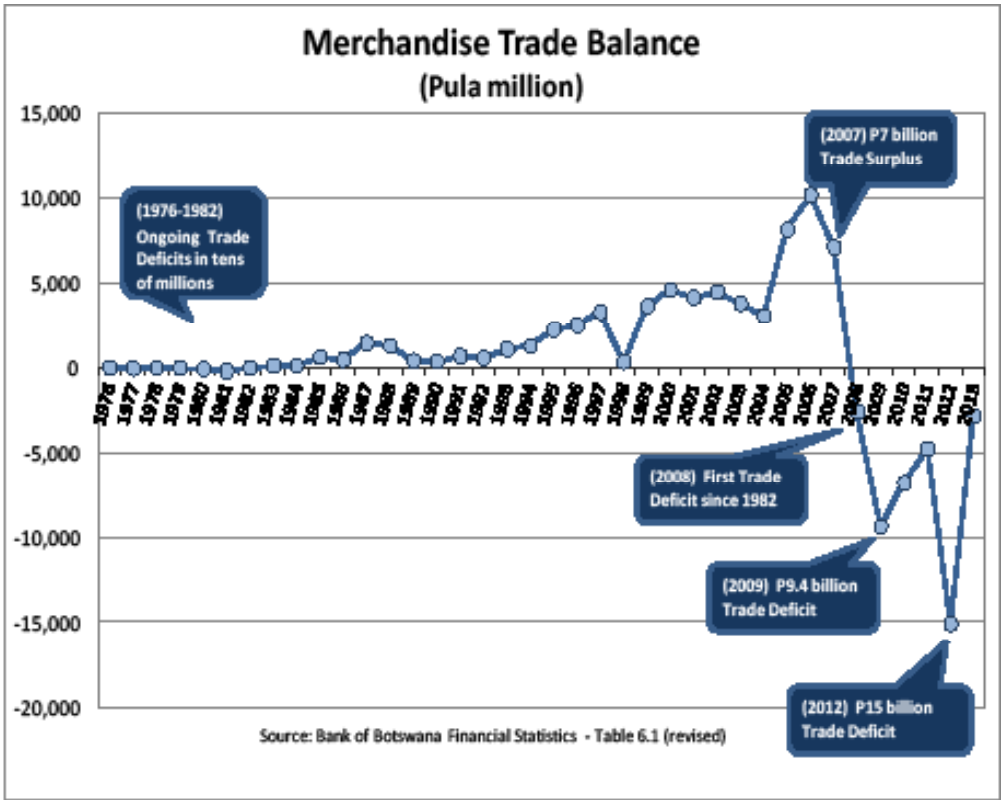
8 In Botswana's crawling peg regime, the central bank intervenes in foreign exchange markets "to sustain the desired exchange rate and maintenance of import levels and spending programmes in the event of temporary shocks to the export market or government revenue" (Bank of Botswana, 2015c p.91).

3.0 Sterilization Policy Experience and Context in Botswana

3.1 Context

Botswana's discovery and mining of diamonds led, from the 1980s onwards, to trade surpluses that were sustained up until the great recession of 2008-09 (Figure 1).

Figure 1: Merchandise trade balance (Pula million)

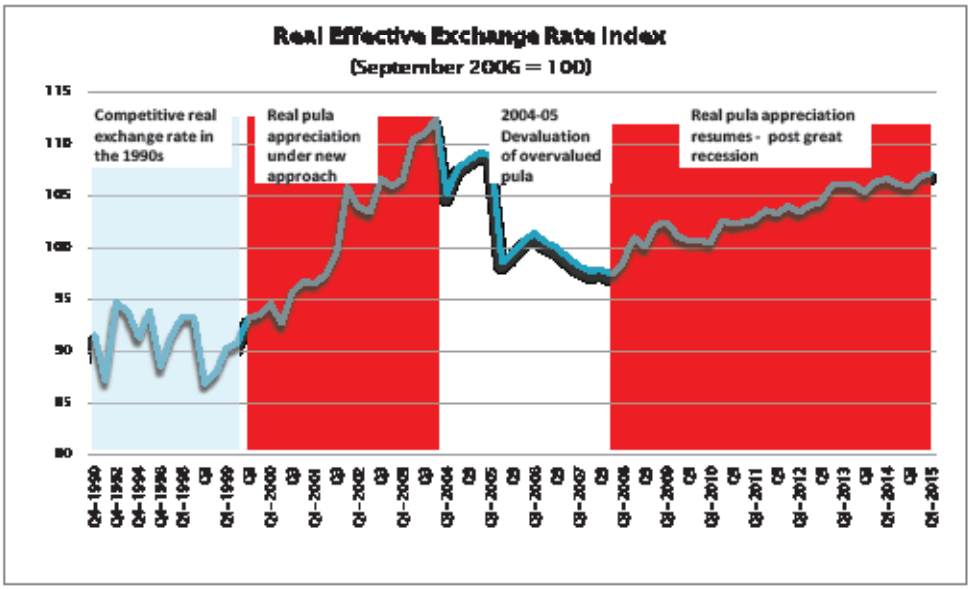


From 1983, trade deficits dating back to the country's independence in 1966 had been replaced by trade surpluses as new diamond mines came on stream. The 1990s through 2007 were characterized by high and rising trade surpluses. The trade surpluses brought the challenge of sterilizing large amounts of excess liquidity in a sustainable, cost-effective manner that curbed inflationary pressures, which did not compromise competitiveness, and did not discourage lending by banks. In the years prior to 2000, prices in Botswana were anchored in part by the exchange rate peg and depended primarily on South African prices; inflation was also influenced by US inflation, to a lesser extent by changes in non-mineral GDP growth, and to an even lesser extent by changes in narrow money, with changes in interest rates having little influence (Atta, Mannathoko and Jefferis, 1996). From the mid-1980s through the adoption of open market operations in 1991 up to 1996, inflation remained above 10%.[9] However, in the 1990s, inflation was on a declining trend and the combined effect of exchange rate and monetary policy overcame the anti-competitiveness effects of inflation and achieved a stable, competitive real effective exchange rate (REER) at a low enough level to support output diversification, which was the primary goal. For the decade 1989/90 to 1998/99, real non-mining non-government GDP grew at an annual average of 7% while real mining GDP grew at 4.8% (2.2% if the 29% real mining GDP growth outlier in 1997/98 is excluded), sustaining the trend towards output diversification since the mid-1980s. Exchange rate policy caused the nominal effective exchange rate (NEER) to depreciate enough to compensate for higher inflation in Botswana (relative to trading partners), leading to a stable REER close to the long-run equilibrium real exchange rate level (World Bank, 2005). Analyzing the period 1985-2004, Iimi (2006b) confirmed the REER alignment with the long-run equilibrium real exchange rate in the 1990s.

However, the end of that decade saw some policy changes. In 1999, exchange controls were abolished followed by a change in the policy focus; the de facto policy shifted from reliance on the exchange rate as a price anchor to a new real exchange rate rule that sought to keep the NEER largely stable by having the exchange rate's movement guided by the inflation differential with trading partner countries. The outcome, however, was significant REER appreciation after 2000 (Figure 2).

9 The drop in inflation to single digits in August 1996 was followed by introduction of a new consumer price basket measure in November 1996.

Figure 2: Real effective exchange rate index



The central bank's Monetary Policy Statement (1999) states that "The policy stance is consistent with having a stable real exchange rate in Botswana, in which changes in nominal exchange rates mirror the differential between Botswana's rate of inflation and that of our major trading partners" .... "Bank of Botswana wants to avoid having to devalue the nominal exchange rate in order to maintain a stable real exchange rate." The central bank still appears to follow this rule, as the Bank of Botswana's exchange rate policy statement (2014 Annual Report, page 23) notes that "the rate of depreciation of the NEER was slightly lower than the differential between domestic and trading partner countries' inflation."

While the aim of this rule is to keep the real exchange rate constant by containing inflation, if it was followed, it may have taken away the exogenous nominal anchor provided by the peg. Adams and Gros (1986) point out that the rule is likely to lead to a host of monetary problems, where countries risk losing control over the inflationary process, since the rule may serve to index both the nominal exchange rate and money supply (through the balance of payments), to the price level. Their findings may explain why the 1999 shift from a peg with discrete adjustments in response to shocks to this real exchange rate rule did not work and was not the best policy choice at a time when monetary inflows were increasing.

An inflation objective (target) was added to the monetary policy framework in 2002, and monetary policy at the Bank of Botswana was now guided by the principal objective of achieving a low, sustainable and predictable level of inflation (Bank of Botswana, 2006a). This new approach still did not work, however, as the price anchor that the peg provided had been weakened. In contrast to the 1990s, the new approach failed to contain inflation as hoped, resulting in the REER appreciation seen in Figure 2 (see also World Bank, 2005) and the Pula becoming overvalued (Iimi, Atsushi, 2006).

Authorities then devalued the Pula in 2005. The 2005 introduction of a crawling peg, which may still follow the real exchange rate rule cited earlier depending on how one interprets the monetary policy statements of the time (Annex IV), failed to contain inflation, and real exchange rate appreciation resumed again after a couple of years.

The Bank of Botswana's 3-6% "inflation objective" range is an approximate inflation target. Normally, inflation targeting refers to a monetary policy regime characterized by public announcement of an official target range for inflation and by explicit acknowledgement that low inflation is the most crucial long-run objective of the monetary authorities. The Bank of Botswana has done both these things; the difficulty, however, is that its regime does not satisfy all the standard prerequisites for a full inflation targeting regime, namely a single target, predictable monetary relationships and central bank independence, hence the "inflation objective" wording. In particular, while the Bank of Botswana Act allows for reasonable central bank independence, the policy regime is such that government decisions relating to the management of foreign reserves can affect monetary policy autonomy. In addition, both exchange rate and monetary policies are active policies that influence each other and have different targets. While the relationship between monetary policy instruments and inflation was relatively stable in the 1990s, the Bank of Botswana struggled to maintain a stable, predictable relationship after the introduction of the inflation objective regime in 2002.

In the 2000s, real non-mining non-government GDP growth was adversely affected, dropping over the six years to 2004/05, to an annual average 4.1% while real mining GDP growth rose to an average 9.3% with the decision to ramp up diamond mining output. This reflected a new trend away from the output diversification of the 1990s – even though development policy still cited diversification as playing a central role. Botswana's National Development Plans (NDPs) emphasized the need for economic diversification, describing it as the main strategic focus of development policy. The tenth National Development Plan (NDP 10, of 2009) states: "For many years, the main thrust of economic policy in Botswana has been to diversify the economy, in order to reduce dependence on the mining sector in general, and on diamonds in particular, and to create poverty-reducing employment and self-employment opportunities." With mining employing less than 4% of the labour force, the plan stated that the government's intention was to "take every possible measure" to make the economy more competitive and attractive to investment, enabling the acceleration in non-mining private sector growth needed to lower unemployment and reduce poverty in a sustainable manner.

On exchange rate policy, NDP 10 states that "it is extremely important for the diversification of the Botswana economy that there should be a competitive exchange rate." It explains the economic rationale for the goal of "avoiding an appreciation of the real exchange rate .... the most obvious indicator of Dutch Disease", noting that "commonly, the Dutch Disease occurs because the revenues from a mineral boom are spent faster than can be used productively, because of the capacity limitations of the domestic economy. This drives up domestic prices, and therefore production

costs, ... reducing the ability of the non-mineral (productive) sectors of the domestic economy to compete with imports... and (resulting in) exporters ... receiving less income after paying higher costs, which eventually leads to lower production and lower investment." By this reasoning, diversification goals sought the more rapid expansion of non-mining export and import-substituting goods, and service industries in particular.

Table 1 and Figure 3 below compare the output and output growth performance of the non-mining export and import-substituting industries with that of the mining and service sectors during different policy episodes in the 1990s and 2000s.

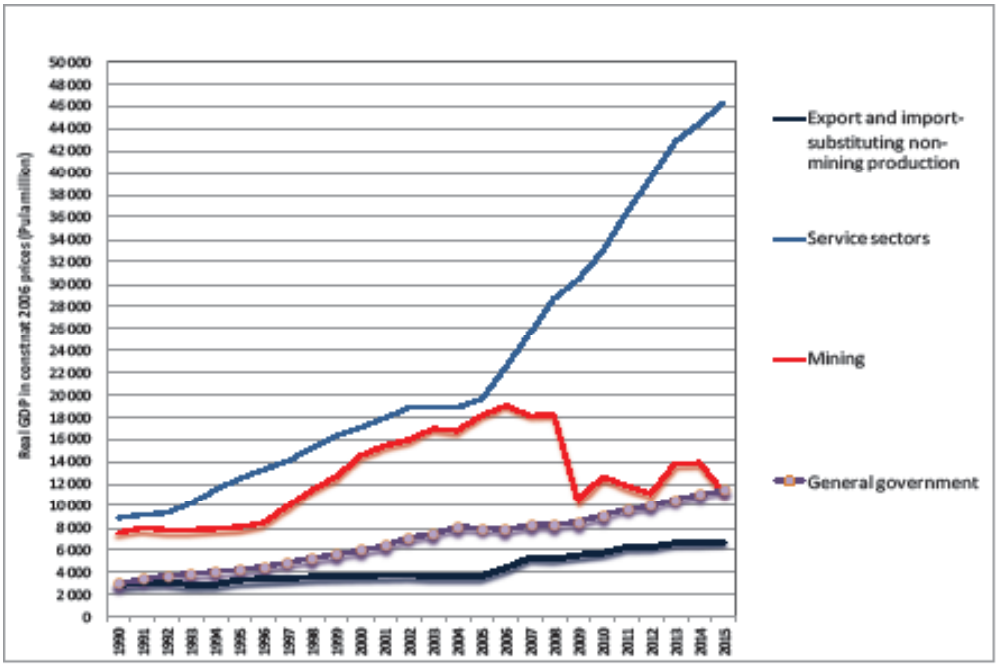
Table 1: Real GDP growth – annual averages

	1991-1996	1997-2000	2001-2005	2006-2008	2009-2015
Mining output	1.7	14.5	4.6	0.2	-4.2
Non-mining exports and import substitution production	2.9	2.2	-0.1	12.9	3.7
Service sectors output	7.0	6.4	2.9	13.5	7.1
General government	6.8	7.3	6.1	1.2	4.7

Key: 1991-96: pre-mining output escalation period
1997-00: mining output escalation period
2001-05: new monetary policy approach leading to over-valued Pula
2006-08: post-2005 Pula devaluation, pre-global recession, no fiscal stimulus
2009-15: resumption of real Pula appreciation, fiscal stimulus

Export and import-substituting non-mining production comprises output from sectors engaged in agriculture and manufacturing. Service sectors output comprises real GDP for wholesale and retail businesses, banks and insurance, business services, construction, transport, telecommunications, water and electricity, social and personal services to households, and hotels and restaurants. Data on the financial sector is included in services even though the sector was targeted as an avenue for diversification. This is because the relatively small off-shore banking sector data that may be said to represent the targeted tradeable services is grouped under "banks and insurance", a category dominated by the insurance and commercial bank sectors (domestic non-traded services).

Figure 3: Evolution of sectoral GDP in Botswana



Several things are clear from the figure and the table. First, mining output expanded significantly from the mid-1990s through 2006, then experienced a sharp drop from 2009 in the wake of the great recession. By 2015, it had not yet recovered to pre-global recession levels. As seen in Table 1, the sector's contraction averaged 4.2% per annum from 2009 to 2015. Second, in the 1990s, non-mining export and import-substituting sectors grew from Pula 3 billion to about Pula 4 billion (Figure 3), then contracted by an average 0.1% per annum from 2001 to 2005 (Table 1) as the real exchange rate appreciated. Following the 2004-05 Pula devaluation to correct for currency over-valuation,[10] the sector experienced rapid growth averaging almost 13% for the three years from 2006 up to 2008 when the global crisis hit. Since 2008, real exchange rate has resumed its appreciation under the post-2000 monetary policy approach, and the sector has again reverted to slower growth. In stark contrast to non-mining export and import-substituting sectors, the services sector has been expanding more rapidly than other sectors, sustaining a more rapid growth trajectory since 2006.

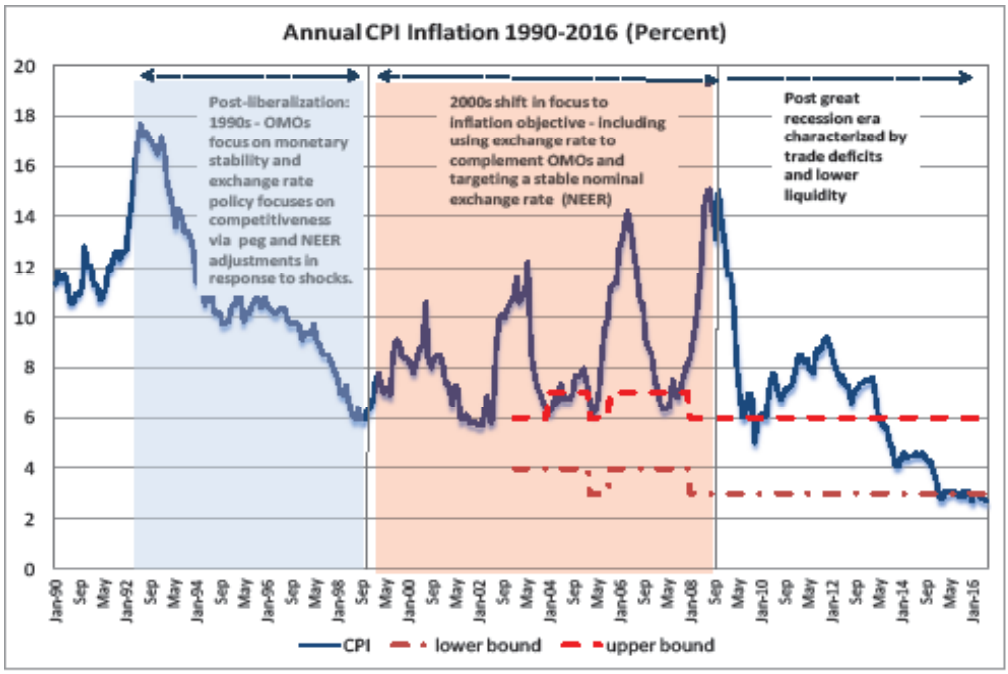
In the wake of the 2004/05 devaluation, policy shifted again in 2005. The fixed peg was replaced by a crawling peg regime, allowing for more exchange rate flexibility

10 At that juncture leading to 2005, analysis by IMF and others found that the Pula was over-valued. It was then devalued significantly. The 2004/05 devaluation boosted non-mining non-government GDP growth for the next three years through 2008 to an average 13.5%. After 2008, however, the adverse impact of the great recession and the absence of exchange rate adjustment in the policy response (resulting in REER appreciation) was reflected in real non-mining non-government GDP growth rates at half the levels seen post the 2005 devaluation.

and implying even less of the price-anchor influence from the exchange rate peg and a larger role in price determination for other monetary policy variables. The shift to a crawling peg, however, did little to abate inflation. As seen in Figure 4, after successful outcomes in the 1990s, the ineffectiveness of the new policy was more or less self-evident as inflation remained outside the target range about 90% of the time over the 2002-2012 decade.

While the Bank of Botswana acknowledges that inflation had "until recently (2013) generally been outside the desired range" it goes on to say that this result "cannot be attributed to the failure of monetary policy but is rather an indication that inflation was mostly driven by factors outside the scope of monetary policy" (Bank of Botswana, 2015c p. 92). The Bank cites factors such as upward adjustments in administered prices and government levies, and the impact of the global food and oil price shocks as being responsible for the consistent missing of the target range. However, a review of inflation based on the central bank's adjusted CPIs, which exclude these exogenous factors (CPIT removes short-term volatilities and CPIXA excludes administered prices), shows annual averages for the indexes that display a similar pattern to that of CPI inflation, being consistently above the objective range from 2006 when they were first published to 2012. Like inflation for the overall CPI index, they only fell within the inflation objective range in 2013.

Figure 4: Annual CPI inflation and the inflation objective (%)



Even if one specifies the principal monetary policy objective according to law, where, under the Bank of Botswana Act, its principal objective is "first and foremost to promote

and maintain monetary stability", the objective was still not met; M2 as share of gross domestic expenditure rose from 23% at the end of 2000 to 55% at the end of 2007. It is not surprising, therefore, that inflation rose over this period.

Consultations were held with key stakeholders during 2006 to get views on monetary policy and related economic development issues (Chibba, 2007). Three questions of interest to this study were included: (i) In your view, what is keeping inflation high in Botswana? (ii) Do you agree with the Bank of Botswana's tight monetary policy? (iii)What policy prescriptions would you offer to tackle high inflation? Chibba's main finding from the consultations was that the private sector in Botswana "had become increasingly disenchanted with very high interest rates that had prevailed for far too long with limited and questionable results in tackling inflationary pressures." Ninety (90) per cent of the stakeholders interviewed believed that the central bank's monetary policy was wrong. The monetary authorities, however, appear to have believed that fiscal actions were to blame for the missed inflation targets and made no further adjustments to their policy approach after 2005. Given that the policy was clearly not working over the span of a decade, it remains unclear why no further action was taken to try and address the consistent missing of monetary policy targets for so long.[11] Given the importance of macroeconomic policies to the performance of the private sector and the economy, this is an area deserving of analysis to determine the reasons for such policy adjustment delays.

Much of the 2002-2012 decade had been characterized by large mineral export receipts and private capital inflows (flows managed on behalf of the public sector). In the wake of the great recession, however, monetary surpluses began to dissipate as Botswana suffered sustained trade deficits and lower inflows. After 25 years of continual trade surpluses, Botswana recorded trade deficits averaging 8.2% of GDP per annum from 2008 to 2015. The adverse impact (on global gem diamond demand and prices) of the global economic slowdown alongside the global diamond industry's restructuring shrank the country's mineral export sales and receipts. Mining's share in real GDP declined from about 30% prior to the great recession to under 15% in 2012. The balance of payments shock had the effect of restraining aggregate demand and curbing inflationary pressures.

The great recession also had a dampening effect on the rate of foreign reserve accumulation, which dropped sharply from 2008 (Table 2) after its recovery in the wake of the BPOPF drawdowns, while the steep rising trend in liquidity held by banks prior to the great recession was reversed. Bank liquidity dropped from over 18 billion Pula in 2008 to about Pula 7 billion in 2014.

11 Informal discussions with monetary authorities revealed that they also sought to improve fiscal-monetary policy complementarity by discouraging repeated large, discrete wage and administered price increases. They do not appear to have considered changing the policy approach beyond the introduction of a crawling peg, which was intended to negate the need for discrete devaluations with a crawl.

In addition to the decline in monetary surpluses, during this period, fiscal authorities also instituted some reforms that helped to reduce excess liquidity in banks. More efficient budget management systems that streamlined the disbursement of funds to government agencies and local authorities reduced the amount of time that these sizeable deposits lay unspent in banks. The measure ensured that government funds were despatched to agencies when they were about to be used, rather than being held as bank deposits over long periods of time. The Real Time Gross Settlement System and electronic funds transfers were also used to improve the efficiency with which tax revenues are remitted. This too reduced the amount of time that funds remained "parked" in deposit accounts before being credited to government accounts at the Bank of Botswana (Bank of Botswana, 2015b).

Table 2: Reserve accumulation
US dollar million, (year on year)

End of	Forex Reserves	Rate of Accumulation (%)
2005	6309	~
2006	7993	27
2007	9790	22
2008	9118	-7
2009	8704	-5
2010	7886	-9
2011	8082	2
2012	7628	-6
2013	7726	1
2014	8323	8

Source: Bank of Botswana Annual Report, 2014

For their part, monetary authorities increased primary reserve requirements of banks after the great recession from 3.25% in 2007 to 10% in 2011. This too helped to reduce excess liquidity. Less liquidity due to the combination of factors meant fewer BoBCs needed to be issued, allowing the interest expense paid on BoBCs to drop from Pula 2.1 billion in 2008 to Pula 1.3 billion in 2010 and P200 million in 2014 (Bank of Botswana Annual Reports).

3.2 Sterilization Experience

Botswana has had sterilization interventions through open market operations for 25 years. With the liberalization in 1991 away from direct interest rate controls and use of the central bank's call account to absorb excess liquidity, monetary authorities adopted open market operations, using the Bank of Botswana Certificate (BoBC) sales to absorb excess liquidity in the banking system (see Annex I for sterilization policy timeline).

As the authorities had chosen a pegged exchange rate regime, the large monetary injections from persistent large trade surpluses caused a structural surplus of liquidity in the banking system,[12] where liquidity in excess of absorptive capacity could push up inflation.

12 In most developed countries, the central bank has to deal with a structural deficit of liquidity in the market, such that the banking system's balance sheet is liability-driven. The central bank lends money to commercial banks through open market operations to make up for the deficit.

Figure 3:

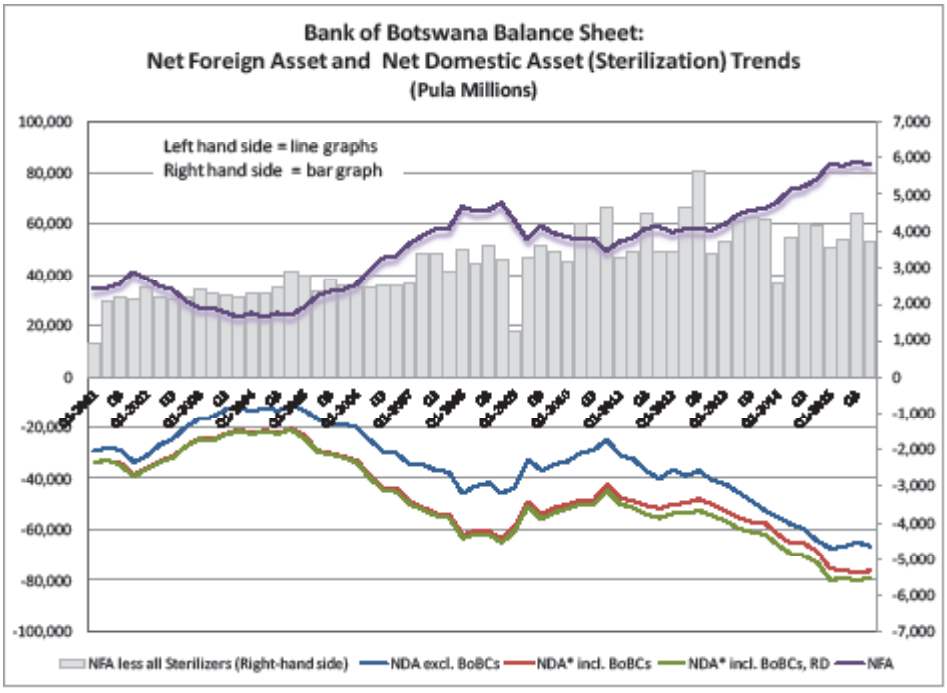
Botswana chose to use its mineral receipts to expand absorptive capacity and help establish a base for long-run growth. Nevertheless, achieving output diversification and a positive long-run growth path has remained an ongoing challenge. Over the period 1983/84 to 2012/13, most mineral receipts were spent (WAVES/ World Bank, 2014). Financial assets were only accumulated as a residual from budget surpluses, after spending decisions had been made. Part of the rationale behind leaving a residual and not spending everything related to limited domestic absorptive capacity and the potential for overheating of the economy. Government spending was supposed to observe a sustainable budgeting index, such that mineral revenues were allocated only to investment in physical and human capital. Mineral revenues were devoted to spending on infrastructure (44%), education (42%) and health (14%). Saved mineral receipts are captured in the Government Investment Account and in the revaluation reserves held at the Bank of Botswana, both serving as the counterpart to foreign exchange reserves in the Bank of Botswana balance sheet. There has been some deviation from the sustainable budgeting principle. However, foreign reserves have also been used to supplement operational costs. In this regard, net financial savings (net of debt) as a share of GDP dropped from 98% of GDP in 2002 to under 20% of GDP in 2005, reflecting drawdowns on mineral receipt savings to augment the public officers' pension fund. Foreign savings recovered to about 50% of GDP in 2008 prior to subsequent erosion to about 20% of GDP in 2012 in the wake of drawdowns made as a reaction to the global economic crisis and the great recession (WAVES/World Bank, 2014). The data show that for the 40 years of mineral exploitation and receipts, the government opted not to accumulate significant financial savings (WAVES/ World Bank, 2014).

The residual from mineral export receipts after spending decisions drove the accumulation of foreign exchange reserves (assets on the central bank balance sheet). Figure 5 shows the central bank balance sheet, and how net domestic assets serve as a counterpart to net foreign assets. For net domestic assets, in addition to holding government deposits, the central bank adopts sterilization interventions to offset the increase in foreign assets by issuing liabilities (Bank of Botswana Certificates, BoBCs). BoBCs are issued to commercial banks through open market operations (OMOs).[13] When government draws on foreign reserves, its deposits at the Bank of Botswana (represented in Figure 5 by "NDA excl. BoBCs"), and when it

13 Prior to the introduction of open market operations, the instruments of monetary policy were limited. Monetary policy was implemented through direct controls over commercial banks' interest rates (until 1986), and subsequently through the Bank of Botswana's call deposit rate. The call deposit rate had been introduced to absorb excess liquidity from the bank-ing system and represented the marginal return on deposits accepted by the banks. The Bank Rate, on the other hand, had little direct monetary impact given the environment of excess liquidity in the banking system, which meant there was almost no lending to the banks. The Bank Rate therefore served more as a benchmark rate. Excess liquidity also meant that changes in reserve requirements were largely ineffective from a monetary policy perspective, as they would have had to be raised to very high levels to have a notable impact on the commercial banks' ability to lend (Bank of Botswana, 2001).

accumulates foreign reserves, its deposits grow. Beyond government deposits at the central bank, BoBC issuance together with reserve requirements and deposits by banks at the central bank add another layer of sterilization and to contain excess liquidity in the banking system.

Figure 5: Bank of Botswana balance sheet



Footnote on sterilizers:
- NDA excl. BoBCs: basically comprises government deposits at Bank of Botswana
- NDA* incl. BoBCs: represents government deposits and Bank of Botswana certificate sales
- NDA* incl. BoBCs, RD: "NDA*incl. BoBCs" minus banks' reserves and free deposits at Bank of Botswana (RD)

Without the draining of excess liquidity from the system, the expectation was that surplus liquidity would lead to falling short-term interest rates with consequences for inflation. The banking system's balance sheet was asset-driven, with the central bank essentially acting as depositor (rather than lender) of last resort, taking "deposits" from banks by selling them securities which then appeared as liquid assets on the banks' balance sheets (banks generally had no need to borrow from the central bank). The central bank drew from the market the amount of liquidity consistent with a level of short-term interest rates that would affect demand conditions in the economy as desired (Bank of Botswana, 2015c). The purchase and sale of BoBCs influenced the cost and quantity of loanable funds. The Bank of Botswana's main monetary policy tool was therefore its policy interest rate derived through sterilization interventions using BoBCs. With the BoBC rate being the Central Bank's de facto policy rate, it

informed the benchmark Bank Rate that signals commercial banks to reset their interest rates. Given this context, Botswana had both an active exchange rate policy and an active monetary policy (liquidity management and sterilization). The Bank of Botswana states that the managed exchange rate regime targeted a stable real effective exchange rate that would ensure that domestic producers of tradeable goods and services were competitive (Bank of Botswana, 2015c p.119 paragraph 5.8). At the same time, the principal objective of monetary policy was articulated as promoting and maintaining price stability (Bank of Botswana, 2015c p.91).[14] Because there was already a pegged exchange rate, the Bank of Botswana's inflation objective and the real exchange rate target were pursued with both BoBCs (open market operations) and the exchange rate as instruments. This meant that the two objectives needed to be pursued in a consistent manner.[15]

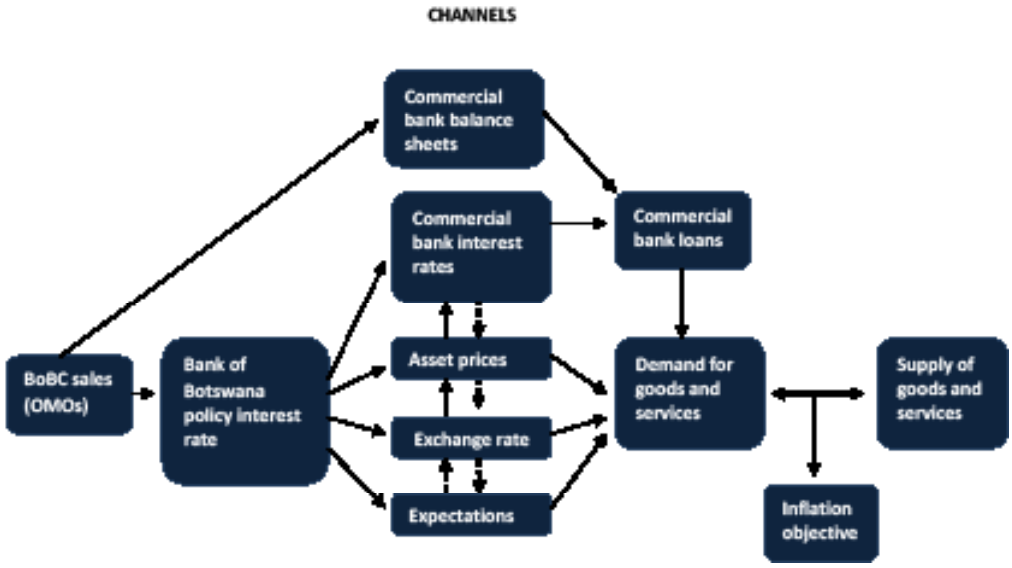
Figure 6 outlines the transmission channel for monetary policy, including its interaction with the exchange rate. As illustrated, it is expected that changes in the policy interest rate affect commercial bank interest rates, asset prices, demand for Pula (which affects the nominal Pula exchange rate to the extent that it is allowed to adjust by the crawling peg exchange rate mechanism), and people's expectations of future interest rates, economic growth, and inflation, which in turn also affect asset prices and the demand for Pula (assets and securities).[16] Large BoBC sales are also likely to affect commercial bank balance sheets and banks propensity to lend. While the Bank of Botswana reports tend to discuss the commercial bank interest rate channel, this study recognizes that the multiple channels in Figure 6 may impact aggregate demand pressures and inflation in varying degrees.

14 The use of two instruments is common in systems with sterilization interventions. Authorities tend to rely on purchases and sales of foreign exchange, and on open–market operations to neutralize effects on the policy interest rate (Benes et al., 2011).

15 The 2005 introduction of a crawling peg exchange rate regime meant that the local Pula currency was no longer completely fixed by the peg, nor did it automatically fully appreciate with sizeable inflows; instead the exchange rate is managed, foreign exchange reserves are accumulated and sterilization is used to curb the resultant excess liquidity in the banking sector.

16 Current practice is that Bank of Botswana will tend to tighten monetary policy (sterilize more to reduce NDA) in response to the central bank's inflation forecasting system which generates equilibrium values for output, real exchange rates and real interest rates, that provide benchmarks for the description of a "neutral" monetary policy stance, which does not contribute to changes in inflation (Phetwe, 2013).

Figure 6: Transmission channels for monetary policy (sterilization)



Source: Adapted from Bank of England (1999), to Botswana.

3.3 Commercial Banks: Sector Structure, Balance Sheets and Profits

Botswana's banking sector (deposit-taking institutions) was very small just two decades ago in the early 1990s, dominated by two foreign banks - Barclays and Standard Chartered - which had operations in Botswana dating as far back as the 1950s. It has since developed rapidly. In the fifteen years to 2009, the sector grew at an average 11.2% per annum in real terms, dominating market capitalization in the Botswana Stock Exchange.

Private banks dominate the banking sector (Table 3), which has assets equivalent to about 50% of GDP. Government banks are not major players in the sector. Four private institutions are classified as large banks in the market today (where a large bank is defined as having total assets that constitute 10% or more of the aggregate banking sector). The concentration of banks is high, with 70% of total bank assets owned by the top three banks (IMF, 2014), increasing the likelihood of a weaker transmission mechanism and the risk that one of these individual banks might at some point be considered too big to fail. As at 31 December 2014, Barclays Bank of Botswana, First National Bank of Botswana, Stanbic Bank Botswana and Standard Chartered Bank Botswana (all foreign banks) qualified as large banks.

Table 3: Relative market share of private and public banks

As at end of	2010	2014
% Market share (assets)	92	91
% Market share (loans and advances)	88	89
% Market share (deposits)	98	96

Source: Bank of Botswana, Banking Supervision Annual Reports for respective years.

Note: Market share refers to private banks' share relative to government institutions.

In 2014, the banking sector had eleven (11) commercial banks, almost all of which were foreign-owned with three listed on the Botswana Stock Exchange (BSE). Two offshore banks and one offshore holding company were also listed on the BSE. There was one merchant bank. Two parastatals (i.e. publicly-owned banks), Botswana Savings Bank (BSB) and Botswana Building Society (BBS), also accept deposits.[17] There have been various bank closures over the years, including the Bank of Credit and Commerce in 1991, Zimbank Botswana in 1993, Botswana Cooperative Bank in 1995 and Kingdom Bank in 2015.

Commercial banks' balance sheets are impacted by large inflows as the (crawling) peg exchange rate regime limits price adjustment through exchange rate appreciation. During periods of large inflows, the banking system has been characterized by excess liquidity (reflecting the surplus of savings over investment). This, alongside sterilization policies, used to absorb the excess liquidity and influenced the structure of commercial banks' balance sheets. BoBCs constituted a significant share of bank assets, with their share exceeding that of loans and advances after the 2006 decision to restrict BoBC sales to banks (Table 4).

Table 4: Commercial bank balance sheets

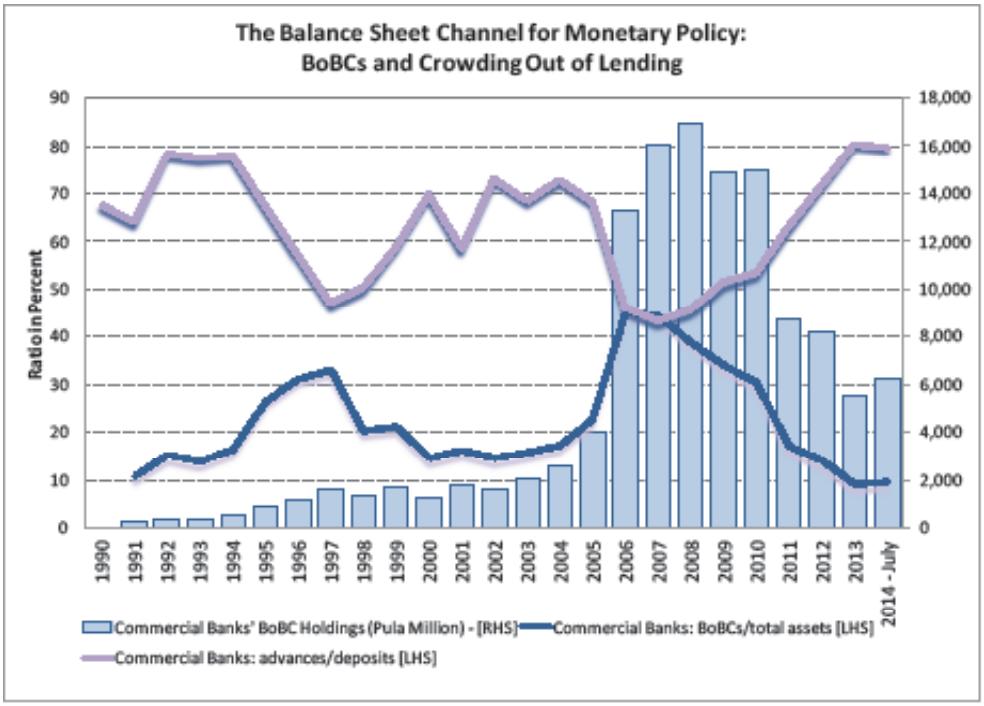
% of total bank assets	1995-2005 (average)	2007 (with restriction of BoBC sales to banks)
Loans and Advances	50%	37%
BoBCs	21%	45%
Balances due from foreign banks, and other assets	29%	18%

Source: Botswana Financial Sector Overview, 2010-11.

17 Moffat and Valadkhani (2011) analyzed the technical efficiency of Botswana banks and found that two foreign banks and one parastatal savings bank were consistently among the most efficient institutions, while two other parastatals - a bank and a lending institution, and one private bank were consistently the least efficient. They found that the size of the institutions (asset base) had no bearing on efficiency.

When the Bank of Botswana placed restrictions on holdings of BoBCs in 2006, limiting them to commercial banks, there was a significant expansion of bank balance sheets with a major inflow of funds into banks from entities that had previously held BoBCs (directly, or indirectly through banks and stock-broking firms). Jefferis and Kenewendo (2011) noted that commercial banks exhibited low lending–to-deposit ratios, financial assets other than loans and advances made up a sizeable portion of the balance sheet, and sterilization measures had an important impact on bank operations and profits.

Figure 7: Commercial banks: Average holdings of BoBCs (RHS); ratio of loans and advances to deposits, and BoBCs to assets (LHS)



With the huge jump in holdings of BoBCs in 2006, total assets of the banking sector increased by 50% in the six months from December 2005 to June 2006 (Jefferis and Kenewendo, 2011). Banking sector assets (just six commercial and merchant banks at the time) reached over 46% of GDP in that year. Corresponding to this, loans as a share of deposits dropped from 70% in 2004-05 to 45% in 2007 (Figure 7). However, this ratio also reflected a rise in deposits. It would appear that some funds that had previously been used by non-banks to buy BoBCs now took the form of deposits in banks, lowering the loan/deposit ratio. Pension fund (and other non-bank financial institutions) BoBC holdings were replaced by pension fund (and other) regular and BoBC-linked deposits in banks. Figure 7, therefore, does not necessarily reflect a direct crowding out of loans by BoBCs but may rather reflect the sharp increase in bank deposits by institutional investors in 2006-07.

Botswana banks had high levels of profitability over the years (Table 5). The high

profitability of the banks continued into the 2000s, peaking in 2006-07 at levels far above the international norm. Interest earned on BoBCs was a sizeable contributor to banks' total income until 2012.[18] As seen from the profitability ratios in Table 5, since the 2007-08 global crisis and subsequent great recession, the profitability of the Botswana banking sector has been in decline, with a significant drop in return on equity and in the share of income from investments and securities relative to total income. The income share from securities dropped from over 35% in 2007 to 26% in 2010, 8% in 2012 and 4.5% in 2014.

Table 5: Banking sector size and profit indicators

As at end of	1998	2002	2005	2006	2010	2014
Banking assets /GDP (%)			37.0	53.0	49.0	48.0
Assets (Pula billions)			18.5	30.4	49.6	68.0
Profitability ratios						
Return on equity – ROE (%)	43.0	44.0	52.9	56.8	34.6	19.1
Return on average assets – ROAA (%)		3.0	4.4	4.0	3.0	2.3
Income on investments and securities to total income – includes BoBCs (%)				35*	25.6	4.5

Source: Banking Supervision Annual Reports for various years, Bank of Botswana.

Note: ROE measures after-tax profit against shareholders' funds; ROAA measures after tax profits as a percentage, shows how efficiently a financial institution's assets are employed. *Income on investments and securities is represented here by interest earned on just BoBCs. The value shown is for 2007.The same value for 2009 was 26.

Bank of Botswana's 2013 Banking Supervision Annual Report indicated that reduced BoBC holdings had impacted bank profitability adversely, while the 2011 Banking Supervision Annual Report noted that given declining profits and the new low interest rate environment, a trend of growing reliance on non-interest income, such as bank charges to boost profitability, had emerged.

Beyond the banking sector, the overall development of the Botswana financial sector over time and the opening of the capital account in 1999 are also important considerations for this paper as they may have impacted the efficiency, and therefore cost of sterilization. The next section, therefore, gives an overview of developments in the non-bank financial sector after the opening of the capital account in 1999.

18 In commercial bank balance sheets, deposits are usually the primary liabilities of banks while reserves and loans are their primary assets. The banks' investment portfolios tend to be a smaller portion of assets and serve as the primary source of liquidity. With sizable sterilization, however, the sterilization securities in the investment portfolio can end up dominating bank assets, competing with loans as the primary assets of the bank.

3.4 Non-bank Financial Sector

The non-bank financial institutions (NBFI) sector in Botswana is now at least at par with and probably even larger than the banking sector, and it has more local ownership than the latter. In addition to this, cross linkages between NBFIs and commercial banks have become significant, with NBFIs' wholesale deposits constituting about 40% of banks' liabilities (IMF, 2014). In 2010, the combined assets of the pension and insurance sub-sectors alone accounted for 49.5% of GDP compared with 41% of GDP for the banking sector's assets (IMF, 2010). In 2014, total assets of NBFIs accounted for about 50% of GDP (IMF, 2014). The NBFI sector covers numerous entities including the Botswana Stock Exchange (BSE) and stock-broking firms, insurance companies, pension funds, asset managers, credit institutions (non-bank lenders) including Letshego which is listed on the BSE, and other smaller lenders, microfinance institutions, collective investment undertakings (CIUs), development finance parastatals (such as the Botswana Development Corporation, the National Development Bank and the Citizen Entrepreneurial Development Agency), and statutory funds such as the Motor Vehicle Accident Fund, the National Petroleum Fund, and the Public Debt Service Fund (which is being phased out).

The influence of this sector on liquidity in the banking sector through portfolio and other capital flows into the country has been considerable. During the years from 2002 to the great recession, the new privately-run Botswana Public Officers' Pension Fund (BPOPF) brought in sizeable capital inflows seeking domestic investment opportunities (Table 6). The government decision to draw down significantly on the country's foreign reserves to fund past liabilities in the pension fund and to transfer its management to the private sector resulted in a large inflow of funds allotted by BPOPF to private fund managers and a correspondingly big increase in demand for domestic investment opportunities.

Table 6: Government transfers to BPOPF and its private investment inflows (Pula millions)

Year1	Government transfers to BPOPF2 (flow)	Value of domestic investments by BPOPF (as at year end)	Share of domestic investments in total investments of BPOPF5 (as at year end)	Fiscal cost of sterilizing excess liquidity (interest paid as a share of non-mining GDP)6
2002	2,201.3	962.63	50.45	3.5%
2003	6,048.2	5,031.84	51.24	4.5%
2004	2,609.5	5,680.0.	48.10	3.6%
2005	1,781.6			3.8%
2006	737.4	7,019.2.	35.74	4.1%
2007	46.8	9,821.7.	37.74	3.9%
2008	197.6	9,897.5.	36.91	3.8%
2009	178.8			2.6%
2010	164.8			
2011	2.5			
2012	9.7			
2013	0.9	17,161.3	43.05	
2014	2.4	18,299.3.	40.59	

Source: Botswana Public Officers Pension Fund, BPOPF Annual Reports (and Bank of Botswana Reports for last column).

Notes: [1] Year ending 31st March.

[2] Transfers by government from foreign reserves/savings into the BPOPF (Pula millions). This is different and separate from annual budgeted employer contributions.

[3] Value as at 30th September 2002 of BPOPF investment portfolio invested in Botswana (Pula millions).

[4] Value as at 31st December 2003 of BPOPF investment portfolio invested in Botswana (Pula millions).

[5] Share of BPOPF investment portfolio invested in Botswana (%).

[6] Calendar year calculations by author.

Botswana was already operating in an excess liquidity environment at the time due to large mineral receipts, with limited opportunities for portfolio investment within the economy. In the year that the government began to transfer funds to the newly privatized pension fund for public officers, portfolio inflows rose, though there were no significant new listings on the stock exchange to absorb more money and the fixed income market was underdeveloped with little new issuance of debt by firms (Poddar, 2002). The Botswana Stock Exchange Index rose by over 69% that year, and at the same time a significant amount of the new funds went to the purchase of Bank of Botswana Certificates, used to mop up excess liquidity (Poddar, 2002).

From the end of 2000 to the end of 2007, BoBCs increased by Pula 12,904 million, which was close to the amount of transfer from the government to the BPOPF. Large private capital inflows were now an important new development that ought to have necessitated careful treatment by monetary authorities. Nevertheless, authorities chose to continue to rely primarily on BoBCs. Prior to 2001, the interest cost paid on sterilization instruments remained well below 3% of non-mining GDP.[19] From 2002 through 2008, this fiscal cost rose above 3% of non-mining GDP, peaking at 4.5% in 2003 (Table 6).

19 Non-mining GDP is the relevant comparator here. Since the government strategy is to use windfall receipts (mineral rev-enues) to develop the non-mining economy, the applicable opportunity cost relates to non-mining GDP.

4.0 Sterilization Calculations and Monetary Autonomy Index Estimation

This section describes calculations used to estimate the cost and sustainability of sterilization, and to construct a monetary policy autonomy index. Calculations are based on the central bank balance sheet (illustrated in Table 7). The left-hand side shows assets, dominated by foreign exchange reserves while the right-hand side shows liabilities, including those that serve to sterilize excess liquidity.

Table 7: Summary of Bank of Botswana Balance Sheet (Pula billions,[20] calendar year-end)

Assets	1994	2007	2010	2011	Liabilities	1994	2007	2010	2011
Foreign Exchange Reserves	11.96	58.52	50.85	60.27	Currency in circulation	0.30	1.36	1.92	2.09
Government Bonds	0.00	0.09	0.04	0.02	Private bank balances	0.09	1.07	0.04	0.16
					Bank reserve requirements			3.00	3.57
Property and Equipment	0.08	0.14	0.20	0.27	Government and other balances<?>	6.75	1.31	3.41	2.36
Other	0.02	0.09	0.12	0.14	Bank of Botswana certificates<?>	1.45	16.62	17.64	11.48
					Dividend to government	0.45	0.23	0.18	0.47
					Other liabilitie<?>s	0.09	0.14	0.10	0.07
					Shareholders funds <?>	2.92	38.11	24.91	39.59
Total Assets	12.06	58.84	51.21	60.70	Total Liabilities	12.06	58.84	51.21	60.70

Source: Various Bank of Botswana Annual Reports.

20 1 billion = 1000 million.

<?> 2007-2011: Current account balances of government, commercial banks, parastatal bodies and others, are repayable on demand and are interest free, except for the Debswana Tax Holding Account. 1994: A uniform reserve requirement had been introduced set at 3.25%. Reserve requirements grew notably in the post-global crisis period.

<?> This value includes reverse repurchase agreements which also serve to sterilize money supply.

<?> In 2010, "other liabilities" include foreign liabilities of P0.71 billion.

<?> In the 1994 balance sheet, this item is denoted as "Capital and Reserves".

4.1 Sterilization Cost and Sustainability

The Bank of Botswana sterilizes the expansionary impact of current account receipts and reserve accumulation by selling domestic liabilities such as Bank of Botswana certificates (Table 7), in this way decreasing the monetary base and pushing interest rates back up to the desired level.

A sterilization cost index, s, is constructed from 1991 when BoBCs were introduced, to 2014. To sterilize, the central bank increases its liabilities. For most of the increase, it pays interest. Adapting the methodology used by Frankel (2007), in any given year t, the net cost of sterilization, $s_{t,}$ must be the difference between interest paid on domestic liabilities used to sterilize and interest earned on the corresponding foreign assets purchased with the surplus funds. Therefore:

$$S_t = i_t L_t - (r_t R_t) e_t^* \quad (1)$$

where: s = the net cost of sterilization

i = domestic interest rate paid on each liability (the BoBC or the reverse repo rate)

r = the interest rate earned on foreign reserves (all reserves or all minus Pula Fund) [21]

L = the value of each (remunerated) domestic liability outstanding in a given period

R = the value of foreign assets accumulated in a given period (all reserves or minus wealth fund)

e^* = dE/E is the exchange rate used to convert the foreign currency interest earned to local currency

Thus, iL = the short-run domestic interest cost (financial cost of remunerated

rR = the international interest earned

(rR) e^* = returns to international reserves invested by Botswana in Pula

21 The Bank of Botswana maintains a primary international reserve, generally referred to as the liquidity portfolio, used to ensure the timely availability of foreign currency at a reasonable price. It provides a buffer for short-term trade and capital account requirements. It has two tranches: one for short-term and the other for medium-term funding. The current benchmark for the liquidity portfolio is six months imports cover. The residual from the liquidity portfolio goes into a second fund called the Pula Fund. This is a long-term investment portfolio established in 1994 to preserve part of the income from diamond exports for future generations. Foreign exchange reserves more than expected medium term requirements are transferred to the Pula Fund liabilities.

i is the domestic interest paid against remunerated liabilities issued such as BoBCs and reverse repurchase (repo) agreements. No interest is paid on other liabilities such as base money, private bank balances and government and parastatal balances at the Bank of Botswana, thus i_i is either the BoBC rate or the reverse repo rate. The net sterilization cost each year can be thought of as:

$$s_t = L_{1t}\,(i_{BoBC)\,t} + L_{2t}\,(i_{repo)\,t} + L_{3t}\,(i_{base\ money)\,t} + L_{4t}\,(i_{bank\ balances)\,t} + L_{5t}\,(i_{govt\ balances)\,t} - (rR)_t e^*_t \quad (2)$$

As the interest paid on base money, bank balances (including reserve requirements) and government and parastatal balances is zero, L_3, L_4 and L_5 help to sterilize at zero cost. The larger L_3, L_4 and L_5 are as a share of total liabilities:

(i.) the lower the overall sterilization cost and the more sustainable the policy is; and

(ii.) the less upward pressure there is likely to be on the domestic interest rate, i.

Two sterilization cost indices are constructed, where the first s^A is based on r^AR^A representing interest earned on all foreign savings (i.e. interest earned on both the liquidity and Pula funds), while the second s^L is based on r^LR^L, being interest earned only on the liquidity fund (in a scenario where the current generation of policy makers cannot access the intergenerational Pula wealth fund or its returns). This distinction is made because while the Bank of Botswana describes it as a sovereign wealth fund, the Pula Fund (managed by the central bank – see World Bank, 2015: 61, 69, 72, Figure 85) is in practice not managed to ensure inter-generational savings; access to the Pula Fund is not blocked, and consequently there have been episodes of substantial outflow from the Pula Fund,[22] and it has also been used for stabilization purposes in addition to supplementing the liquidity fund. The Pula Fund was 40% of GDP in 2013, down from 120% of GDP in 1998. Due to this treatment of the Pula Fund, we estimate sustainability under both the latter de facto scenario and the former de jure scenario.

For sterilization to be sustainable, the cost of servicing liabilities in a given year, *iL,* cannot exceed interest earnings on the foreign assets bought with the surplus funds, *(rR)e*,* that is $iL \leq (rR)e^*$ must hold. This means that the net sterilization cost, s^j calculated for each distinct year, *t,* is sustainable as long as:

$s^j_t = i^j_t L^j_t - (r_t R_t)^j e^{j*}$ is zero or negative. Therefore, the sustainability condition is:

$$s^j_t \leq 0 \quad (3)$$

22 The first large outflow was with the sizeable transfer from reserves to the Botswana Public Officers Pension Fund after 2001, and the second followed the 2008 global crisis which period has again seen a significant erosion in reserves; in part to maintain the liquidity portfolio which suffered significant depletion after 2008. The WAVES/World Bank analysis shows that the current level of savings in the Pula Fund is far from sufficient to serve an inter-generational savings role. The Pula Fund was only 100% of GDP in 2000, and by 2013 it had declined even further to just 40% of GDP.

4.2 Monetary Policy Autonomy

If sterilization policy is to be functional, some degree of monetary policy autonomy is required. Following from Frenkel (2010) and using all international reserves R^A, the index reflecting the degree of monetary policy autonomy at time t, A_t will be calculated as:

$$A_t = (L_1 + L_2)_t / R^A_t \quad (4)$$

Frenkel showed that given the ratio A of the stock of the Central Bank's remunerated liabilities (L_1 and L_2) to the stock of international reserves, R (valued in domestic currency), then if A is less than unity, the maximum sustainable policy rate i^{max} can be higher than the foreign interest rate, r, for interest earned on foreign reserves, and there will still be a positive degree of monetary autonomy.

The higher the degree of monetary policy autonomy, the lower A is.

5.0 Theoretical and Empirical Framework for the Efficiency of Sterilization

To examine the efficiency of sterilization policy, the possibility of transitory monetary policy autonomy effects and trade-offs between sterilization measures and capital flows are allowed for. The relationship between sterilization, mineral receipt and capital inflows and monetary policy efficiency can be investigated using a combination of two approaches - as usually found in the literature related to the empirical analysis of this issue. The theoretical framework for analysis and interpretation normally used comprises: (1) the estimation of the sterilization coefficient, based on the estimation of the monetary policy reaction function, MFR (e.g. Cumby, Huizinga and Obstfeld, 1981b); and (2) the estimation of the offset coefficient, capturing offsetting capital inflows, usually based on the theoretical framework in Kouri and Porter (1974), who derived a model of international capital flows for a small open economy with a fixed exchange rate regime. The Kouri and Porter model gives a capital-flow equation that responds to monetary policy, reflecting the co-dependent nature of capital inflows and monetary policy measures. Ljubaj et al. (2010) adopted a simplified version of the capital-flow equation.

Ouyang et al. (2007), Ljubaj (2010) and others derived the Cumby and Obstfeld monetary policy reaction function by assuming that the central bank sterilizes the monetary effects of capital inflows from abroad by changing its (net) domestic assets. Kouri and Porter (1974) and Obstfeld (1980) point out that in a country practicing sterilization policy with an open capital account, it is likely that sterilization activities, reflected in changes in net domestic assets (ΔNDA), will depend on what is happening to foreign exchange reserves, reflected in changes in net foreign assets (ΔNFA), and vice versa. They surmise that this simultaneity then makes it likely that the explanatory variable ΔNFA in the MFR equation is in fact endogenous and not exogenous. Likewise, the explanatory variable ΔNDA in the capital-flow equation is also endogenous.

Following Ouyang et al. (2007) and others, the Cumby and Obstfeld monetary policy reaction function (MFR) is given by:

$$\Delta NDA_t = \alpha_0 (CA+K)_{t+j} + \gamma' X_t + \varepsilon_t \qquad (5)$$

where ΔNDA is the change in the central bank's net domestic assets, α_1 captures the degree of sterilization, CA is the current account balance, K is the capital account balance and X is the vector containing other variables that could also affect monetary policy actions.

As the sum of current and capital account balances (CA + K) in period t is equal to the change in the central bank's net foreign assets ΔNFA (from period t-1 to t),[23] equation (6) can be written as:

$$\Delta NDA_t = \alpha_0 + \alpha_1 \Delta NFA_t + \gamma' X_t + \varepsilon_t \quad (6)$$

Equation (6) is a simplified monetary policy reaction function, where the coefficient α_1 ranging between -1 and 0 measures the degree of sterilization (sterilization coefficient).

- When α_1 is -1, sterilization is complete. The central bank fully neutralizes the increase in reserve money caused by growth in the central bank's net foreign assets by reducing its net domestic assets (through BoBC issuance) by the same amount.[24]

- When the value of the sterilization coefficient α_1 is between -1 and zero, this means that the reserve money generated by the central bank's intervention is not fully neutralized and some is left in the market; net domestic assets are reduced by less (ΔNDA < ΔNFA). Less sterilization has occurred.

- If α_1 is 0 (no sterilization takes place), then growth in net foreign assets translates into an equivalent increase in domestic money supply.

For the MFR equation (6), changes in domestic monetary creation (represented by ΔNDA) are determined by changes in foreign reserves (represented by ΔNFA) and other independent explanatory variables. For explanatory variables in vector X in equation (6), we take real output growth as the independent explanatory variable in the MFR equation. A positive sign is expected for the coefficient on real GDP because, as real GDP increases, money supply and therefore NDA increases. For the model to be statistically valid, the instrumental variables in the MFR regression need to be both correlated with the endogenous explanatory variable ΔNFA, and uncorrelated with the residuals from the estimated model. The nominal exchange rate satisfies these

23 ΔNFA can be thought of as the change in international reserves, ΔR.

24 In this scenario, the central bank purchases foreign exchange through interventions in the foreign exchange market and this creates reserve money; at the same time, it uses BoBCs to withdraw all the money created from the market. Thus, the change in reserve money is equal to zero, while the increase in NFA is equal to the reduction in the central bank's NDA (due to increased liabilities through BoBC issuance).

conditions. The change in the exchange rate of the Pula against the Rand was chosen as the instrument, as the Pula is pegged (crawling band peg) to a basket including the Rand as a key component.[25] The central bank maintains the exchange rate through foreign exchange interventions, which in turn impact foreign exchange reserves (NFA), hence the correlation.

For the capital flow equation, the dependent variable (capital flows) is proxied by the change in the central bank's net foreign assets (ΔNFA), while the change in the central bank's net domestic assets (ΔNDA), which reflects the monetary policy sterilization action, is the endogenous explanatory variable. Exogenous variables which may affect capital inflows are included in the explanatory vector Z in equation (7) below. These variables would normally be chosen based on what induces capital inflows into the country (Ouyang et al., 2007). In the Botswana experience, the inflows originated from a policy decision that essentially transferred foreign reserves to private entities that then brought the funds into the country. As there is no variable to represent this directly, we use the capital flow regression to check whether the real interest rate differential as an independent variable in Z based on interest rate parity theory (changes in capital flows are influenced by interest rate differentials) was a significant explanatory variable. If it is not, then its insignificance as an explanatory variable for capital flows probably reflects the special conditions under which sizeable capital inflows occurred in Botswana, where the inflows may have been influenced more by domestic asset managers feeling they understood the domestic market and wanting to increase the domestic component of the BPOPF investment portfolio. For the instrumental variables in the regression, as before they need to be both correlated with the endogenous explanatory variable ΔNDA in equation 7 and uncorrelated with the disturbances. These conditions are satisfied by the change in the money multiplier (ΔMM2) as it is normally used in the literature by monetary authorities to guide their sterilization decisions (i.e. decisions on changes in net domestic assets, NDA).[26]

The capital flow equation is given as:

$$\Delta NFA_t = \beta_1 \Delta NDA_t + \delta j' Z j_t + v_t \qquad (7)$$

where parameter α_1 is the offset coefficient. α_1 ranges between -1 and 0.

25 Initially, the MFR regressions were run using changes in the exchange rates of the Pula against both the Rand and SDR as instruments, as the Pula is pegged to a basket comprising of both the Rand and SDR. However, this led to some equations being over-identified. The results for these MFR regressions are shown in Annex III.

26 Initially, the real interest rate differential was added as a second instrument in the capital flow regressions (and dropped as an explanatory variable) since it was also monitored by monetary authorities to guide sterilization decisions. However, as with the MFR regressions, we find that some equations became over-identified when the two instruments were used. These initial results are shown in Annex III.

- When α_1 is –1, capital is fully mobile such that when authorities sterilize, the reduction in NDA is negated by an equal capital inflow which increases NFA, while the supply of money in the system remains unchanged. Sterilization is therefore not effective because the amount sterilized is replaced by new foreign exchange inflows of equivalent amount. This additional inflow then needs to be sterilized again.

- When α_1 lies in-between–1 and 0, then when authorities sterilize, the capital inflow still occurs, but it is less than the reduction in NDA; therefore, part of the reduction in liquidity in the banking system due to sterilization is sustained.

- If α_1 is 0, then there is no capital inflow in response to sterilization and the policy is fully effective in controlling excess liquidity.

Theory tells us that the value of α_1 depends on the degree of capital mobility and the degree of substitution between foreign and domestic assets. With higher capital mobility and better substitution between foreign and domestic assets, α_1 is lower (closer to -1). Authorities then have less monetary policy autonomy (ability to control excess liquidity). With low capital mobility or low substitution between foreign and domestic assets, or both, α_1 is more than -1 and closer to 0. This suggests more monetary policy autonomy and should correspond to a high (absolute value) sterilization coefficient, reflecting a more efficient monetary policy.

Incorporating the variables selected for vectors X and Z as informed by Ouyang et al. (2007) and Ljubaj et al. (2010, adapted to the Botswana context) into the MFR and capital flow equations gives equations (6′) and (7′) below.

$$\Delta NDA_t = \alpha_0 + \alpha_{1i}\Delta NFA_t + \alpha_{2i}\Delta GDPR_t + \varepsilon_t \quad (6')$$

$$\Delta NFA_t = \beta_0 + \beta_{1i}\Delta NDA_t + \beta_{2i}\Delta r + v_t \quad (7')$$

where:

ΔNDA_t = change in net domestic assets

ΔNFA_t = change in net foreign assets (less valuation adjustment)

$\Delta GDPR_t$ = real gross domestic product growth

Δr = real interest rate differential (BoBC – US Treasury bill)

with:
Δxr2 = changes in the Rand exchange rate against the Pula as the instrument in equation (6′)
ΔMM2 = changes in the money multiplier as the instrument in equation (7′)

Given the simultaneity between ΔNDA and ΔNFA (as per Obstfeld, 1980, and Kouri and Porter, 1974), the MFR and capital flow equations are estimated concurrently using two-stage least squares (TSLS). Simultaneity applies in the Botswana case. The de facto regime is a crawling peg, rather than a fixed one, and the flexibility the crawl introduces makes simultaneity between ΔNFA and ΔNDA possible. Furthermore, with the abolition of exchange controls and the rapid growth of the non-bank financial sector in recent years, alongside the role played by the public officers' pension fund (BPOPF) in bringing in capital inflows, endogenous responses are likely. Therefore, in addition to estimating the sterilization coefficient under the simultaneity assumption, this paper also estimates a capital-inflow offset coefficient under this assumption, as inflows may have played some role in offsetting sterilization efforts.

Some studies that have estimated trade-offs between sterilization measures and capital flows, and between monetary policy autonomy and control of foreign exchange reserves with a framework including a monetary reaction function (MFR) and capital inflow offset measures, have used VAR models with predefined lag structures and no current period impact, or else have opted for the two-stage least squares (TSLS) method. This study needs to capture the immediate (current period) impacts of changes in explanatory variables (such as monetary and exchange rate variables) on the dependent variable so that the VAR approach is not optimal. TSLS, an instrumental variables approach allowing simultaneity, is used.

A small offset coefficient α_1 alongside a large sterilization coefficient α_1 imply that the central bank has a high degree of monetary policy independence (autonomy) and can neutralize the impact of capital and mineral receipt inflows effectively and sustainably. On the other hand, a large offset coefficient implies an ineffective sterilization policy whose impact is not sustained.

6.0 Data Presentation and Analysis of Results

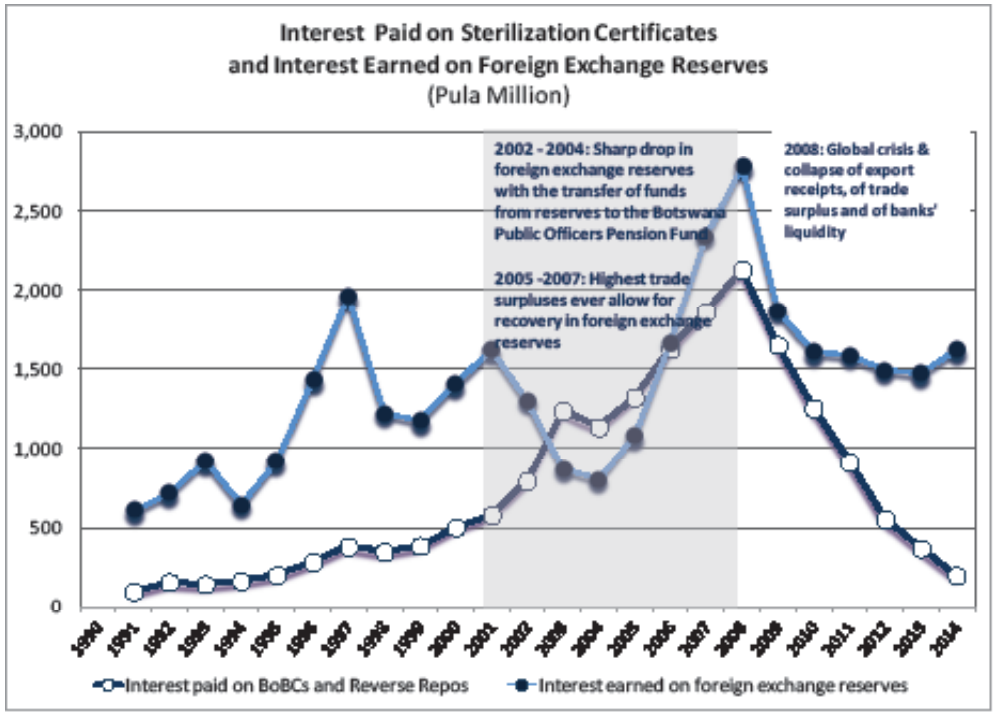
6.1 Data

Unless otherwise specified, all data for tables, charts and analysis are taken from Bank of Botswana annual reports and financial statistics. For the net sterilization cost and monetary autonomy calculations, these are based on accounting identities and the analysis includes the period 1991 to 1999 (prior to the abolition of exchange controls), and the subsequent period after 1999 when sterilization occurred under an open capital account. For the econometric analysis, the period from 2002 when government began transfers to the public officers' pension fund and a new policy approach was adopted, to 2015, is assessed. The apparent structural break in 2008/09 is also taken into account.

The Bank of Botswana annual reports provide pre-calculated values of the domestic interest cost of sterilization instrument issuance, $i_i L_i$ for both BoBCs and reverse repurchase agreements, and of the interest earnings on foreign exchange reserves in Pula currency, rRe* (for all reserves). These two annual time series are plotted in Figure 8. The data suggests that the two series trend together, though the interest earned on foreign exchange reserves seems to fluctuate significantly. The

annual data was entered in the accounting equations (1) and (3) used to estimate the annual cost of sterilization and its sustainability.

Figure 8: Interest paid on sterilization certificates and interest earned on foreign exchange reserves (Pula million)



Source: Data from Bank of Botswana Annual Reports.

Separate series for the values of liquidity instruments L and reserves R were also sourced from the Bank of Botswana Annual Reports and used in equation (4) to compile a monetary policy autonomy index, A.

With respect to the efficiency of sterilization operations, the estimation of sterilization and offset coefficients in equations 6 and 7 is done with two-stage least squares regression analysis using quarterly data for the period from 2001 quarter 4 to 2015 quarter 4. The use of higher frequency data to determine efficiency is appropriate in this case, where the regression equations have mainly monetary variables which tend to respond quickly to changes in the economic environment.[27] Exchange rate fluctuations are netted out of the data (valuation adjustment) to ensure only sterilization and offset effects are measured. The use of quarterly rather than monthly data means that the explanatory variables are not lagged as the response to a change in a given variable occurs within the same quarter. The absence of lags also allows for more degrees of freedom.

27 It was not possible to secure some of the pertinent monthly series, and therefore the use of quarterly data.

Data are sourced from Bank of Botswana and International Financial Statistics, IFS (for real interest rate differentials). Log values were taken for all variables except interest rates, interest rate differentials and the exchange rate. Plots of the exchange rates suggest they are non-stationary (have a trend) but not exponentially so – so they do not require logs, while real interest rate differential plot appears stationary. The time series characteristics of the variables in equations 6 and 7 were determined through unit root testing using the standard ADF unit root test (Annex Table II). All variables were found to be I (1) with stationary first differences except for real interest rate differential which was already stationary, I (0). The (stationary) regression instruments used were the change in the exchange rate and the change in the money multiplier. Given the possibility of a structural break around 2009, the econometric models are estimated for the full period Q4 2001-Q4 2015 including a structural break in Q3 2009, and for the sub-periods Q4 2001-Q1 2009 and Q4 2009-Q4 2015.

The variables in the accounting equations 1 and 4 for net sterilization cost and monetary autonomy and the regression variables for equations 6 and 7 are shown below (Table 8).

Table 8: Variables used in estimation of net sterilization cost, monetary autonomy, MFR and capital flows

Dependent Variables			Data source
Eqn. 1	S	The net cost of sterilization	calculated
Eqn. 4	A	Monetary policy autonomy index	calculated
Eqn. 6	ΔNDA (logs)	Change in central bank's net domestic assets (reflecting government deposits, BoBC issuance, etc less valuation adjustment)	BoB
Eqn. 7	ΔNFA (logs)	Change in central bank's net foreign assets (approx. Δ foreign reserves)	BoB
Independent Variables			**Data source**
Eqn. 1	L_1 i_{BoBC}	The short-run domestic interest cost on BoBCs (financial cost of remunerated liabilities)	BoB ARs
	L_2 i_{repo}	The short-run domestic interest cost on reverse repurchase agreements (financial cost of remunerated liabilities)	BoB ARs
	rRe*	The international interest earned on foreign reserves in Pula	BoB ARs
Eqn. 4	R	The value of foreign assets accumulated in a given period	BoB
	L_1	The value of domestic liabilities (BoBCs) outstanding in a given period	BoB
	L_2	The value of domestic liabilities (rev. repos) outstanding in a given period	BoB
Eqn. 6	ΔNFA (logs)	Change in net foreign assets (in reserves, ΔR)	BoB
	ΔGDPR (logs)	Real gross domestic product growth (annual)	BoB
	ΔXR2(logs)	Change in Rand-Pula exchange rate (regression instrument)	BoB

Eqn. 7	ΔNDA (logs)	Change in central bank's net domestic assets	BoB
	Δr	BoBC-US T-Bill real interest rate differential	BoB, IFS
	ΔMM2	Change in money multiplier = M2/M0 (regression instrument)	BoB

Note: BoB denotes Bank of Botswana Statistics; AR denotes annual report; IFS = International Financial Statistics.

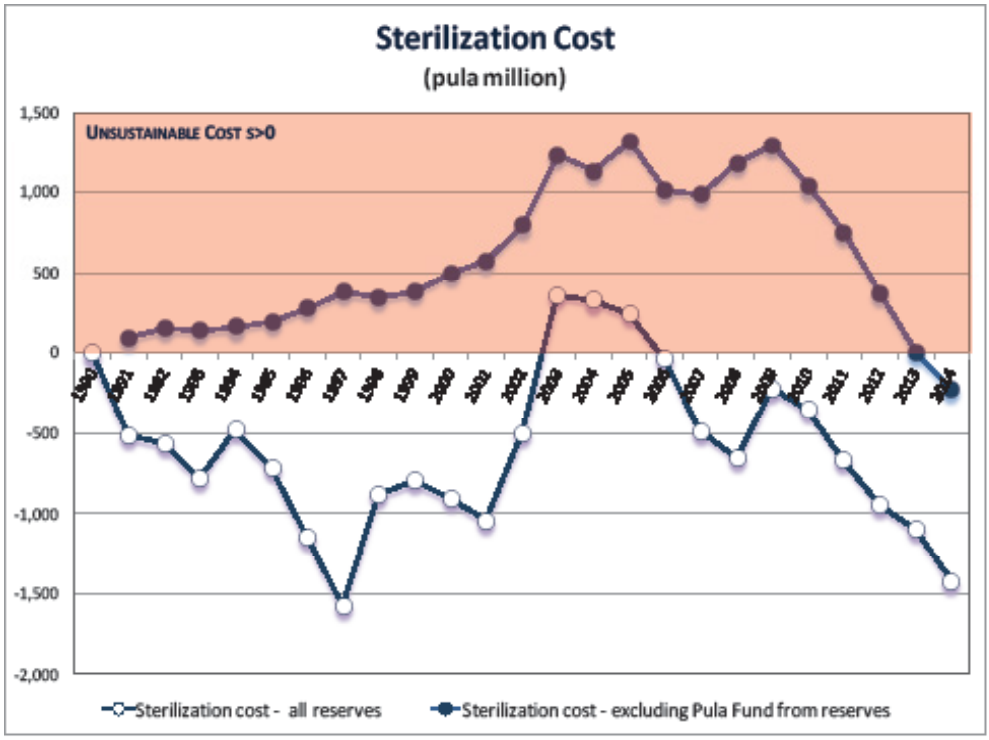
The various data trends reviewed show that from the early 2000s, Botswana experienced sizeable inflows alongside large trade surpluses. It is, therefore, possible that surges in offsetting inflows hampered the ability of monetary authorities' sterilization interventions to contain inflation, resulting in a decade of missed inflation targets and sustained appreciation pressure on real exchange rate. The data also show the rising net fiscal cost of monetary interventions over this period, suggesting sustained and aggressive sterilization activity. These outcomes point to the ineffectiveness of monetary policy in the first decade of the 2000s. The following results from this paper's analysis help to explain why these outcomes occurred; why sterilization policy was ineffective during this period.

6.2 Results on Sterilization Cost and Sustainability

The sterilization cost and sustainability calculations confirm that the net sterilization cost was high and unsustainable in the 2000s. The data plotted earlier in Figure 8 showed a sharp upward trend in the domestic interest (cost) paid out on BoBCs from the early 2000s through 2008, prompting an assessment of the fiscal cost. This cost assessment was done using the conventional measure, net sterilization cost, s, calculated from equation 1 for each year from 1991 to 2014 as shown in Figure 9. Figure 9 enables a comparison of net fiscal costs in the 1990s with net fiscal costs in the 2000s. The calculation shows that the net sterilization cost (defined as the difference between interest paid on liabilities used to sterilize and that earned on foreign reserves) was contained from 1991 when BoBCs were first introduced through 1998. However, it rose significantly from 2002 as the privately-run Botswana Public Officers Pension Fund brought substantial investment funds transferred from foreign exchange reserves into the country. Though monetary policy reforms[28] were introduced, they failed to contain the net sterilization cost.

28 This included the introduction of an inflation objective range and the shift from a fixed to a crawling exchange rate peg.

Figure 9: Sterilization cost (Pula million)



Source: Author's calculations.

The net sterilization cost, s, is sustainable as long as it is zero or negative. The net sterilization cost measure using all foreign reserves s^A, entered unsustainable territory (in the red) and remained unsustainable from 2003 through 2006 before reverting to sustainable levels. The 2007 recovery was due to a sharp 40% increase in foreign exchange reserves, reflecting in part the highest trade surpluses ever recorded in Botswana from 2005 through 2007 rather than a reduction in the interest cost of BoBCs issued by the central bank. The BoBC interest cost continued to rise.

It is worth noting, however, that if the Pula Fund was treated de facto as an inter-generational savings fund (as stated in policy), then its resources would be inaccessible to government and to the central bank's liquidity portfolio during the current generation of policy makers. The sustainability of the sterilization cost, s^L, would then be based on foreign exchange reserves as represented by the six-months import cover in the liquidity portfolio. If foreign reserves are defined in this way, excluding the Pula Fund, then the cost calculations presented in Figure 9 (black dot chart) show that the sterilization cost was marginally sustainable at the time BoBCs were introduced in 1991, but became increasingly unsustainable (in the red) over time, with the deterioration most pronounced after 2000. With this measure (s^L), the net sterilization cost only reached sustainable levels in 2013-2014.

The trend to recovery in sustainability after 2009 was enabled by the dissipation

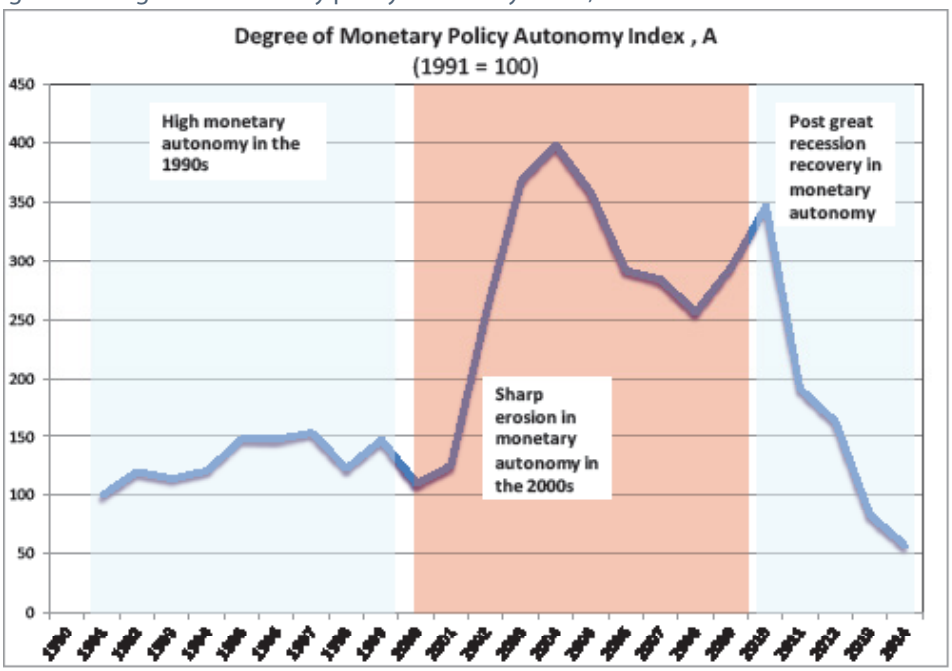
of excess liquidity pressures (reflecting the trade deficits seen in the wake of the great recession) and lower BPOPF inflows, and by the corresponding decline in the domestic interest cost of BoBCs issued by the Bank of Botswana. Thus, in the wake of the great recession, sterilization outcomes were more positive because sterilization became less important (lower excess liquidity pressures), and not necessarily because the policy itself became more efficient.

6.3 Results on the Degree of Monetary Policy Autonomy

An index, A, is constructed, depicting the degree of monetary policy autonomy. The monetary policy autonomy index illustrates the huge adverse impact the transfer of foreign reserves to fund public sector pensions had on monetary policy autonomy. The index, A, is calculated from equation 4. It is given by the ratio of domestic liabilities issued to foreign reserves and illustrates how accumulation of foreign exchange reserves contributes to improved monetary autonomy (reflected in a decline in the index). It therefore captures the role that reserve accumulation plays as an anchor for monetary autonomy in this monetary regime. The higher the degree of monetary policy autonomy, the lower index A is.

The index (Figure 10) reveals the relatively high monetary policy autonomy in the 1990s, reflecting the strong reserve accumulation (under a pegged exchange rate regime and capital controls), during this period - averaging 174% of non-mining GDP (110% of GDP) and 27 months import cover between 1990 and 2001. After 2000, there was a sharp deterioration in the degree of monetary policy autonomy, A, seen between 2001 and 2004 with the transfer of significant foreign exchange reserves to the privately-run Botswana Public Officers' Pension Fund. As seen earlier, the transfer fed a parallel increase in private sector inflows into the country. Foreign reserves dropped to an average 92% of non-mining GDP (68% of GDP) and 16 months import cover between 2002 and 2015. The period 2005-2008 saw a partial recovery in the degree of monetary policy autonomy, A, as reserves rose relative to GDP. A sharp increase in inflows through the trade account had fed into reserve accumulation before A was eroded again between 2008 and 2010 by draw-downs from foreign reserves in the wake of the great recession.

Figure 10: Degree of monetary policy autonomy index, A



Source: Author's calculations.

Sustaining of reserves post-2010 enabled by current account surpluses funded by transfers (primarily SACU transfers),[29] alongside much lower issuance of domestic liabilities[30] helped, by 2013, to restore monetary policy autonomy to levels last seen in the 1990s. In 2013, enough monetary policy autonomy was attained to allow sterilization to take effect and inflation to fall within the target range. However, in the wake of the great recession, it is SACU transfers rather than export receipts or inflows that have accounted for the current account surpluses that support reserve accumulation. This scenario where current account surpluses are dependent on SACU transfers driven by diamond industry imports is not the desired sustainable long-term solution, which requires a current account surplus driven by diversified exports and by investment inflows. It still leaves the economy exposed to the vagaries of the domestic and global diamond industry. If the domestic industry declines or SACU transfers dissipate for any reason, reserve accumulation will decline. This would then erode monetary autonomy once again and could eventually lead to adverse outcomes.

29 From 2012, there has been a doubling of inward government transfers in the current account, with the increase reflecting the sharp boost in Southern African Customs Union (SACU) receipts to government, corresponding to a sharp increase in rough diamond imports with the expansion of the diamond processing industry.

30 Less BoBC issuance was needed. With the decline in aggregate demand pressures given the trade deficits and a general economic slowdown, there were lower excess liquidity pressures and sterilization needs as predicted by theory.

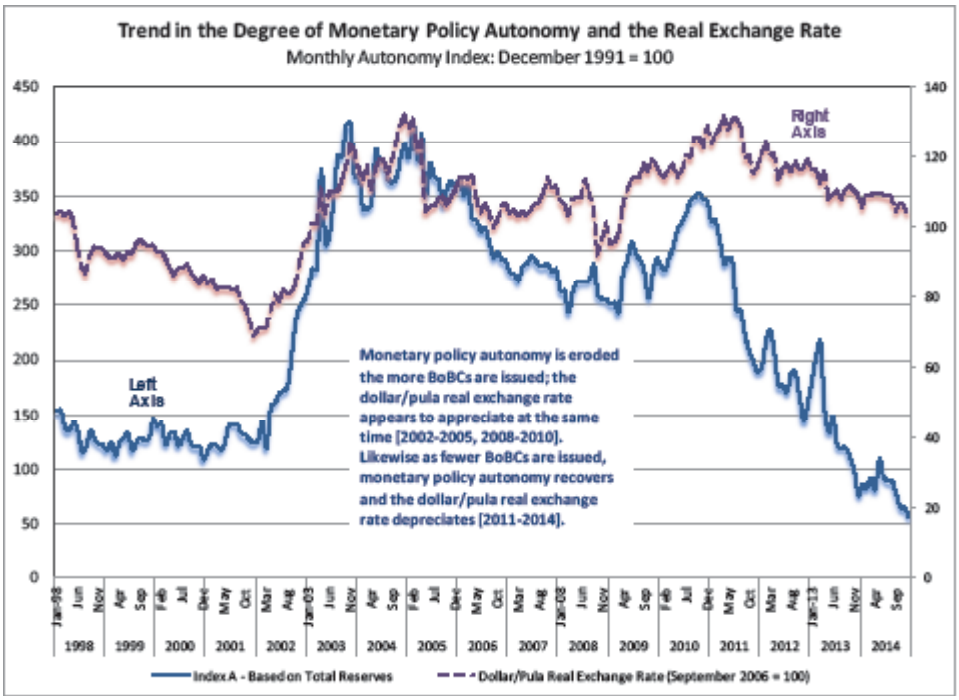
6.4 Results on Monetary Policy Autonomy and Real Exchange Rate

In the 2000s, whenever monetary policy autonomy deteriorated, driven by draw-downs on foreign reserves (mainly dollar-denominated due to the SDR-weighted currency allocation), monetary policy was unable to contain real Dollar/Pula exchange rate appreciation (Figure 11). As monetary policy autonomy decreased (and the effectiveness of sterilization diminished), real exchange rate appreciated. This occurred repeatedly. With the 2000 shift in policy approach, policy makers had difficulty sustaining higher levels of monetary policy autonomy over time, and therefore sterilization interventions were unable to prevent repeated episodes of real exchange rate appreciation.[31]

Frenkel's (2007) methodology implies that during episodes of unsustainable sterilization cost and low monetary policy autonomy, there is a higher likelihood that the currency will be over-valued. This over-valuation of the Pula was confirmed by analysts in the mid-2000s. In recent years, in the wake of great recession, and with trade deficits and the dissipation of excess liquidity pressures, monetary policy autonomy has been restored, accompanied by real Dollar/Pula exchange rate depreciation.

31 Notwithstanding the graphical story in Figure 11, regression analysis would be needed to determine whether the implied relationship in Figure 11 is spurious, or if instead there is in fact a true causal relationship. This study does not explore this issue further, since it is not the central focus of this paper.

Figure 11: Trend in degree of monetary policy autonomy and real exchange rate



Source: Author's calculations and Bank of Botswana Financial Statistics (BFS).

The large movements seen in the two series in Figure 11 are explained by policy actions taken at those times. After 2002, the rapid deterioration in monetary policy autonomy and the accompanying real exchange rate appreciation correspond to the 2002-2004 transfer of funds from foreign exchange reserves to the Botswana Public Officers Pension Fund, and corresponding inflows.[32] The improvement in the degree of monetary policy autonomy from 2005 to 2008 was due to a partial recovery in reserves following large receipts through the trade account, as noted earlier. The Dollar/Pula real exchange rate depreciated in line with this (supported initially by a nominal Pula devaluation). After the great recession, however, large draw-downs from foreign exchange reserves through 2010 again eroded monetary policy autonomy and real exchange rate appreciated again. Since 2012, recurring trade deficits and low aggregate demand have led to a sharp drop in excess liquidity pressures and, with this, a sharp drop in BoBC issuance and a significant increase in monetary policy autonomy. The downward trend in the Dollar/Pula real exchange rate since 2011 is consistent with this.

32 There was also upward pressure on the Pula from the sharp Rand appreciation against the Dollar, but under the new monetary policy approach, authorities chose not to use exchange rate policy to correct for this.

6.5 Results on the Efficiency of Sterilization

Simultaneous monetary reaction function (MFR) and capital flow equations were estimated using TSLS to confirm that there were offsetting inflows hampering sterilization. Table 9 summarizes the results of the estimated equations 6 and 7, providing the sterilization and offset coefficients. For both the MFR and capital flow equations, three sets of estimations are shown, for the full period Q1 2002 to Q4 2015, and then for the pre and post-great recession sub-periods. The net effect over the full sample period (allowing for a structural break in 2009) produced a sterilization coefficient of -1 and an offset coefficient of -0.66. The large sterilization coefficients for all periods assessed (of around 1 or more) from the MFR equation 6 suggest aggressive sterilization took place both prior to and after the great recession, with the coefficient being larger for the latter period.[33] The net sterilization effect differs significantly, however, depending on which of the two periods one is considering. The estimated offset coefficient from the corresponding capital flow equation is large and statistically significant prior to the great recession, but much lower and less statistically significant in the wake of the great recession. These results indicate a notable degree of inflows offsetting sterilization, with the bulk of offsetting inflows seen prior to the great recession. The offsetting capital inflows resulted in a weaker net-sterilization effect and help to explain the poor monetary policy outcomes up to 2009. Post-2009, improving policy results reflect lower offsetting inflows, increased monetary autonomy and dissipation of excess liquidity pressures, leading to positive policy outcomes by 2013.

The added exogenous explanatory variable in the MFR equation (real GDP) is not significant, though it is of the expected (positive) sign prior to great recession. This insignificance suggests that reserve accumulation effects and their sterilization dominated any effects of GDP growth on domestic monetary expansion (changes in net domestic assets). In the post-crisis period characterized by recession and low growth, it is not surprising that GDP growth is not a significant contributor to monetary expansion.

The regression results confirm that during the period 2002-2009, sterilization was inefficient. While sterilization interventions mopped up 90% of the excess liquidity, the impact was transitory as the interventions were offset by similarly large inflows, with 80% of the sterilization being negated by off-setting inflows, leaving the excess supply of money in the domestic economy only slightly changed.[34] In contrast, an

33 Authorities have boosted reserve accumulation since 2013 despite lower real GDP growth (probably reflecting the authorities' post-crisis decision to allocate more funds towards long-term savings in international reserves, alongside increased SACU transfers and foreign borrowing by government). More rapid reserve accumulation in recent years corresponds to the large sterilization coefficient in this period.

34 An ADL equation would be needed to determine how long sterilization was sustained before it was negated by inflows, but part of the required monthly data series needed to explore lag structures in this way was not available for this research.

offset coefficient closer to zero would have meant that the significant sterilization measures undertaken in the domestic market were sustained and were not offset by additional inflows. The offsetting inflows explain the poor inflation performance and upward pressure on the real exchange rate during that period. The authorities' policies led to the additional inflows, but monetary and exchange rate policy measures were not structured to accommodate the new surge in inflows. Efforts to curb inflationary pressures probably entailed repeated sterilization of the new inflows, at an additional fiscal cost. Sterilization was, therefore, costly and failed to achieve the stated objectives. It was inefficient.

In the post-great recession period (2009-2015), only half the sterilization was offset by inflows while the large sterilization coefficient for this period in the MFR equation suggests considerable ongoing sterilization in this latter period. The full and sustained sterilization was enabled by the recovery in monetary policy autonomy with improved reserve accumulation from 2013, lower excess liquidity pressures and the reduction in offsetting capital inflows. Reductions in liquidity in the banking system due to sterilization could now be sustained, providing space for monetary pressures and inflation to subside.

Table 9: Results of simultaneous estimation of monetary policy reaction function and capital flow equation – Estimated using two-stage least squares in E-views (variables in logs)

Dependent variable, ANDA Full sample observations 57	Full Sample Q1 2002 - Q4 2015		Pre-Crisis Sample Q1 2002 - Q1 2009		Post-Crisis Sample Q4 2009 - Q4 2015	
Variable	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic
Δ Net Foreign Assets (sterilization coefficient)	-1.1	-8.7*	-0.9	-5.2*	-1.8	-2.8*
Δ real GDP	0.02	0.34	0.01	0.13	-0.005	-0.03
Constant	0.001	0.45	-0.003	-0.48	0.011	0.79
Instrument: Δ Rand/Pula exchange rate						
R^2	0.944		0.953		0.54	
Adjusted R^2	0.942		0.950		0.50	
F-statistic	55.7		28.5		3.94	
Probability (F-statistic)	0.000000		0.000000		0.034454	
Durbin-Watson statistic	2.62		1.61		1.98	
J-statistic (instrument test)	0.00		0.00		0.00	
Probability F(2,53)[a]	0.1387 F(2,53)		0.5031 F(2,26)		0.3402 F(2,22)	
Obs*R-squared Prob. Chi-Square(2)	0.1338		0.4741		0.3113	
Dependent variable, ANFA Full sample observations 57	Full Sample Q4 2001 – Q4 2015		Pre-Crisis Sample Q4 2001 – Q1 2009		Post-Crisis Sample Q4 2009 – Q4 2015	
Variable	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic
Δ Net Domestic Assets (offset coefficient)	-0.66	-4.28*	-0.80	-6.52*	-0.51	-2.47**
Real interest rate differential	-0.0009	-0.56	-0.0003	-0.17	0.0064	1.09
Constant	0.006	1.22	-0.003	0.71	0.010	1.37
Instrument: changes in money multiplier						
R^2	0.899		0.985		0.77	
Adjusted R^2	0.895		0.983		0.74	
F-statistic	17.1		40.3		3.12	
Probability (F-statistic)	0.000000		0.000000		0.073632	
Durbin-Watson statistic	1.82		1.71		2.16	
J-statistic (instrument test)	0.00		0.00		0.00	
Probability F(2,54)[a]	0.9025 F(2,54)		0.3450 F(2,27)		0.3306 F(2,15)	
Obs*R-squared Prob. Chi-Square (1)	0.8978		0.3208		0.2911	

Note: * denotes significant at 1%, ** denotes significant at 5%, *** at 10%

a Breusch-Pagan-Godfrey heteroskedasticity test (non-zero probability confirms homoskedasticity)

Obs*R-squared for Breusch-Godfrey LM test statistic (non-zero probability confirms no serial correlation)

While the sharp reduction in excess liquidity pressures in the wake of the great recession has taken the pressure off sterilization for now, it remains to be seen whether monetary policy authorities will have learnt from experience and be better able to handle large inflows, should they recur in future.

Regarding the validity of the regressions, the standard regression output results in Table 9 show that all the equations have a good fit (strong R^2 and a similar adjusted R^2), with key explanatory variables significant at the 1% level and the F-statistics confirming the validity of the specifications. Apart from the standard statistics shown, serial correlation and heteroskedasticity tests were applied to the residuals

from the estimated equations, confirming both homoskedasticity and the absence of serial correlation as required, in all cases. The Breusch-Pagan-Godfrey test used is the Lagrange multiplier test for heteroskedasticity. The null hypothesis for the test assumes that the regression errors are both homoskedastic and independent of the regressors, and that the linear specification of the model is correct. Failure of any one of these three conditions leads to rejection of the null. If the p-value for the test statistic is essentially zero, we reject the null hypothesis, so we want a p-value that is more than zero to confirm that the model is valid and homoskedastic with no serial correlation. The Obs*R-squared statistic given is the Breusch-Godfrey LM test statistic for serial correlation. As before, we require that its p-value be more than zero. The p-values are non-zero in all cases.

Given the use of instruments, the equations were also tested for over-identification. None of the regressions are over-identified. The J-statistic is used to test for over-identifying moment conditions. When there are more moment conditions (more instruments) than parameters, the system of equations may not have an exact solution and is said to be over-identified. The null for the J-test is that the model is over-identified. A J-statistic more than zero denotes over-identification; therefore, we want a J-statistic that is near-zero or zero to confirm that the model is not over-identified. The J-statistic is zero in all cases.

7.0 Conclusions and Policy Implications

The evidence from this study provides a cohesive explanation for Botswana's sub-optimal monetary policy outcomes in the 2000s that challenges the popular storyline. The deterioration in monetary policy outcomes after 2000 followed major policy decisions relating to the lifting of exchange controls and the use of foreign exchange reserves, alongside a shift in the approach to implementing monetary policy which was inconsistent with these major policy decisions. The loss in monetary policy effectiveness had little to do with administered prices, government levies or global food and oil price shocks, as often cited.

The evidence clarifies why sterilization policy failed to contain inflation in the 2000s, and how the choices made eroded monetary policy autonomy and triggered offsetting inflows leading to an inefficient and ineffective monetary policy. The evidence also informs suggestions on how, under similar conditions in future, policy performance could be improved and the fiscal cost of sterilization mitigated.

The sharp contrast seen in monetary policy performance in the 1990s compared to the 2000s is consistent with findings in other studies on monetary policy in Botswana. The study finds that compared to the 1990s, monetary policy autonomy and effectiveness deteriorated significantly in the first decade of the 2000s. Studies on policy performance in the 1990s (Kone, 1996; Masalila and Phetwe, 2001; Setlhare 2004), also found that monetary policy in Botswana was effective at that time. Setlhare (2013) found there was limited policy effectiveness in the 2000s. This study's findings suggest an explanation for this difference and in particular for why policy outcomes changed in the 2000s. The results help to explain Setlhare's "unexplained findings"; why it was that while "shocks to monetary policy influenced inflation in the right direction,.... the impact was not significant"; and why there was "an unexplained reversal of the impact on inflation (of monetary shocks) over the forecast horizon, and the counter-intuitive impact on output." This study shows that off-setting capital inflows in the 2000s would have accounted for the limited policy impact and for the reversal of the monetary policy impact on inflation during the 2000s. Similarly, BPOPF inflows comprising inward investments (real estate acquisitions, development, etc) could have impacted economic activity positively given the ineffectiveness of contractionary monetary measures.

On monetary independence, comparison of monetary and exchange rate policy performance in the 1990s with that in the 2000s shows that significant monetary

policy autonomy in the earlier decade enabled successful policy outcomes, while a sharp deterioration in monetary autonomy in the 2000s led to missed policy targets. The monetary autonomy index for the 1990s confirms that sterilized intervention can in fact serve as an adequately independent policy tool in an economy such as Botswana, driven by large mining export receipts. What matters is the combination of policies in play that influence sterilization outcomes; the right combination of policies can provide successful outcomes, while the wrong combination will hamper the independence and effectiveness of sterilization as a policy tool.

The monetary autonomy index constructed in the paper points to the importance of recognizing how reserve accumulation anchors monetary policy autonomy in this regime, and how important it is to track and preserve that monetary autonomy. The failure to meet stated objectives in the first 2000s decade was due in part to a shift in policy emphasis from the exchange rate as a price anchor towards relying more on monetary operations to control inflation at a time when other policy choices were causing a dramatic weakening of monetary policy autonomy. In particular, the post-1999 abolition of exchange controls and the transfer of substantial foreign exchange reserves to private sector pension fund managers (responsible for public officers' pensions) eroded monetary policy autonomy and led to the subsequent large increase in private inflows that hindered the efficacy of sterilization. It is possible that the new policy approach adopted by the central bank at that time, which sought to give monetary policy a stronger role, in fact indexed both the nominal exchange rate and money supply to prices – in line with the warnings in Adams and Gros (2001). The new approach failed to plan counteractive measures for the additional inflows or to address the sharp erosion in monetary policy autonomy that rendered monetary policy through sterilization largely ineffective. This was in stark contrast to the 1990s when the focus on the pegged exchange rate regime (alongside some capital controls) and adequate reserve accumulation allowed for the significantly higher monetary policy autonomy seen in the 1990s.

The findings also show how the harmony or complementarity between monetary, exchange rate, foreign reserves and public pension policy choices that was sustained through the 1990s was subsequently lost in the 2000s, pointing to the importance of consistency and proper coordination of macroeconomic policies.

The experience of some Asian economies such as Singapore, which is arguably one of the top performing development stories globally with regard to rapid growth, employment and improvements in social indicators such as education, life expectancy and housing has shown that intermediate (monetary and exchange rate) regimes can in fact be viable alternatives to the standard classical prescriptions of fixed or floating regimes, when coupled with consistent macroeconomic and microeconomic policies, and strong institutions (Robinson and Lee, 2004). The Botswana experience in the 1990s validated this view, while its experience in the 2000s illustrates the financial and economic costs when inconsistent policy choices are made in such a regime.

Monetary and exchange rate policies were not able to contain real exchange rate appreciation during this period of low monetary policy autonomy, high inflation and

large inflows in the 2000s. During this episode, there was a higher likelihood that the Pula currency would become over-valued; this over-valuation was confirmed. While an attempt was made to correct for overvaluation in 2004-05, the correction was not sustained over time under the approach used by the monetary authorities, and it has continued to enable real Pula appreciation and erode price competitiveness over time.

These findings confirm that monetary authorities should have acted on private sector concerns over the ineffectiveness of monetary policy in the early 2000s. Sterilization had been relatively efficient in the 1990s when monetary and exchange rate policies targeted monetary stability and a competitive real effective exchange rate, but this efficiency deteriorated in the 2000s. The regression results confirm that during the period 2001-2009, sterilization was inefficient. This inefficiency manifested as a failure to achieve the objectives of monetary stability through low, stable inflation and a competitive and stable real effective exchange rate. The authorities had the opportunity to use the constructive criticism from the private sector at the time to review and correct their policy approach, but this did not happen. This failure to correct monetary policy outcomes during the decade of missed targets is an area deserving further analysis that would determine the reasons for the policy correction delays, helping to establish whether such delays were caused by technical, organizational, behavioural or political economy constraints, for example, and so informing the crafting of policy solutions in future.

Public concerns over the cost of sterilization in the 2000s were also justified. The net cost of sterilization rose sharply under the new policy approach introduced in the 2000s. The fiscal cost rose from an average 2.5% of non-mining GDP in the 1990s to an average 3.7% of non-mining GDP between 2000 and 2008, peaking at 4.5% of non-mining GDP in 2003. The beneficiaries of this fiscal transfer were foreign-owned banks. From 2003 to 2011, the central bank paid these commercial banks between Pula 1 billion and Pula 2.2 billion per annum interest on Bank of Botswana Certificates.

Cost concerns were also justified because, for a period, the policy was unsustainable. The sustainability of sterilization policy becomes a concern as soon as the interest cost paid on sterilization instruments exceeds the interest earned on foreign exchange reserves. When this happens, the risk of a crisis is heightened. Sterilization policy was unsustainable for some years in the mid-2000s.

The results from both the accounting and econometric analyses point to the need for a re-think of sterilization policy to deal more effectively with large trade surpluses and capital inflows in future. Had better sterilization modalities been designed to handle the inflows caused by the transfer of the government pension fund to private management, the adverse outcomes seen in the 2000s could have been avoided or contained. More thoughtful treatment of public pension funds would have helped, such as keeping them as privately-run funds, but on the central bank balance sheet or preparing special long-term investment vehicles to better capture large inflows at lower cost, and re-directing the interest paid by government away from foreign entities that repatriate these funds, to entities that would retain the funds in-country, contributing to the development of Botswana. Rapid re-accumulation of reserves

after the large draw-downs would also have helped. Even without such advance preparations, given the specific context of the inflows in Botswana, policy makers had enough information on magnitudes and timing of potential private inflows to predict and plan for the new inflows, but proper preparation for the additional inflows did not take place, leaving only BoBCs to absorb the additional inflows.

In the wake of the great recession, the collapse in excess liquidity pressures has provided monetary authorities with a brief respite; a period that can be used to design a more effective response to a future recovery in trade account receipts and future capital inflows. A re-think of sterilization policy to deal more effectively with large current account surpluses and capital inflows is needed, where the monetary stability objective can be met without sacrificing competitiveness. It may also be worth re-examining whether or not the current real exchange rule implemented through the crawling peg is problematic. Similarly, the current reliance on official (diamond-import linked SACU) transfers to government, which have helped to maintain current account surpluses and enable the reserve accumulation that is boosting monetary policy autonomy, is risky. Thus, a long-term solution that is not overly reliant on the diamond industry is still needed.

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Annex

Annex I: Sterilization policy timeline

1976 - 1980s	Monetary policy framework comprises both a managed exchange rate (peg) and an active monetary policy. Bank of Botswana used direct interest rate controls. Bank of Botswana Call Account used to absorb excess liquidity.
	Monetary policy allowed negative real interest rates to promote lending; but this enabled an inflationary environment amid rapid fiscal expansion (Government of Botswana, World Bank, 1989). Policy of low interest rates seen to cause disintermediation as banks turned away large deposits that they could not earn a profit on.
	Mid-1980s: Growing mineral revenues and large balance of payments surpluses led to pervasive excess liquidity (Leith, 1996), derived from a structural excess of savings (from diamond sales) over investment. Attempts to use the call account at Bank of Botswana to mop up excess liquidity (sterilize) were unsuccessful as the real call rate at the time was negative. By extension, the real prime lending rate of commercial banks was negative. This approach was later seen by some as a tax on banks. Government and parastatals' deposits at Bank of Botswana also played a dominant role in sterilization, though this role was later reduced.
1991	Liberalization: Monetary policy reforms replaced controls on interest rates with market determined rates. In May 1991, open market operations with Bank of Botswana Certificate sales were used to absorb excess liquidity in the banking system. Call Account at Bank of Botswana discontinued.
Late 1990s – 2001	Bank Rate used as a signalling device. Reserve requirements used sparingly to help curb liquidity – seen to put commercial banks at a disadvantage vis-à-vis other institutions that provided similar services (Masalila and Phetwe, 2001). Theory also suggests that excessive reserve requirements may push up bank interest rates. Bank of Botswana reliant almost exclusively on BoBC sales to sterilize excess liquidity. BoBCs initially auctioned to a broad base, including the whole financial sector (banking and non-banking) and major corporates; and could be held by individuals and firms through brokers or banks. Measures taken to refine the liquidity management framework with the introduction of short-term liquidity forecasting. BoBCs expected to achieve positive real interest rates (measured by effective yield on 3-month BoBCs) comparable to those prevailing in world financial markets, and to help attain price stability (Bank of Botswana Annual Reports). 1998 Monetary Policy Statement introduced. September 1998, repurchase agreements (repos) and reverse repurchase agreements (reverse repos) introduced to facilitate day-to-day liquidity management by commercial banks between BoBC auctions. Available to banks for periods ranging from overnight to one month (see Bank of Botswana Annual Reports). Secured Lending Facility (SLF) an additional short-term liquidity management tool. February 1999 exchange controls abolished and capital account opened. 1999 shift from an exchange rate peg with discrete adjustments in response to shocks, to a real exchange rate rule guided by the domestic-foreign inflation differential.
2000s	2002 - Annual objective for inflation of 4-6% introduced; 2006 - rolling 3-year inflation objective of 3-6% introduced. Commercial bank credit growth used as an intermediate target (BoB). The target growth for credit was defined as expected growth rate for GDP plus the inflation objective and two percentage points added to accommodate financial deepening (Bank of Botswana, 2015c). Policy tended to keep interest rates high through the sale of large volumes of BoBCs, in an effort to control liquidity and inflation. Policy also imposed restraints on bank charges and interest rate spreads (Jefferis and Kenewendo, 2011) in an effort to improve intermediation.

2001 – 2007	Botswana Public Officers Pension Fund transferred from government to market management in September 2001. Bulk of funds transferred to banks from the foreign exchange reserve fund after 2002; caused sizeable liquidity injection into the domestic market through to 2007. Assets under management in the pension market (some invested locally), grew from P9 billion end of 2002 to P34 billion in December 2007, before declining to P28 billion in 2010, in the wake of the great recession.
2006	March 2006 - BoBC auctions restricted to six commercial and merchant banks (nine banks in 2012). The rationale offered was that non-bank regulation was not in place at that time. Non-bank regulation has now been in place for at least five years (Regulator established in 2008) but the restrictions remain. Commercial banks' assets grew overnight to over 50% of GDP as all BoBCs were transferred to them. Purpose of BoBCs was to absorb excess liquidity in the banking sector, but they also provided banks with an alternative low risk, high return asset; banks have not had to pursue riskier or potentially lower return (risk-adjusted) lending opportunities. High BoBC interest rates made earnings on BoBCs an important contributor to bank profits (Jefferis and Tacheba, 2010).
2006-2010	Great recession saw collapse of mining GDP, halving its contribution to total GDP with a steep drop from 28.3% of GDP in 2007 to 13.5% of GDP in 2012; substantial decline in mineral export receipts. Created a post-crisis environment after 2010 with much lower liquidity pressures. Level of primary reserve requirements increased from 3.25% to 5% in February 2006 and from 5% to 6.5% in November 2010 and to 10% in 2011. Contributed to sterilization. 2008 – credit growth target dropped.
->2011	BoBCs sold in weekly auctions with maturities of 2 weeks to 1 year. Repurchase and reverse – repurchase agreement system manages short-term liquidity fluctuations. BoBC rate remains the policy rate. The Bank Rate is supposed to represent the charge by Bank of Botswana on loans to banks – however, little if any such borrowing occurs due to persistent excess liquidity in the banking system. The Bank Rate derives from movements in the BoBC rate and serves primarily as a signalling devise to banks, to adjust their rates.
2011	Noticeable decline in excess liquidity sustained (Bank of Botswana, 2013). Less sterilization needed. July and November 2011, the Bank of Botswana increased commercial banks' primary reserve ratios and capped Bank of Botswana Certificates (BoBCs) at P10 billion. Intention being to reduce the interest cost the Bank of Botswana was paying on outstanding BoBCs by reducing the amount of BoBCs available for auction, while limiting the liquidity held by banks (Mmegi Newspaper, 2012b). Reverse repurchase agreements allowed banks to invest funds overnight with the Bank of Botswana earning an interest rate pegged at 4.5% since December 2010.
2015	Low liquidity – Outstanding BoBCs declined from P17.7 billion end 2010 to P4.6 billion February 2015. April 1, 2015 primary reserve requirements halved from 10% to 5%, releasing over Pula 2 billion to augment commercial banks' loanable funds (Bank of Botswana, 2015b).

Annex II: Unit root tests results

Regression Variables (all variables in logs)					
Variable	Levels		First Difference		Order of Integration
	Intercept	Intercept and Trend	Intercept	Intercept and Trend	
Net Foreign Assets	-0.480386 (0.8871)	-3.611994 (0.3774)	-5.800388 (0.0000)*	-5.797313 (0.0001)*	I(1)
Net Domestic Assets	-0.165586 (0.9366)	-1.585932 (0.7868)	-6.102592 (0.0000)*	-6.108197 (0.0000)*	I(1)
Real GDP	-0.969074 (0.7583)	-4.796533 (0.0014)	-7.981594 (0.0000)*	-7.961219 (0.0000)*	I(1)
Real interest rate differential (BoBC vs US T-Bill)	-2.349357 (0.1605)	-4.363715 (0.0052)*			I(0)
Instruments (all variables in logs)					
Variable	Levels		First Difference		Order of Integration
	Intercept	Intercept and Trend	Intercept	Intercept and Trend	
Money multiplier	-2.540999 (0.1112)	-2.509271 (0.3228)	-9.886750 (0.0000)*	-9.812423 (0.0000)*	I(1)
Rand-Pula exchange rate	-1.613333 (0.4714)	-2.105684 (0.5349)	-9.597137 (0.0000)*	-9.538848 (0.0000)*	I(1)
SDR-Pula exchange rate	-0.973168 (0.7571)	-2.928643 (0.1613)	-9.851837 (0.0000)*	-9.763344 (0.0000)*	I(1)

Note: *, ** and *** denotes that a variable is stationary at 1%, 5% and 10% level of significance, respectively. The values in parenthesis denote the probabilities (P-values)

Annex III: Monetary reaction and capital flow two-stage least squares regression results – with two instruments in each equation

Dependent variable, ΔNDA Full sample observations 57	Full Sample Q1 2002 – Q4 2015		Pre-Crisis Sample Q1 2002 – Q1 2009		Post-Crisis Sample Q4 2009 – Q4 2015	
Variable	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic
Δ Net Foreign Assets (sterilization coefficient)	-1.1	-22.0*	-1.1	-30.4*	-1.7	-3.10*
Δ real GDP	0.03	0.34	0.13	2.49**	-0.008	-0.05
Constant	0.0015	0.45	-0.005	-1.51	0.009	0.79
Instruments: Δ Rand/Pula exchange rate, Δ SDR/Pula exchange rate						
R2	0.939		0.980		0.63	
Adjusted R2	0.937		0.978		0.59	
F-statistic	259.5		499.1		4.86	
Probability (F-statistic)	0.000000		0.000000		0.017844	
Durbin-Watson statistic	2.55		2.44		2.05	
J-statistic (instrument test)	0.1017		5.0939		0.2522	
Probability F (2,53)a	0.1492		0.8392		0.2936	
Obs*R-squared Prob. Chi-Square (2)	0.1437		0.8235		0.2677	
Dependent variable, ΔNFA Full sample observations 57	Full Sample Q4 2001 – Q4 2015		Pre-Crisis Sample Q4 2001 – Q1 2009		Post-Crisis Sample Q4 2009 – Q4 2015	
Variable	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic
Δ Net Domestic Assets (offset coefficient)	-0.71	-6.91*	-0.79	-6.78*	-0.47	-2.06**
Constant	0.004	1.42	-0.003	0.71	0.007	1.28
Instruments: real interest rate differential, changes in money multiplier						
R2	0.921		0.964		0.727	
Adjusted R2	0.919		0.963		0.715	
F-statistic	47.7		45.9		4.23	
Probability (F-statistic)	0.000000		0.000000		0.051332	
Durbin-Watson statistic	1.97		1.68		1.86	
J-statistic (instrument test)	0.3743		0.0048		0.7602	
Probability F (2,53)a	0.9552		0.6941		0.8116	
Obs*R-squared Prob. Chi-Square (1)	0.9542		0.6817		0.8017	

Note: *denotes significant at 1%, **denotes significant at 5%, *** at 10%

a Breusch-Pagan-Godfrey heteroskedasticity test (non-zero probability confirms homoskedasticity)

Obs*R-squared for Breusch-Godfrey LM test statistic(non-zero probability confirms no serial correlation)

J-test: Zero or near-zero J-statistic required to confirm there is no over-identification due to instruments.

Annex IV: Was the de facto policy in the 2000s based on an exchange rate peg or on a real exchange rate rule?

	Monetary Policy Statements (excerpts quoted from statements)
1999	Bank of Botswana tries to keep the real exchange rate stable by having changes in the nominal exchange rate mirror changes in the inflation differential.
2002	Bank of Botswana targets the inflation rate needed to achieve stability in the real effective exchange rate and defines this target using the inflation differential with trading partners.
2003	Exchange rate policy aims to keep the nominal effective exchange rate of the Pula stable. The Bank seeks to achieve a rate of inflation that, at a minimum, will maintain relative stability in the real exchange rate and avoid the need for a devaluation of the Pula.
2004	The Bank aims to keep the nominal effective exchange rate of the Pula constant. Specifically, the policy is to peg the value of the Pula to a basket of currencies comprising the South African rand and the International Monetary Fund's Special Drawing Right (SDR).
2006	(Crawling band exchange rate regime introduced in 2005). The Pula continued to be pegged to a basket of currencies comprising the South African Rand and the IMF Special Drawing Right (SDR)... The crawling band arrangement adjusts the Pula in small continuous steps, based on the differential between the Bank's inflation objective and the forecast inflation for trading partner countries on a forward-looking basis.
2007	The objective of monetary policy is price stability, which also contributes towards achieving REER stability through attaining the level of inflation that is not higher than the average inflation of trading partner countries. To the extent that Botswana's inflation objective is higher than the average inflation of trading partner countries, the nominal exchange rate has to crawl downwards to avoid the appreciation of the REER.
2008	The objective of monetary policy is price stability, which also contributes towards achieving a stable REER through attaining a level of inflation that is in line with the average inflation of trading partner countries. To the extent that Botswana's inflation objective is higher than the average inflation of trading partner countries, the nominal exchange rate will crawl downwards to attain stability of the REER.
2009	Since 2005, the Bank has been implementing the crawling band exchange rate mechanism that is aimed at maintaining international competitiveness of domestic producers. In the short term, this is achieved through stabilising the real effective exchange rate (REER). In this arrangement, the annual rate of crawl for the nominal effective exchange rate (NEER) is determined on the basis of the differential between Botswana's inflation objective and the forecast inflation for trading partner countries.
2010	In part, stability of the REER is attained through adjustment of the NEER of the Pula, but it could also be realized when domestic inflation is equal to inflation in trading partner countries. Thus, in instances where the inflation objective is higher than the forecast inflation in trading partner countries, a downward crawl of the NEER would be required to maintain international competitiveness of exports and domestic tradeable goods.
2011	If Botswana's inflation differs from that of trading partners, a stable REER is attained through the adjustment of the NEER of the Pula. ... An important feature of the model is adjustment of the nominal effective exchange rate (through adjustment to the rate of crawl) in line with the inflation objective and underlying real trends.
2014 2015	(Elements of monetary policy framework) .....monitoring of exchange rate developments and implementation of the crawling band exchange rate policy to support competitiveness of local producers.

"Several countries have adopted exchange rate rules that consist in depreciating the nominal exchange rate in line with a measure of the difference between inflation at home and abroad. .... to keep the real exchange rate constant..... (Examples studied) suggest that the monetary authorities may no longer be able to control inflation if they set the nominal exchange rate according to a real exchange rate rule."

Adam and Gross (1986), IMF Staff Papers

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