The compensation hypothesis: a monetary transmission mechanism for exchange rate and financial stability?

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Abstract

A system of compensation could enable the central bank to achieve both its monetary policy and financial stability objectives. Excess reserves do not determine the expansion of loans, but could be used by banks to speculate in the domestic foreign exchange market by increasing the bid-ask spread and/or demanding more foreign currency assets. This will place pressure on the exchange rate to depreciate. Therefore, the central bank could simultaneously allow the banks to substitute an interest earning liquid asset for the excess reserves, while easing the pressure to depreciate the rate. The liquid assets provide a new profit centre for the commercial banks instead of the non-remunerated excess reserves that are injected when the monetary authority accumulates international reserves, which further enhance the foreign currency constraint in the domestic market. Excess liquid assets and excess reserves may also reduce the volatility of the portfolio of assets demanded by the banks.

Key words: impossible trinity, monetary transmission mechanism, compensation thesis, Caribbean economies

1 Introduction

This paper analyses the implementation of monetary policy in economies with an exchange rate anchor. It explains how the monetary authority's instrument used for compensating commercial banks also contributes to financial stability by diminishing the volatility of the portfolio of assets[1]. Although not completely unique to exchange rate anchors of the Caribbean, there are a few stylised facts that make an exchange rate anchor more likely to be the chosen as the monetary policy framework. Firstly, it was recognised a long time ago that the financial system of the Caribbean is oligopolistic (Moore and Craigwell 2002, Blackman 1998). Secondly, there is the persistence of non-remunerated excess reserves and interest earning excess liquid assets that reflect oligopolistic interest rate mark-up over a foreign benchmark interest rate (Khemraj 2006).

[1] According to the IMF's de facto exchange rate classification, there are 79 economies with exchange rate anchors and their own national currencies (IMF 2013, p. 5). To obtain 79 subtract the number of 'dollarized' economies from the total number of countries with an exchange rate anchor.

Thirdly, any central bank in small open developing economies must demand significant levels of international reserves for the purpose of macroeconomic and exchange rate stability (Blackman 2006, Banchs and Mollejas 2010). Moreover, management of foreign exchange reserves with a prudent fiscal policy should be at the centre of macroeconomic policy making (Worrell 2012). The third point could very well be the deciding factor in forcing other small open developing economies – now classified as inflation, monetary or other regime targets by the IMF (IMF 2013, p. 5) – to eventually adopt exchange rate anchors. This is because the small open developing economy operates within context of a perpetual long-term foreign exchange constraint.

The three stylised facts are not modelled as part of the transmission mechanism of small open developing economies like those of the Caribbean. This paper argues that these features will have profound implications for the operation of monetary policy. The existing literature, taken from the advanced capitalist economies, often imply the central bank controls an instrument of monetary policy – typically a benchmark interest rate like the Taylor rule – that it reacts in different stages of the business cycle[2]. For us to understand why these three stylised facts are crucial aspects of the transmission mechanism, we have to move away from the conventional explanations of the monetary transmission mechanism meant for the advanced capitalist economies[3]. The question must be asked whether the central bank's demand for foreign exchange reserves is a potential transmission mechanism, determining exchange rate and financial stability. Does the accumulation of international reserves affect excess bank liquidity and other assets of the banking system? There is sparse empirical evidence making the connection between central banks' demand for international reserves and commercial bank assets and liabilities. The mainstream literature often emphasises sterilisation as a way of insulating the monetary base from the accumulation of international reserves. Several notable authors also argue that sterilised interventions are mainly "smoke and mirror" as they exert modest, if any, long-term effect on exchange and interest rates (Obstfeld and Rogoff 1995). The latter argument

[2]However, Banchs and Mollejas (2010) argue that the monetary policy framework must take into account whether the economy in question has a globally accepted currency or not. They observe that most countries are reserve earning economies, thus requiring them to build-up ample foreign exchange reserves. The level of the foreign reserves has implications for the effectiveness of an interest rate monetary policy instrument.

[3]Khan (1998) tests some of the conventional transmission mechanisms in the Caribbean context. Using vector autoregressions, Khemraj (2007) argues that excess reserves do not appear to determine loans and are actually determined by loans.

no doubt stems from the notion of the impossible trinity and the money neutrality thesis in the context of an open economy.

Invoking the importance of national pride and political economic forces, a few Caribbean economists have noted the importance of a fixed exchange rate as a nominal anchor even with de facto capital mobility (Williams 2006, Worrell et al. 2000). In so doing, they have indirectly questioned the applicability of the impossible trinity when thinking about the implementation of monetary policy. Khemraj and Pasha (2012) emphasise the tendency of some Caribbean economies – owing to oligopolistic banking and imperfect foreign exchange markets – to circumvent the straightjacket imposed by the impossible trinity. Over the years, other scholars often argue sterilisation is merely endogenous, reflecting offsetting changes on the liability side of the central bank's balance sheet (Lavoie 2001, Lavoie and Wang 2012). Instead of active exogenous sterilisation, these authors argue in favour of a compensation mechanism. Therefore, with the compensation system with commercial banks that mark-up interest rates, the possibility exists for the monetary authority to have both an exchange rate and independent monetary policy in light of capital mobility.

The paper is organised as follows. Section 2 discusses the central bank's demand for foreign exchange reserves. Section 3 discusses and reinterprets the emerging literature on excess bank liquidity. Section 4 proposes the notion of compensation – heretofore not mentioned in the Caribbean literature – by explaining the possibility of dual nominal anchors. Section 5 discusses the possible forms of the central bank's reaction function. Section 6 shows how compensation contributes to financial stability, and section 7 concludes.

2 Foreign exchange reserves

A lot of emphasis went into explaining why the large emerging economies demand foreign exchange reserves. The consensus appears to have settled on the need for hold precautionary balances after the Asian crisis (Aizenman and Marion 2003). However, what happens after the build-up of foreign reserves is important for our purposes. In small developing economies, the long-term trend level of international reserves has to be upward sloping, even though there will be short-term deviations from the trend. This implies that over a long enough period, the central bank's purchases of foreign currency in the domestic market will be greater than sales. These purchases will impact on domestic financial assets and bank liquidity (see: Khemraj 2006;

Banchs and Mollejas 2010; Shrestha 2014). We should also note that the national currencies are not globally traded; hence the long-term net purchase is done in the domestic financial system.

For Caribbean-type economies the level of foreign exchange reserves is often constrained by a perpetual foreign currency constraint. Although the need for precautionary balances is recognised, the economies may not possess the real sectors to generate sufficient precautionary balances. Worrell (2012, p. 6) argues that the small very open economy (SVOE) is "an economic engine that runs of foreign exchange." The perpetual foreign currency constraint, therefore, restricts the policy options, according to Worrell. This requires balancing aggregate demand through fiscal policy with the requirement to hoard foreign currency reserves. In the Keynesian tradition, Thirlwall developed a class of growth models that restrict long-term growth to the health of the current account of the balance of payments (Thirlwall 2013). In spite of its obvious intuitive appeal, Thirlwall's growth model – first conceptualised by Thirlwall in 1979 – is yet to be tested in the Caribbean context. The basic idea is the long-term the capacity of the small economy to earn foreign exchange is determined by global demand forces. The long-term demand determines the rate of growth for SVOEs.

The tide is turning, however, as more concrete theoretical and empirical works start to emerge from Caribbean economists. As mentioned above, the 2012 paper by Worrell puts management of international reserves through fiscal policy at the centre of the stabilisation agenda. In Worrell's framework, economic policy makers are required to think in terms of the tradable versus non-tradable sectors. If the SVOE is to stand a chance of maintaining an upward trend in foreign reserves, then special attention has to be given to the competitiveness of the tradable sector, which is the sector that earns the foreign exchange to ease the long-term foreign currency constraint. This idea combined with Thirlwall's demand-centred growth model could be the basis for future work in growth analyses in these types of systems. This paper will concentrate more on the issue of stabilisation, which although short-term in focus, has long-term implications for economic growth.

3 Excess Liquidity and Omitted Variable Bias

For the purpose of understanding the compensation hypothesis, we must first take note of how the long-term accumulation of international reserves determines the level of financial assets and liquidity in the overall financial system. There is an immediate connection between excess liquid assets (demanded in local currency) and foreign exchange reserves. Recall, excess liquidity takes

two forms. Firstly, there is the component that earns a rate of interest – the excess liquid assets. These are often securities used for monetary policy purposes. Often these are reported as Treasury bills used to "mop up" excess reserves. However, their role is much more fundamental, being part of a system of compensation in the post-liberalised period. There might also be special securities created for the purpose of monetary policy, as is the case in Jamaica. Secondly, there is the non-remunerated component of excess reserves. There are some instances in which excess reserves pay a low rate of interest, but most times they carry zero rate of nominal interest.

A large literature focuses on explaining the determinants of excess liquidity. Often this literature does not make the distinction between excess bank liquidity which earns interest and that which does not. This distinction is crucial because as is argued later, the build-up of excess liquidity reflects the deeper structural feature of the foreign currency constraint and the requirement that the central bank manages around it. The popular approach to modelling the demand for excess liquidity is to specify an ARDL econometric model with various control variables, including several proxies for volatility. One of the early examples is Saxegaard (2006) who tried to determine whether the banks' demand for excess liquidity is involuntary or voluntary (the precautionary motive). This paper was comprehensive taking into account the Monetary and Economic Community of Central Africa (CEMAC) region, Nigeria and Uganda. The author shows that the monetary transmission mechanism weakens in the presence of excess liquidity.

Another well-known attempt to disentangle the voluntary and involuntary nature of excess liquidity was Agénor et al. (2004). The authors put forward the novel idea that the stability of the demand for excess liquidity determines whether the slowdown of credit reflects a supply-side credit crunch or was it demand-induced. If the empirical demand is unstable it reflects the possibility the demand is involuntary, thus being consistent with a demand slowdown. The ARDL approach has found wide applications. For a more comprehensive review see the paper by Primus et al. (2014). The latter authors examine the dynamic evolution of involuntary liquidity closer to home, Trinidad and Tobago. Their empirical strategy was quite novel. First, they estimate a model taking into account various estimates for volatility. The first stage allows the authors to simulate voluntary and involuntary excess liquidity. In their second stage, they use a vector error correction model (VEC) to analyse the dynamics of involuntary liquidity given a shock to government expenditure. They found that a shock to the government

fiscal balance will increase involuntary liquidity. The implicit assumption of this research project is non-remunerated excess reserves could potentially stimulate the supply of loans in an involuntary regime of excess liquidity.

Other researchers, however, question whether excess reserves determine the supply of loans. In so doing this literature questions the relevance of excess reserves to the bank lending channel of the transmission mechanism (Lavoie 2007, Chapter 3). Using the method of vector auto-regression, Khemraj (2007) shows that excess reserves have no effect on the quantity of bank loans. Instead, the quantity of excess reserves responds negatively given a positive shock in the quantity of loans. In other works, the author introduces a different interpretation of voluntary and involuntary excess liquidity (see Khemraj 2006). Voluntary excess liquidity occurs when the commercial bank's liquidity preference curve – drawn in the space of loan interest rate and excess reserves – is horizontal. This implies the demand for excess reserves is perfectly elastic at a nominal interest rate above zero, unlike the popular interpretation of a liquidity trap in which the curve is flat at the zero lower bound.

The demand is involuntary when the market interest rate rises above the rate at which the demand for excess liquidity is perfectly elastic. This rate is interpreted as a minimum rate or a mark-up lending rate by an oligopolistic commercial bank (Khemraj 2006). Since excess reserves and loans are perfect substitutes at the mark-up, the banks will seek to invest the non-remunerated asset into an interest earning one, such as foreign assets. This they could do even in the voluntary or involuntary regimes once there is sufficient foreign exchange. However, they are prevented from doing so in all time periods because of the foreign exchange constraint. The constraint is made worse when the central bank accumulates international reserves. The alternative interpretation of voluntary versus involuntary excess reserves has two primary implications. Firstly, it implies the ARDL functions – modelling the demand for excess liquidity (E) – suffer from omitted variable bias.

$$E = L(x_V, 1/r, \Omega) \qquad (1)$$

ARDL time series models often include controls for volatility, which is derived from some underlying variable such as demand deposits or a series representing the nominal exchange rate. This is indicated by the variable x_V. The symbol Ω indicates control for other variables. The omitted variable is $1/r$, which implies an asymptotic liquidity preference curve. The latter is not included in the typical ARDL model which is popular for estimating voluntary and involuntary

excess liquidity. As these models are estimated by least squares, the omitted variable could bias the estimated coefficients. Secondly, excess reserves could be invested in other profit-making assets instead of being extended into loans. In an economy dominated by an oligopolistic banking sector, the investment demand for bank loans is constrained since the mark-up rate is above where the purely competitive rate would have been. If excess reserves are to be invested in foreign currency assets, the impact on stability is immediate. Therefore, there is the need for some mechanism to replace the profit making centre of the commercial bank when the monetary authority accumulates foreign reserves in an already foreign currency constrained economy.

4 Compensation and Dual Nominal Anchors

In the context of this paper, the compensation mechanism obtains its name from the fact that we will interpret the sales of Treasury bills, for the purpose of mopping up excess reserves, as a compensation system so that the commercial banks do not bid up the foreign exchange bid-ask spread, thereby adversely affecting the stability of the exchange rate[4]. In doing so, this paper argues that monetary policy can achieve its stabilisation goal through a compensation system. The system of compensation also has implications for financial stability and the nature of the instrument of monetary policy (and therefore the reaction variable in the central bank's reaction function). This section will focus on explaining the compensation mechanism, while the next two focuses on the central bank's reaction function and the issue of bank stability.

The compensation hypothesis has a long history and possibly a slightly different meaning from the one proposed in this paper. Marc Lavoie and his co-authors have done a tremendous amount of research explaining and testing the idea at the theoretical and empirical level. The basic hypothesis holds there are endogenous adjustments taking place on the central bank's balance sheet when there are capital inflows. The adjustments are seen as automatic and reflect private decision making. For this reason, Lavoie and Wang (2012) interprets the mainstream notion of sterilisation as an endogenous endeavour resulting from offsetting changes on both the asset and liability sides of the monetary authority's balance sheet. In addition, the central bank could create special monetary policy securities that are held as liabilities. Government deposits at the central bank could also allow this endogenous compensating system to occur when foreign

[4] Empirical studies have found evidence consistent with the view that greater exchange rate volatility is negatively associated with economic growth in small open economies (Schnabl 2008, Vieira et al. 2013). The volatility may work through impeding the development of capital markets in emerging economies (Hajilee and Al Nassar 2014). The latter authors find volatile exchange rates had a negative effect on stock market development in more economies compared with positive effects.

currencies flow into the economy. Therefore, capital inflows result in simultaneous changes on the asset and liability sides of the balance sheet without any change in the monetary base. Accompanying the compensation thesis is the reflux mechanism that is explained in detail in Lavoie (2001). Suffice to say, the reflux principle implies banks will use all excess reserves to repay their debt to the central bank. Excess reserves are not loaned out since banks make loans and "search for reserves later" (Lavoie 2001, p. 228).

Since excess reserves are a much more persistent and recurring feature in the banking system, commercial banks often do not borrow reserves from the central bank, unless there is a severe financial crisis. The excess reserves are injected into the system when the central bank accumulates foreign exchange reserves, which are kept at a specified number of months of import cover. Commercial banks cannot invest all reserves in foreign currencies because the central bank's demand for foreign reserves creates a foreign exchange constraint, a friction preventing all non-remunerated excess reserves from being invested in foreign assets. Therefore, the central bank compensates the commercial banks with Treasury bills so as to encourage them not to increase the bid-ask spread. This compensation system results because of the foreign currency constraint that is created when the central bank demand foreign reserves (Khemraj 2006). Furthermore, the foreign exchange constraint comes on top of the fact that the long-term trend level of foreign reserves is constrained by the balance of payments as specified by Thirlwall's growth model.

Let us examine the compensation hypothesis within the context of an oligopolistic banking sector. It is assumed a commercial bank is a major institutional trader of foreign currency, buying and selling the hard currencies in the domestic market. The bank not only has market power in loan and deposit markets, but also in the foreign exchange market. The bank, of course, uses domestic currency for the making purchases and sales. The market power in the foreign exchange market implies the bank can maintain a wide bid-ask spread. In the short-term, owing to sustained shortages of foreign exchange, the dominant bank would be tempted increase the selling rate (the rate importers pay), thus depreciating the currency and widening the spread. In this case, the monetary authority has to respond by offering an alternative asset in which the banks can make money. Here the central bank can sell Treasury bills or a special monetary policy instrument to the commercial banks. Since the banks do not use the excess reserves to make loans – which are constrained at the mark-up rate – they will purchase the liquid asset once

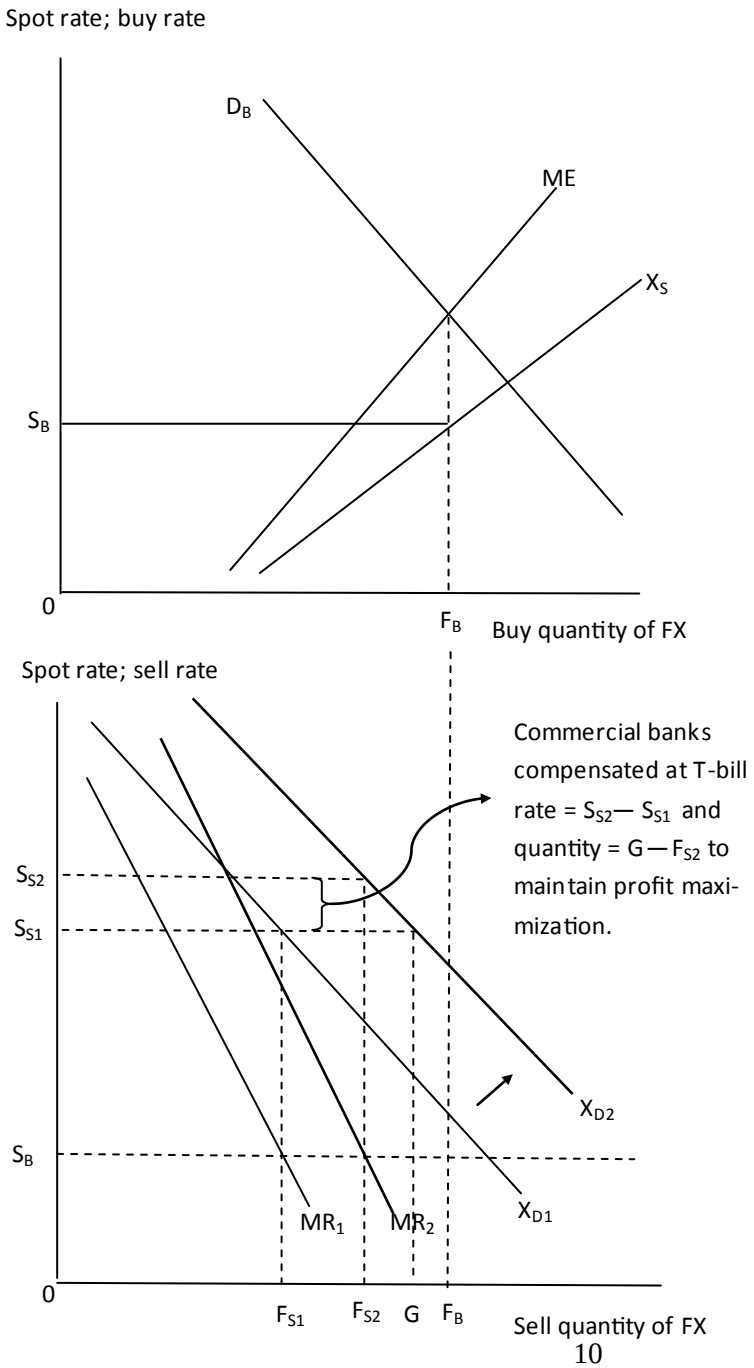
the rate is acceptable. However, the banks can even collude to bid at a high Treasury bill rate, thus preventing the central bank from having a true benchmark interest rate. Nevertheless, the central bank controls the quantity of Treasury bills it sells to preserve the bid-ask spread at which the banks are already making profits. In other words, the monetary authority compensates the commercial bank by selling them liquid assets, thereby engendering the build-up of interest earning excess liquid assets, while diminishing non-remunerated excess reserves. In the next period, however, excess reserves again rise as the central bank maintains its upward trend level of foreign reserves, thus requiring another round of liquid assets. The compensation system is necessary because of the long-term foreign exchange constraint and the requirement of foreign currency reserves.

Let us explain this idea using an imperfect competition model of the foreign exchange market. Typically the foreign exchange market is seen as a flexible price market closer to pure competition. That may very well be true for a globally traded currency that trades at all the main centres of global finance. However, our small very open developing economy does not possess a globally traded currency or a vehicle currency. The economy faces a perpetual foreign exchange constraint in the long-term. The imperfect competition model is different in that it allows for the persistence of the foreign exchange bid-ask spread. Since the market is local and the constraint is consistent, triangular arbitrage will not always exist to drive the bid-ask spread towards zero as would tend to be the case in the global foreign exchange market. There are just not sufficient quantities of all the main hard currencies for continual triangular arbitrage to take place. In the typical localised market, there tends to be larger quantities of US dollars than the other main currencies like Japanese yen or Euros.

Figure 1 gives a model of compensation within the context of an imperfect foreign exchange market. Both the buying and the selling sides of the market are given. On the buying side the dominant foreign exchange trader – possibly a price leader – purchases the hard currency as it enters the market through capital inflows, export earning or remittances. The quantity bought is F_B. The dominant bank trader would need to fulfil the requests by its clients for foreign exchange. Therefore, it will sell hard currencies equal to the amount F_{S1}. This allows it to hoard some for the purpose of buying foreign assets for. The quantity it hoards is given by $F_B - F_{S1}$. At this initial equilibrium the buying rate is S_B and the selling rate is S_{S1} (with the bid-ask spread = $S_{S1} - S_B$). The central bank, however, needs a cut of the amount hoarded since it has

to maintain ample international reserves. Therefore it buys foreign exchange from the domestic market by crediting excess reserves of the commercial bank trader. The demand curve shifts outward from X_{D1} to X_{D2}, thereby potentially causing the selling rate to depreciate from S_{S1} to S_{S2} (assume the exchange rate is quoted as local currency/one US$). Note that the quantity hoarded by the bank declines from $F_B - F_{S1}$ to $F_B - F_{S2}$.

Figure 1. Central bank compensation in an imperfect market



For the central bank to maintain the exchange rate at S_{S1} it will have to sell another asset to the commercial bank trader. Let us assume it sells Treasury bills to the dominant bank. Maintaining the exchange rate at S_{S1} requires that the central bank compensate or sell G amount of Treasury bills to the bank at a rate of interest that depends on the elasticity of demand for imports. The more inelastic the demand the higher will have to be the compensation interest rate. The rate of interest offered by the central bank has to be commensurate with the desired increase in the bid-ask spread from $S_{S1} - S_B$ to $S_{S2} - S_B$. The bank's market power to collude and fix the short-term interest rate will obviously depend on how steep the bid-ask spread is likely to increase. Therefore, while the central bank does not exercise full control over the rate of interest, it can exert control on the amount of Treasury bills it sells, thus controlling the level of excess liquid assets in the banking system. This implies excess liquidity and excess reserves are intricately connected to the system of compensation that is associated with the fact that a central bank in a SVOE has to hold sufficient foreign currency reserves. When the monetary authority purchases hard currencies it pays with excess reserves, but simultaneously worsens the foreign exchange constraint faced by the private traders. Therefore, it sells Treasury bills as compensation for the lost profits the banks would have made by increasing the bid-ask spread.

5 The Reaction Function

Compensation has a major implication for the choice of the monetary instrument and the variable that enters the central bank's reaction function as the dependent variable. Moreover, the tendency for the commercial banks to collude to influence the interest rate on Treasury bills implies there is no true short-term benchmark rate which pins down the domestic term structure. The collusion diminishes the potency of the short-term interest rate as the monetary instrument. Nevertheless, the auctioning system of Treasury bills was developed for the purpose of eventually allowing for the implementation of inflation targeting through the use of a short-term interest rate benchmark as the instrument (Tovar 2007). Tovar notes several reasons that have impeded the progress towards inflation targeting, including fiscal dominance in Jamaica and persistent excess liquidity in Trinidad and Tobago. However, in the reinterpretation of this paper, excess liquidity plays an important role in the compensation channel of the transmission mechanism.

Compensation is crucial and most relevant in the small open economy context. The conventional view of the trilemma says that in a fixed exchange rate economy (or one with a managed float), with at least de facto capital mobility, monetary policy becomes endogenous.

This means the central bank cannot choose an instrument independently – particularly an interest rate rule – because capital flows in and out will weaken the power of the instrument. This idea is further justified by theory that says there can be only one nominal anchor – exchange rate or money (interest rate) – in the long run. Empirical evidence emerging in recent years suggests that economies can lean against the trilemma. Aizenman et al. (2012) observe various trilemma configurations and their effect on price and output volatility. They discover a tendency to lean against the trilemma in which countries can hoard massive amounts of international reserves in order to have an independent monetary instrument and managed or fixed exchange rate in a system of capital mobility. Caribbean economies, however, do not possess an abundance of foreign exchange reserves, but Khemraj and Pasha (2012) observe a similar tendency, which they call the dual nominal anchors phenomenon. They argue that the ability of Caribbean central banks to seemingly violate the trilemma has to do with the oligopolistic nature of the banking system. Essentially, commercial banks mark up their interest rates against a foreign benchmark rate, thereby allowing the central bank the buffer against rapid capital outflows in normal and uncertain times. Using an econometric approach, Lavoie and Wang (2012) argue that the compensation mechanism they discover implies the People's Bank of China can have a managed float with a very narrow band, an independent interest rate instrument and the regime of de facto capital mobility. Hence, the Chinese central bank is able to lean against the trilemma.

The SVOE operates in an open economy. Therefore, its monetary policy is rooted in stabilisation taking into account global shocks. In this open economy context with oligopolistic short-term interest rate and oligopolistic banks trading in domestic foreign exchange market, there is no unique reaction function as the New Keynesian consensus puts forward. One can hardly publish a macroeconomics paper without including a Taylor rule reaction function. Interest rate rules, like the Taylor rule, are an integral part of the DSGE framework. However, this rule assumes the central bank uses a benchmark interest rate as the instrument of monetary policy. The effectiveness of the short-term interest rate is weakened for different reasons, some of which are spelled out by Tovar (2011). The approach above suggests that a reaction variable could be neither money nor an interest rate. Instead, the quantity of Treasury bills (or more likely the rate of change of Treasury bills) could be the variable reacting given the bid-ask spread (for a managed float) or the quantity of foreign currencies in the case of a fixed exchange rate economy. Therefore, it might be possible to express the reaction as follows

$$\Delta G_t = R(f_t, b_t, \Upsilon) \quad (2)$$

Where ΔG_t indicates the first difference of Treasury bills or the change from one period to the next, f_t is the foreign currency constraint (possibly represented by the deviation of foreign reserves from the target[5]), b_t the foreign exchange market bid-ask spread previously expressed as $S_S - S_B$. Υ represents control for other variables such as the output and inflation gaps. The researcher should experiment with alternative lags if this function is to be estimated. In their quest to integrate monetary policy and financial stability, Agénor and Pereira da Silva (2013) also proposed a reaction function, which is the traditional Taylor rule augmented with a measure of the credit gap. Therefore, it might be possible to take in to consideration the credit gap to address some of the concerns raised by these authors. In this context credit could be interpreted as loans by commercial banks.

6 Financial Stability

In recent years, a major focus of the literature has been to combine monetary policy with financial stability within the context of an inflation targeting framework. A comprehensive review of this agenda was given by Agénor and Pereira da Silva (2013). Previous empirical studies have also shown that excess liquid assets promote relatively more stable banking systems (Moore 2007, Deléchat et al. 2012). Earlier it was argued that the central bank could simultaneously have an independent monetary instrument – the quantity of excess liquidity it permits – and target the nominal exchange rate. This section examines the effect of excess liquidity on the variance and expected return of a stylised bank's portfolio. The bank is assumed to hold four assets that when expressed in ratio form can be written as follows $h + r + l + g = 1$. The assets are foreign currency assets (hoardings) converted into local currency ($h = H / A$), excess liquid assets or government securities ($g = G / A$), excess reserves ($r = R / A$) and loans in domestic currency ($l = L / A$). The expected return on each asset takes into consideration a probability of losing money on that asset. Therefore, the expected return on loans includes a discount representing the probability that some borrowers will not repay (this probability is denoted by ρ). Similarly the expected return on the government security is discounted by the probability the government will not repay or default (ψ_1). The expected return on hoarding FX

[5] Khemraj (2006) subtracts the aggregate sales of foreign exchange from the total sales to obtain a measure of the foreign exchange constraint.

takes into account the movements in the foreign exchange rate. When the nominal exchange rate depreciates ($\Delta S > 0$) the bank makes money on hoarding foreign exchange or foreign exchange assets. When the nominal exchange rate appreciates, however, ($\Delta S < 0$) the bank loses money on its stock of foreign exchange[6]. Therefore, we must take into consideration the probability the exchange rate will depreciate (ψ_2) and the probability it will appreciate ($1-\psi_2$).

The expected return on domestic currency loans is given as $E_L = (1-\rho)r_L$. The expected return on the government security is $E_G = (1-\psi_1)r_{GR}$. When the exchange rate is flexible the expected return on hoarding is given by $E_H = Er_F + \psi_2 \Delta S - (1-\psi_2)\Delta S$, where Er_F represents the forecast or expected foreign benchmark rate. In a fixed exchange rate regime, return on hoarding foreign asset is just Er_F. Note that if the commercial bank merely holds foreign currency in its vault its return on hoarding is 0% in the case of a fixed exchange rate. Given the ratio of each asset and the individual returns, the expected return on the portfolio can expressed as

$$E_P = E_L l + E_G g + E_H h \tag{3}$$

Substitute into equation 3 the asset ratio constraint $h = 1 - r - l - g$. Rearranging the formula will give us the expected return in deviations from the expected return on hoarding

$$E_P = (E_L - E_H)l + (E_G - E_H)g + (1-r)E_H \tag{4}$$

In a completely fixed exchange rate the expected return is simply deviations from the benchmark foreign interest rate. The benchmark foreign rate (r_F) could be, for example, the US Treasury bill rate. The stronger the oligopoly influence in the loan market implies that the bank can make more money. For the fixed exchange rate economy the expected return is given as

$$E_P^f = (E_L - r_F)l + (E_G - r_F)g + (1-r)r_F \tag{5}$$

Notice how bank excess reserves in domestic currency play a crucial role in reducing the influence of hoarding or the foreign asset on the portfolio return. Higher levels of excess reserves act as a constraint on bank demand for foreign asset. How would this situation emerge? The answer: by compensating the banks with government securities that pays the compensation interest rate (r_{GR}). The difference between the loan rate and the foreign rate and the Treasury bill rate and the foreign rate is determined by the oligopolistic mark-up. As the banking structure

[6] Note depreciation and resulting exchange rate pass-through to inflation could cause the banks to lose money on the assets denominated in domestic currency, for example its loan portfolio.

tends towards monopoly we can expect the mark-up to increase, thus increasing the portfolio return. However, increase in excess reserves reduces the effect of hoarding on the return of the portfolio even in an oligopolistic banking structure.

For the purpose of financial stability we must examine the variance of the portfolio of assets. The variance of the portfolio can be expressed as follows

$$\sigma_P^2 = E(r_P - E_P)^2 = E[l(r_L - E_L)^2 + g(r_{GR} - E_G)^2 + h(r_H - E_H)^2] \quad (6)$$

As usual *E* represents the expectations operator. The expression $r_H - E_H$ indicates the deviation of actual returns from expected returns on hoarding. The formula suggests that volatility results from the appreciation and depreciation of the exchange rate, increase in the default probability of borrowers, and the probability the government will default, since these are built into the respective expected returns. The equation further suggests that a fixed exchange rate would remove some of the volatility in the bank's portfolio. A completely flexible rate results in more volatility. In a fixed exchange rate economy the portfolio variance becomes.

$$\sigma_P^2 = E[l(r_L - E_L)^2 + g(r_{GR} - E_G)^2 + h(r_F - Er_F)^2] \quad (7)$$

The best forecast of the foreign rate reduces volatility further (that is $r_F = Er_F$). It was observed above that the oligopolistic mark-up increases the return on the portfolio. Let us now examine how the variance is affected by the mark-up. Substituting $h = 1 - r - l - g$ into equation 7 (the case for the fixed exchange rate) and rearranging will give

$$\sigma_P^2 = E\left\{l[(r_L - E_L)^2 - (r_F - Er_F)^2] + g[(r_{GR} - E_G)^2 - (r_F - Er_F)^2] + (1-r)(r_F - Er_F)^2\right\} \quad (8)$$

If the expression $(r_L - E_L)^2 - (r_F - Er_F)^2$ is expanded it becomes obvious that the square of the spread $(r_L - r_F)^2$ is embedded within the measure of portfolio volatility. Therefore, we can conclude that after controlling for the fixed exchange rate regime, volatility will increase as the mark-up rises. The expression $(r_{GR} - E_G)^2 - (r_F - Er_F)^2$ can also be simplified to $(r_{GR} - r_F)^2$.

Equation 8 can be seen as a decomposition of the volatility (or variance) when the banks possess oligopoly market power in the loan and Treasury bill markets. Therefore, it provides an insight into how policy might reduce the variance of the portfolio in the aggregate banking sector. First, throughout the Caribbean the spread between the loan rate and foreign rate ($r_L - r_F$) is often greater than the spread between the compensating interest rate and the foreign rate ($r_{GR} - r_F$). In other words, to the extent the central bank's policy shifts the portfolio towards

interest earning liquid assets from loans, it will diminish the variance. Second, to the extent the central bank can wrestle some of the market power away from the commercial banks in the Treasury bill market, the volatility will decline. In other words, the central bank might be able to excise some control over the compensating interest rate and let the banks decide the quantity of G; in which case the spread ($r_{GR} - r_F$) declines. Moreover, the ability of the central bank to control the rate depends on the elasticity of import demand (as seen in Figure 1). Third, an increase in excess reserves – often caused by the long-term accumulation of foreign reserves – will diminish the portfolio volatility. Fourth, anticipating foreign financial and macroeconomic conditions will result in a convergence between $r_F \rightarrow Er_F$, thus reducing the variance. The latter points to the importance of research and forecasting and the dissemination of the information to the commercial banks.

7 Conclusion

This paper argued that the excess liquidity phenomenon that is persistent across Caribbean economies (and possibly also other small open developing economies) reflects the long-term trend of an upward sloping level of central bank international reserves. Since the foreign exchange market is domestic, the central bank credits the commercial banks with excess reserves that are mainly non-remunerated; hence, the phenomenon has little to do with monetary policy at the zero bound, as is typically the case in advanced economies. The upward long-term trend takes away foreign exchange from the private sector in economies that already face long-term balance of payments and foreign exchange constraints. Therefore, the excess of liquid assets reflect a compensation system at work, whereby the commercial banks are sold an interest earning asset in the place of the non-remunerated excess reserves. The paper demonstrated algebraically that this compensation could diminish the variance of the portfolio of bank assets, thus promoting financial stability. This argument, furthermore, calls for a reinterpretation of the voluntary and involuntary nature of excess reserves since the latter does not engender excessive – if any – loan expansion, but could potentially allow for purchasing foreign currency assets in times of stress.

Given the discussion in this paper, several empirical questions could be explored in the near future. The first hypothesis is to re-examine central bank reaction functions. Does the reaction function have an interest rate as the reaction instrument as is the case of the Taylor rule? The latter would tend to be more relevant to competitive money markets instead of oligopolistic

ones. Secondly, researchers should examine whether excess reserves determine loans or are determined by loans. Thirdly, do excess reserves influence the bid-ask spread in the foreign exchange market? Or does the spread determine the level of excess reserves? If the compensation hypothesis holds we should find a negative relationship since the central bank is substituting liquid assets for excess reserves in times of a widening bid-ask spread. If the relationship is positive it implies that the central bank is not compensating but excess reserves are influencing the spread. Answering these questions and more could provide insights into new monetary policy transmission mechanisms. This paper notes that monetary policy is helpful in promoting stability if viewed through the lens the compensation mechanism.

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