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Evaluating sterilized intervention under an inflation-targeting framework: the case of the Philippines*

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After the 1997 financial crisis, several East Asian economies, including the Philippines, adopted an inflation-targeting framework. The shift in the policy stance of the Bangko Sentral ng Pilipinas (BSP) came with the acknowledgement that a flexible exchange rate framework is better suited to cushioning domestic economic performance from external disturbances than fixed nominal exchange rates. However, many inflation-targeting central banks, including the BSP, have continued to intervene in the foreign exchange market. This paper evaluates the impact of sterilized intervention using an economy-wide macroeconometric model instead of a partial-equilibrium framework. A loss function is used to evaluate the effectiveness of sterilized intervention, the latter being modeled as incorporating the exchange rate in the monetary authority's reaction function. The key features of the New Keynesian macroeconometric model are as follows: (a) the policy interest rate of the BSP responds to inflationary, output gap, and exchange rate pressures; (b) changes in the BSP policy rate affect changes in the nominal exchange rate based on the uncovered interest parity (UIP) condition; and (c) the nominal peso-dollar rate is an effective transmission mechanism, as both direct and indirect pass-through effects to inflation are relatively above average. Theory indicates that incorporating the exchange rate in the BSP reaction function may lead to unintended consequences. Simulation results show that such a policy has a favorable outcome if the exchange rate also appears in the BSP's objective function. Otherwise the exchange rate has to be dropped from the reaction function.

JEL classification: C32, E52
Keywords: foreign exchange intervention, monetary policy rule, central bank objective function

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1. Introduction

In January 2002, the Bangko Sentral ng Pilipinas (BSP) formally shifted to an inflation-targeting (IT) framework from a monetary aggregate targeting approach in formulating monetary policy. The shift in the BSP's policy was prompted by the observation that the historical relationship between inflation and money supply had weakened, thus undermining the effectiveness of the policy of targeting monetary aggregates. Innovations in financial products and financial markets, and greater financial liberalization have altered the link between money supply and inflation.

With more open capital accounts, many countries—including the Philippines—decided that a flexible exchange rate framework is better suited to cushioning domestic economic performance from external disturbances than fixed nominal exchange rates. In this context, the inflation target, rather than the fixed exchange rate, performs the role of a nominal anchor. The BSP is expected to intervene less in the foreign exchange market, allowing the exchange rate to absorb shocks induced by capital flows.

During the period between 20 September 2005 and 29 February 2008, the peso appreciated by 39 percent against the US dollar. This prompted the BSP to intervene in the foreign exchange market. The latter usually involves the purchase of foreign currency with domestic currency, which changes the monetary liabilities of the monetary authority, and thus the monetary stance. Typically, intervention aims at the following [IMF 2007]: (a) influencing the level of the exchange rate, (b) dampening exchange rate changes, (c) smoothing exchange rate flexibility, and (d) accumulating reserves.

In the typical inflation-targeting model, the exchange rate does not play a role in the reaction function of the monetary authority. However, the latter—particularly those in developing countries—may need to take exchange rate movements into consideration for several reasons. First, the evolution of the exchange rate has an important impact on inflation owing to the open nature of most economies. Second, the presence of a thin foreign exchange market or temporary shocks in developing countries often forces these countries to dampen short-term exchange rate volatility. Finally, to protect the competitiveness of their tradable sectors, many central banks have tried to resist domestic currency appreciation by intervening strongly in currency markets, typically through the accumulation of international reserves.

This paper attempts to determine whether BSP intervention in the foreign exchange market is consistent with its inflation-targeting framework. The empirical methodology will be largely based on the dissertation of Bayangos [2007]. By evaluating the effect of sterilized intervention on BSP's loss function, it will be determined whether the intervention has improved or impaired BSP's

credibility. A New Keynesian macroeconometric model is at the heart of the empirical methodology.

2. BSP intervention in the foreign exchange market

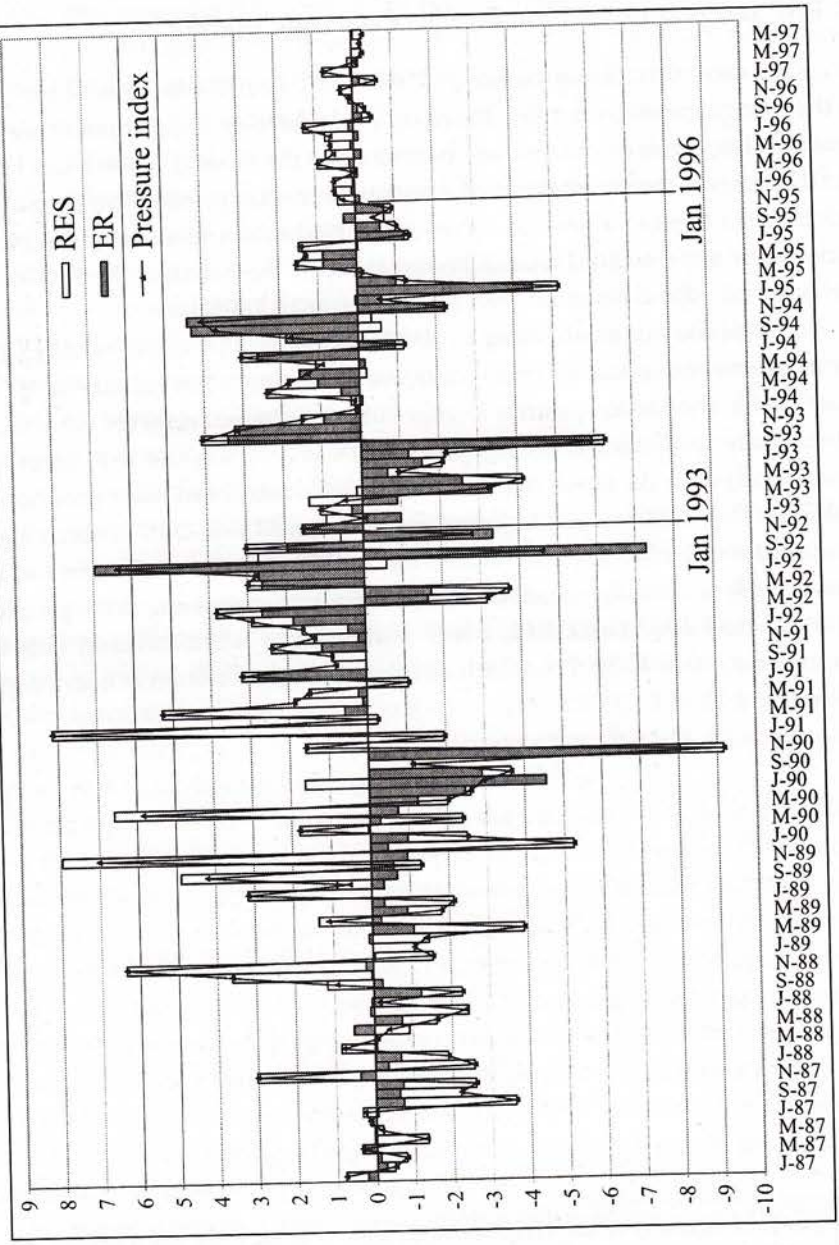
Data show that during the period 1998-2007, the BSP continued to intervene in the foreign exchange market. Based on a calculated exchange market pressure (EMP) index, the intervention was heavier after the crisis (Figure 1 and Figure 2).[1] The bars in the figure divide the exchange market pressure on the positive axis into the need to allow the currency to appreciate and a rise in reserves to prevent the appreciation. A useful comparison is the behavior of EMP during the surge of capital flows in 1996 and the surge in 2005.

In 1996, the maximum value of EMP was only 1.3 (August), while in 2005 the maximum value was 4.7 (February), even reaching 9.1 in January 2006. The chart clearly shows that positive changes in international reserves contributed substantially to exchange market pressure. Not only has the BSP intervened more heavily after the crisis, sterilization has apparently been more pronounced (Table 1). The sterilization coefficient for the period 1998–2007 is much higher compared to the coefficient between 1987 and 1997.[2] The coefficient has also been steadily increasing, which can be observed by comparing the regressions for the period 2002.1–2004.12, which is the period when inflation targeting was initiated, 2005.1–2007.8, which covers a period of relatively heavy capital inflows, and 1998.1–2007.8.

[1]The EMP is calculated as $\Delta\%er_t + (\sigma\Delta\%er/\Delta res)\Delta res_t$. The exchange rate is defined as \$/peso, and *%er* and *res* are the percentage month-on-month change of the exchange rate and international reserves, respectively. The EMP normalizes the size of the intervention, therefore making comparisons across time valid.

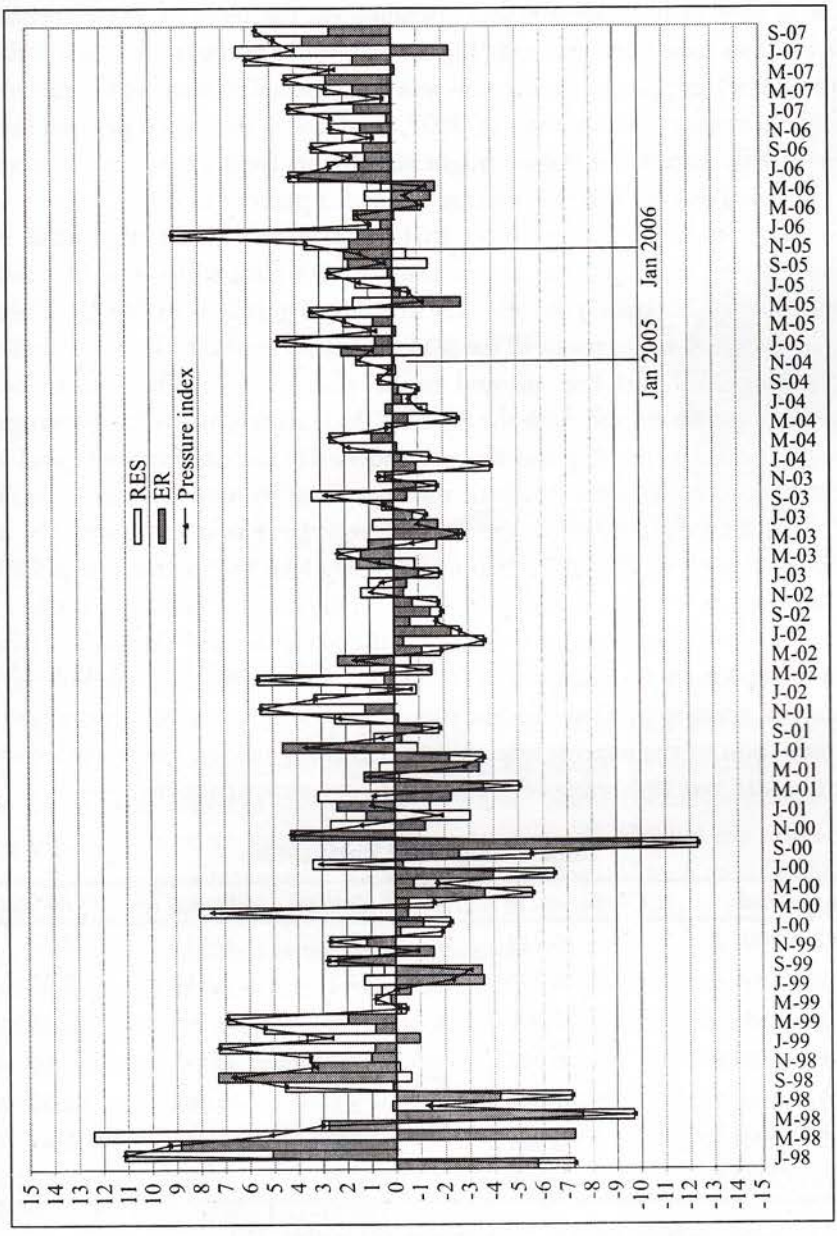
[2]The sterilization coefficient is the coefficient from a regression on the contribution of net domestic assets to reserve money growth on the contribution of net foreign assets to reserve money growth.

Figure 1. Pressure index: 1987–1997



Source of basic data: BSP and IMF

Figure 2. Pressure index: 1998–2007



Source of basic data: BSP and IMF

An important tool for sterilization beginning in 2006 was the special deposit account (SDA) facility. Established in 1998, SDA is BSP's alternative to open market operations. Banks can place funds with the BSP under the SDA facility, which is subject to interest rates depending on the term of the placements. Interest rates have been generally higher than those in the money or interbank markets. For example, when the SDA was first opened to state firms and banks' trust units in the second quarter of 2007, it offered as much as 8 percent for the three-month tenor while the overnight placements facility stood at 7.5 percent. The 91-day Treasury Bill rate averaged only 5.3 percent in 2007.

Data from 2004 onward show that the SDA was hardly used until 2006 (Figure 3). In April 2006 the amount in the SDA jumped to Php 19.3 billion from just Php 2.5 billion in February and Php 9.6 billion in March. Then in September 2006 the amount in the SDA facility increased to Php 49.7 billion.

In May 2007, the BSP allowed banks' placements in the SDA to be an alternative way to comply with the liquidity floor requirements for government deposits. Access to the SDA was likewise widened to include trust units and state firms. According to some analysts, this was done to mop up excess liquidity and maintain inflation within the target levels. In that same month the SDA increased sharply to Php 222.9 billion from only Php 54.2 billion in April 2007. The amount in the SDA stood at Php 583.3 billion as of February 2008.

Because of the surge in the size of the SDA, the BSP decided in March 2008 to implement immediately the following refinements in the facility: (a) the closure of existing windows for the two-, three-, and six-month tenors; and (b) the reduction of the interest rates on the remaining tenors. There was concern that the SDA was siphoning off funds from investment activity.

Table 1. Degree of sterilization

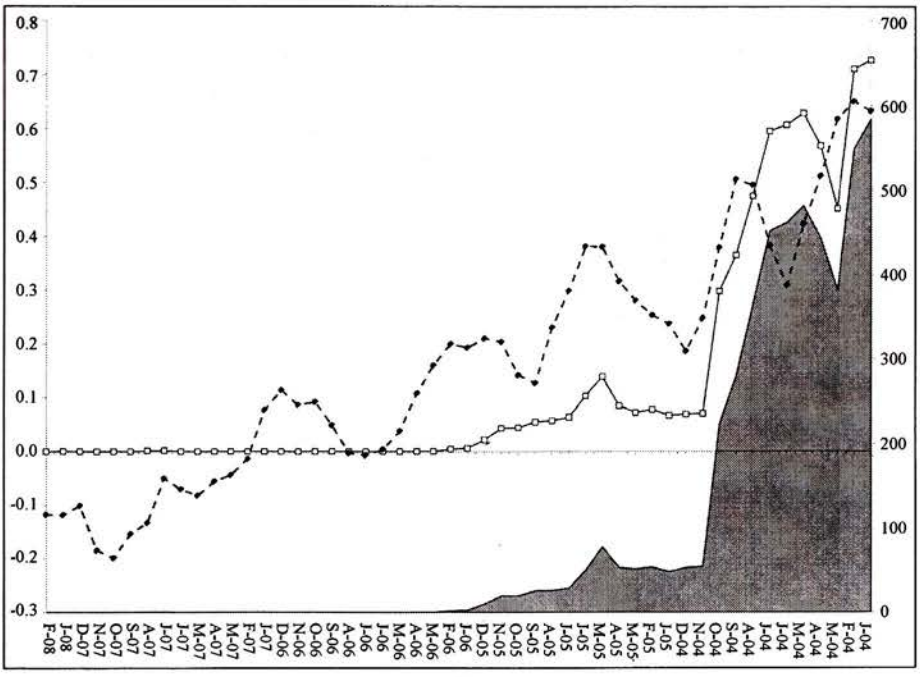
Time period	*Coefficient of ΔNFA*	*T-statistic*	*Adjusted R^2*	*D.W. Stat*
1987.1–2007.8	-0.714	13.4	0.419	2.32
1987.1–1997.6	-0.242	4.2	0.119	2.09
1993.1–1996.12	-1.020	5.6	0.392	2.50
1998.1–2007.8	-0.924	11.5	0.533	2.16
2003.1–2007.8	-1.050	8.6	0.568	2.00
2002.1–2004.12	-0.931	5.6	0.466	2.44
2005.1–2007.8	-1.100	6.9	0.605	1.74

Dependent variable: ΔNDA Explanatory variable: ΔNFA

Frequency of data: Monthly

Source: BSP Key Indicators

Figure 3. Special deposit account, 2004.1–2008.2



3. Has sterilized intervention been effective?

Before evaluating the consistency between sterilized intervention and the inflation-targeting framework, it would be useful to determine whether the former succeeded in some of its objectives. Some country studies looked specifically at how an inflation-targeting framework affected the efficacy of foreign exchange intervention [Domaç and Mendoza 2004; Kamil 2008]. The econometric methodology involves the estimation of only a few equations since what is of interest is the relationship between the specific intervention and exchange rate behavior. For example, Kamil [2008] examined the daily dollar purchases of the Central Bank of Colombia (BdR), which is defined as the intervention.[3] The main focus is on the estimate of the contemporaneous impact of intervention on the level of the exchange rate (the coefficient β_1). If central bank intervention is effective, then purchases of foreign currency will depreciate the domestic currency and so β_1, the parameter of interest, will be positive and statistically significant.

[3]The methodology is described in the Appendix.

The normal procedure would have been to compare the estimation results for a sample period during which inflation targeting was implemented and the estimation results for a sample period when inflation targeting was not yet implemented. However, Kamil applied the model to two periods during which inflation targeting was already the prevailing regime. There was more interest in determining whether discretionary intervention to stem domestic currency appreciation is more effective when there is consistency between monetary and exchange rate policy goals.

The empirical results show that in one period there was statistically significant evidence that intervention affected the level of the exchange rate in the intended direction. Moreover, foreign exchange intervention moderated the appreciation of the Colombian peso vis-à-vis the US dollar without undermining the central bank's ability to meet the inflation target. This implies that an inflation-targeting regime can be effective even though the exchange rate regime is not an entirely clean float.

However, intervention was ineffective during the period when large-scale intervention became incompatible with meeting the inflation target in an overheating economy. At that time, markets perceived the BdR as pursuing two mutually inconsistent goals. Kamil's main conclusion is that intervention cannot systematically influence the level of the exchange rate when intervention creates a conflict with other goals of monetary policy that the public perceives as overriding.

Meanwhile, Domaç and Mendoza [2004] employed an exponential GARCH framework using daily data on foreign exchange intervention. Empirical results suggest that both the amount and frequency of foreign exchange interventions have decreased the volatility of the exchange rates in Turkey and Mexico. The findings corroborate the notion that if foreign exchange interventions are carried out with finesse and sensibly—i.e., not to defend a particular exchange rate—they could play a useful role under an inflation-targeting framework in containing the adverse effects of temporary exchange rate shocks on inflation and financial stability.

A recent International Monetary Fund (IMF) study [2007] using primarily correlation analysis found limited evidence of systematic links between sterilized intervention and exchange rates in the Philippines, Indonesia, India, Republic of Korea, and Thailand. The general result is somewhat unexpected given the low degree of substitutability of emerging market assets and the large size of interventions relative to currency market turnover in emerging markets. The IMF explains the results as follows:

> First, persistent structural factors may be driving the appreciation of the currency, obscuring any effect of intervention beyond a short period. Second, to the extent that sterilized intervention prevents the domestic interest rate from adjusting (especially downwards), it would have limited effects on capital flows driven by interest rate differentials, thereby failing to alleviate upward pressure on the currency.

4. Macroeconomic framework

The issue of whether sterilized intervention is effective under an inflationary targeting regime can be extended to an economy-wide framework. In this context, the more relevant question becomes: "Should the exchange rate be included in the monetary authority's reaction function?" Including the exchange rate in the reaction function does not necessarily imply sterilized intervention since the monetary authority can react directly to exchange rate movements without intervening in the foreign exchange market. However, sterilized intervention does imply that the monetary authority reacts to movements in the exchange rate mainly by adjusting quantity aggregates leading to movements in the interest rate.

This is largely an unresolved issue. For example, Edwards (2006) finds it difficult to disagree with Taylor (2001) when the latter expresses some skepticism on the general merits of adding the exchange rate into the interest rate equation for at least two reasons. First, in properly specified models, the exchange rate already plays an indirect role through its effect on prices and output; second, adding the exchange rate (or any other asset price, for that matter) into the Taylor rule is likely to add considerable volatility to monetary policy.

The reasons for Central Bank intervention in the foreign exchange market were listed in the previous section. These can also be construed as justification for incorporating the exchange rate in the reaction function. Some analysts also argue that the latter will result in more stable macroeconomic outcomes (e.g. Ball, 1999).

The macroeconomic framework centers on three equations:[4]

1. The expectations-augmented Phillips curve equation, which is the key ingredient in an IT framework;
2. An aggregate demand equation assuming a closed economy, which resembles the traditional IS curve;

[4]The discussion underlying equations (1), (2), and (3) was lifted from Bayangos [2007:74-76].

3. A 'prescribed guide for monetary-policy conduct' (Svensson, 2002) with flexible use of policy instruments and the objective of stabilizing inflation and output gap, which replaces the old LM curve;

The expectations-augmented Phillips curve equation is specified as:

$$\pi_t = \alpha\pi^e + \delta y^g + \rho\pi_{t-1} + e. \quad (1)$$

Equation (1) assumes that the current realized inflation π_t depends on the expected inflation rate π^e, the output gap y^g, measured as the gap between output and the natural rate of output at full employment (or potential output), and an inflation shock e which captures any other factor affecting inflation. This also assumes that the central bank controls the inflation rate through its policy instruments. Price rigidity is reflected through π_{t-1} but full price flexibility holds in the long run. This means that economic agents react to new information but cannot fully adjust to it immediately. The implication of stickiness is that shifts in aggregate demand, including those induced by monetary policy, can affect output and employment in the short run. The New Keynesian assumption in an expectations-augmented Phillips curve equation is modelled by the forward-looking expected inflation rate. This captures the firms' concern about the future path of inflation since they fix prices for several periods.

The reduced form representation of the demand side of the model is specified as follows:

$$y_t^g = py_{t-1}^g + \varpi ey^g - \vartheta i^r + \varepsilon. \quad (2)$$

Equation (2) relates the demand equation with the current output gap y_t^g determined by the past y_{t-1}^g and expected future output gap ey^g, the real rate of interest and a demand shock ε. Equation (2) resembles the traditional IS curve, but expenditure decisions are seen to be based on intertemporal optimization of a utility function as captured by the lagged adjustment and forward-looking elements.

Thus far, there are two approaches in specifying the role of monetary policy. One approach uses a rule for setting a short-term interest rate—or the central bank's policy rate—in response to changes in inflation and output, often referred to as the Taylor rule [Taylor 1993]. According to this rule, the central bank should raise interest rates when inflation and output rise above target levels, with the inflation response relatively higher than the output response. Conversely, when inflation or output falls below its target, the central bank should cut interest rates.

Another approach starts with the central bank's objectives, typically assumed to be stabilization of inflation and the output gap. This approach allows the central bank more flexibility in setting its policy instrument in order to achieve said objectives. Walsh [2002] argued that one advantage of this approach is that it serves to highlight how changes in the objectives of monetary policy over time will result in a different policy behavior.

This approach is represented in equation (3), in what Svensson [2002] described as a "prescribed guide for monetary-policy conduct":

$$i_t^n = (1-\upsilon)\left[i^* + \pi^e\right] + ky^g + \sigma\left(\pi - \pi^*\right) + \upsilon i_{t-1}^n. \tag{3}$$

Some argue that Equation (3) replaces the old LM curve. In this equation, the nominal interest rate i_t^n is based on the "equilibrium" real rate of interest i^*, that is, the rate of interest consistent with the zero output gap implied in equation (2), expected inflation or a constant rate of inflation; the output gap and the deviation of realized inflation from the target π^T (or "inflation gap"). Some models use the inflation forecast (a two-year ahead forecast) instead of realized inflation. The lagged nominal interest rate represents interest rate "smoothing" undertaken by monetary authorities.

The issue at hand is whether the exchange rate should appear in equation (3). Edwards [2006] argues that this is a country-specific empirical question that should be dealt with by analyzing country specific evidence—both historical and based on simulation exercises. Hence, it would be useful to apply a macroeconometric model in order to shed light on this debate, at least in the Philippine context.

5. Description of the macroeconometric model[5]

The structural, dynamic, quarterly, macroeconometric model of Bayangos [2007] can be described as New Keynesian following the work of Ball [1999]. Such a model deliberately abstains from any optimizing foundation by assuming that inflation and output are backward-looking. A purely backward-looking specification is relevant since it resembles the empirical macroeconometric models used by many central banks [Ball 1999]. Such a specification is appropriate for an IT strategy that has only just been introduced, implying that the public is still learning about the new monetary policy regime. Important nominal rigidities underpin the macroeconomy, typical of the New Keynesian approach. In addition, there are lag effects in the transmission mechanism.

[5]The discussion in this section is lifted from Bayangos [2007], chapter 5. The complete model is available upon request.

The agents in this macro model include (i) households, (ii) domestic firms, (iii) government, (iv) the rest of the world (which provides capital, goods and services demanded by the domestic economy and a market for domestic production) and (v) the central bank. It is the task of the central bank to anchor the nominal side of the economy. It does this by adopting an IT framework, thus becoming a flexible inflation targeter, and it sets a short-term interest rate to achieve an inflation target, consequently providing nominal stability. There are lags and delays between a change in interest rate and inflation. Given these lags and price and wage rigidities, the use of a simple interest rate rule is required to anchor inflation in the long run, therefore limiting the role of money supply limited [Romer 2000]. This characteristic of the interest rate constitutes an integral part of an IT framework.

Meanwhile, this model also describes an economy in which there is excess supply. Therefore, aggregate output is demand-determined in the short to medium run. This model characterizes markets with the following features: (i) goods markets are monopolistically competitive leading to profits for firms that charge non-competitive sticky prices, and which clear all of domestic production to satisfy demand (net of imports) for consumption, investment, government spending and exports; (ii) labor equilibrium is not perfectly competitive as households and firms negotiate a non-competitive real wage and engage in sticky nominal contracts; when setting prices, firms' mark-up is responsive to demand and monetary conditions; (iii) asset markets (domestic and foreign) are imperfect.

The three major links of the model through which the policy rate impacts various variables are: (i) the traditional channel of the interest rate, or the 91-day treasury bill rate, deposit and lending rates and their impact, albeit limited, on consumption, investment demand and money supply; (ii) the real exchange rate and its impact on international trade, durable investment, the price level and the expected exchange rate; and (iii) inflation expectations and their impact on consumption and investment.

The transmission mechanism is triggered when domestic interest rate policy is set by the BSP. The overnight reverse repurchase rate (RRP) is prescribed as the nominal policy interest rate, the behavior of which is modelled after Clarida, Gali and Gertler [2000]. The RRP adjusts to inflationary pressure measured by the difference between the inflation forecast and the inflation target announced by the government, the output gap and exchange rate pressure, measured as the difference between the expected peso-dollar rate and the realized peso-dollar rate. The specification is as follows:

$$r_t^p = \alpha + \beta\left(\pi_t^f - \pi_t^*\right) + \rho\left(q_t - q_t^*\right) + \gamma\left(E_t e_{t+1}^n - e_t^n\right) + \varepsilon_t, \quad (4)$$

where r_t^p is the RRP, α connotes the neutral monetary policy stance, π_t^f is the inflation forecast, π_t^* is the medium-term inflation target announced by the government, q_t is real output, q_t^* is the potential real output, $E_t e_{t+1}^n$ is the expected nominal peso-dollar rate at time t, e_t^n is the realized nominal peso-dollar rate and the error term is ε_t.

The parameter β in equation (4) is expected to be less than 1. The parameter β is an indicator of whether the BSP as an inflation targeter is strict (when the parameter $\beta = 1$) or flexible (or when the parameter $\beta < 1$). A strict inflation targeter implies that the BSP's sole objective is price stability. The parameter β is expected to be less than 1 in the Philippine case.

Apart from being a flexible inflation targeter, the BSP is also assumed to smooth the interest rate based on a small set of indicators. A simple policy guideline for its operating target of overnight reverse repurchase rate (RRP) is prescribed which adjusts to the output gap, expected exchange rate gap—the difference between the expected exchange rate and realized exchange rate—and inflationary pressure measured by the difference between the inflation forecast and inflation target.

$$RRP = C(1) + C(2)^* POTGAPL1(-3)^* 100 + C(3)^* (EXPFXR - FXR) + C(4)^* (FINFL - INFTAR) + C(5)^* RRP(-2) + C(6)^* DUMASIAN$$

The estimated equation is as follows:

Dependent variable: RRP
Method: Two-stage least squares
Sample (adjusted): 1994Q1 2003Q3
Included observations: 39 after adjustments
Convergence achieved after eight iterations
Instrument list:

$$C\left(POTAGPL1(-3)^* 100\right)(EXPFXR - FXR)FINFL - INFTARRRP(-2)$$
$$DUMASIAN\left(POTGAPL2(-2)^* 100\right)(XPFXR(-2) - FXR(-2))$$
$$FINFL(-2) - INFTAR(-2)RRP(-2)\left(POTGAPL1(-4)^* 100\right)$$
$$(EXPFXR(-4) - FXR(-4))FINFL(-4) - INFTAR(-4)RRP(-4)$$

Lagged dependent variable and regressors added to instrument list

$$RRP = \underset{(1.825)}{1.851} + \underset{(2.199)}{0.349^{*}}\, POTGAPL1(-3)^{*}100 + \underset{(2.086)}{0.287^{*}}\,(EXPFXR - FXR) + \underset{(2.247)}{0.387^{*}}\,(FINFL - INFTAR) + \underset{(9.951)}{0.716^{*}}\, RRP(-2) - \underset{(2.343)}{1.435^{*}}\, DUMASIAN$$

Diagnostic tests	Statistic (p value)	Level of significance */ 5% **/ 10%
Adjusted R^2	0.75	
DW	2.01	
Prob (F-statistic)	0.00	
Jarque-Bera	2.602 (0.272)	*/
White (with cross terms, Obs R^2)	24.799 (0.167)	*/
Breusch-Godfrey (2 lags, Obs R^2)	3.653 (0.161)	*/
Ramsey *RESET* (2 fitted items, F-stat)	0 .780 (0.468)	*/

Changes in the RRP affect the nominal peso-dollar exchange rate and the expected nominal exchange rate. The macroeconometric model incorporates the UIP cum risk premium assumption in determining the nominal exchange rate. Indeed, the UIP relies on arbitrage arguments which are assumed even though arbitrage is often subject to limits. The UIP is seen as

$$E_t e^n_{t+1} - e^n_t = r^f_t - r^d_t + u^e_t, \tag{5}$$

where the difference between the foreign interest rate r^f_t and the domestic interest rate r^d_t is the interest rate differential; $E_t e^n_{t+1}$ is the expected nominal exchange rate; and u^e_t is the risk premium.

In equation (5), the risk premium is assumed to follow the stationary process,

$$u^e_{t+1} = \rho_e u^e_t + \varepsilon^e_{t+1}, \tag{6}$$

where $0 \leq \rho_e < 1$. In this equation, ρ_e captures the persistent movements in the risk premium and ε^e captures exchange rate shocks. In the simulations of the model it is assumed that the risk premium is constant in this equation. This implies that when the effects of, say, alternative interest rate policies are assessed the model would assume that the time series for u^e_t is invariant to such policies. That is, *ceteris paribus*, movements in r^d_t lead one-to-one to movements in expected nominal exchange rate, where one of the factors held fixed is u^e_t.

This is arguably as good an assumption as any. Equation (5) then feeds into the BSP reaction function in equation (4).

Modelling exchange rate expectations requires detailed data on the foreign exchange market. However, in the absence of microstructure data on this market and of concrete information about the expected exchange rate in the next period, it could be argued that agents form expectations starting with knowledge about the current exchange rate and about the model behind the exchange rate. This implies that the only information that agents have are the exchange rate in the current period and an estimate of the exchange rate equation, which is usually based on domestic and foreign interest rates. Actual future exchange rates may differ from this expectation due to exchange rate shocks.

The estimation follows the convention in which an increase in the nominal peso-dollar rate (FXR) and the real peso-dollar rate (FXPR) corresponds to a depreciation rather an appreciation of the peso. The BSP maintains a freely floating peso, the value of which is determined largely by supply and demand factors. The general dummy DUMCRISIS takes into account the impact of all crises in the Philippines from 1988 to 2003.

$$LOG(FXR) = C(1) + C(2)^{*} CA(-1)/(GDP(-1)/FXR(-1)) +$$
$$C(3)^{*} LOG(LIBOR90(-1)) + C(4)^{*} LOG(FXR(-1)) +$$
$$C(5)^{*} DUMCRISIS$$

The estimated equation is as follows:

Dependent variable: LOG(FXR)
Method: Least squares
Date: 07/06/06 Time: 04:41
Sample: 1994Q1 2003Q4
Included observations: 40
Convergence achieved after 10 iterations
White Heteroskedasticity-Consistent Standard Errors & Covariance

$$LOG(FXR) = \underset{(2.902)}{0.774} - \underset{(-2.348)}{0.116}^{*} CA(-2)/(GDP(-2)/FXR(-2)) +$$
$$\underset{(5.286)}{0.109}^{*} LOG(LIBOR90(-1) - TBR91(-1)) + \underset{(14.014)}{0.741}^{*} LOG(FXR(-1)) +$$
$$\underset{(3.216)}{0.071}^{*} DUMCRISIS$$

Diagnostic tests	Statistic (p value)	Level of significance */ 5% **/ 10%
Adjusted	0.98	
DW	1.94	
Jarque-Bera	0.091 (0.956)	*/
White (with cross terms)	1.751 (0.128)	*/
Breusch-Godfrey	0.163 (0.851)	*/
Ramsey RESET	0.438 (0.650)	*/

The empirical results in equation (4a) indicate that the BSP reaction function incorporates the exchange rate, i.e., the coefficient of the variable (*EXPFXR–FXR*) is significant. However, the vast majority of central banks do not openly recognize that they explicitly take into account exchange rate developments when conducting monetary policy [Edwards 2006]. The BSP is definitely part of this "vast majority".

Indeed, if pressed, most IT central bankers would go as far as saying that since exchange rate changes tend to affect inflation and the economy as a whole, they play a role on monetary policy. For example the BSP claims that the treatment of the exchange rate in the IT framework is one where there is willingness to tolerate a significant degree of variability in the exchange rate and to be sufficiently disciplined to participate in the foreign exchange market only in well-defined circumstances. The BSP intervenes in the market only to temper wide swings in the exchange rate that can lead to disorderly market conditions. However, the BSP would be reluctant to acknowledge that the exchange rate plays a direct role of its own in the monetary policy rule itself. Whether or not the BSP does incorporate the exchange rate in its reaction function, the next step would be to evaluate the soundness of this policy stance.

6. Simulation results

The impact of incorporating the exchange rate in the reaction function on BSP credibility is based on the estimated BSP objective function (or the welfare loss of a policy rule or the "policy loss function"). The idea is to map the impact of policy simulations and cases to the BSP's objective function over time, not to derive the optimizing policy loss function. A welfare or credibility loss (gain) to the BSP is measured by a higher (lower) value of the policy loss function. The impact on interest rates, the exchange rate, the money supply, components of GDP, and finally inflation and inflation expectations are also assessed.

The objective function of the BSP is assumed to exhibit the standard quadratic form with some modifications:

$$L = \frac{1}{2}\left[\varpi\left(\pi_t^f - \pi_t^*\right)^2 + \rho\left(q_t - q_t^*\right)^2 + \gamma\left(E_t e_{t+1}^n e_t^n\right)^2\right], \tag{7}$$

where π_t^f is the inflation forecast, π_t^* is quarterly inflation target announced by the government, q_t is actual quarterly real GDP growth, q_t^* is potential real GDP, E_t denotes expectations conditional upon the information set available at time t, and e_t^n is the average quarterly nominal peso-dollar exchange rate. Meanwhile, ϖ, ρ, and γ represent, respectively, the BSP's aversion to inflationary pressure, real GDP growth fluctuations around the potential (the output gap), and nominal peso-dollar exchange rate fluctuations around the expected rate.

In the empirical estimation of RRP (equation [4a]) inflationary pressure (ϖ in equation [7] above) carried a coefficient of 0.39, implying that the BSP is a flexible inflation targeter. Meanwhile, ρ and γ are estimated to be 0.35 and 0.29, as the BSP responds to shocks on the output gap and peso-dollar rate, respectively.

As with the debate on the role of the exchange rate in the reaction function (equation [4]), it is also unclear whether the exchange rate should have an independent role in monetary authority's objective function. Edwards [2006] points out that if the authorities have modelled the economy correctly—and in doing so, have incorporated the effects of the exchange rate on prices and output—there is no need to include an exchange rate term in equation (7). If, however, there is a lagged response of both inflation and output to exchange rate changes, the central bank may want to preempt their effect by adjusting the policy stance when the exchange rate change occurs, rather than when its effects on prices and output are manifested.

The analysis includes three subperiods: pre-IT (first quarter 1994 to fourth quarter 2000), the IT period (first quarter 2001 to first quarter 2003), and forecast IT period (second quarter 2003 to fourth quarter 2006). Meanwhile, the forecast IT period is based on an ex post forecast. Annualized quarterly growth and volatility using the coefficient of variation (CV) are computed. Volatility is a measure of how wild or quiet an indicator is relative to its history. The CV is a comparative measure defined as the ratio of the standard deviation to the mean.

Four simulations were run, defined as follows:

Case 1: The exchange rate is present in both the reaction function and the objective function.

Case 2: The exchange rate is deleted from the reaction function but retained in the objective function.

Case 3: The exchange rate is present in the reaction function but deleted from the objective function.

Case 4: The exchange rate is deleted from both the reaction function and objective function.

The results are shown in Table 2. Case 1 is baseline scenario in the study of Bayangos [2007], which was then compared to Case 2. Case 3 and Case 4 are the simulation runs made for this study.

Comparisons can be made between Case 1 and Case 2, and between Case 3 and Case 4. The results indicate that incorporating the exchange rate in the reaction function improves BSP's credibility if the exchange rate is included in the objective function. This conclusion is reached by comparing Case 1 and Case 2. The value of the BSP objective function increases in all three simulation periods. A different result is obtained if the exchange rate is not included in BSP's objective function. The value of the BSP objective function in Case 4 is less than in Case 3. However, in both cases the volatility of the BSP's objective function increases if the exchange rate is excluded from the reaction function.

7. Conclusion

The simulation results appear to be tautological. If the BSP "cares" about the exchange rate, then it should incorporate the latter in its reaction function. This improves the value of the objective function, i.e., it leads to a lower value of the loss function. On the other hand, if the exchange rate is excluded from the BSP's objective function, then the preferred strategy would be to drop the exchange rate from the reaction function.

The debate should then resolve whether or not the BSP should include the exchange rate in its objective function. Economic theory tends to support the exclusion of the exchange rate. Exchange rate movements filter through inflation and output, making the exchange rate a redundant target. The challenge would then be to estimate a robust and representative macroeconometric model. Moreover, parsimony in terms of setting objectives is always a virtue because of the limited number of policy variables.

Table 2. Empirical Results

	Case 1		Case 2		Case 3		Case 4	
Economic indicators	*Levels*	*CV*	*Levels*	*CV*	*Levels*	*CV*	*Levels*	*CV*
GDP AND COMPONENTS (YEAR-ON-YEAR GROWTH)								
Domestic demand								
Personal consumption	3.67	0.27	3.65	0.27	3.67	0.27	3.65	0.27
Private construction	7.51	1.74	7.48	1.04	7.51	1.74	7.48	1.04
Government construction	10.51	1.75	10.54	1.75	10.51	1.75	10.54	1.75
Durable goods	3.06	1.90	3.11	1.88	3.06	1.90	3.11	1.88
External demand								
Total exports								
Year-on-year growth	6.28	2.43	6.17	2.47	6.28	2.43	6.17	2.47
Total imports								
Year-on-year growth	7.59	1.59	7.73	1.57	7.59	1.59	7.73	1.57
FINANCIAL INDICATORS (%)								
Money supply (year-on-year growth)	17.32	0.95	17.56	0.97	17.32	0.95	17.56	0.97
RRP	8.02	0.30	8.14	0.31	8.02	0.30	8.14	0.31
91-day treasury bill rate	12.33	0.15	12.34	0.15	12.33	0.15	12.34	0.15
Lending rate	14.28	0.09	14.28	0.09	14.28	0.09	14.28	0.09
Savings deposit rate	7.56	0.08	7.56	0.08	7.56	0.08	7.56	0.08
Nominal peso-dollar rate (year-on-year growth)	3.90	1.95	3.72	2.03	3.90	1.95	3.72	2.03
Expected nominal peso-dollar rate (year-on-year growth)	3.82	1.99	3.60	2.09	3.82	1.99	3.60	2.09

Table 2. Empirical results (continued)

	Case 1		*Case 2*		*Case 3*		*Case 4*	
Economic indicators	*Levels*	*CV*	*Levels*	*CV*	*Levels*	*CV*	*Levels*	*CV*
MACROECONOMIC INDICATORS (%)								
Real GDP growth	3.54	0.72	3.52	0.72	3.54	0.72	3.52	0.72
Output gap (in billion pesos)	-382	-10.5	-383	-10.4	-382	-10.5	-383	-10.4
CPI-inflation	5.57	0.41	5.54	0.41	5.57	0.41	5.54	0.41
CPI-inflation forecast (two years)	5.41	0.40	5.38	0.40	5.41	0.40	5.38	0.40
CPI-inflation expectations (long run)	6.08	0.33	6.06	0.33	6.08	0.33	6.06	0.33
BSP OBJECTIVE FUNCTION (1994-2006)								
Pre IT period: 1994 Q1-2000 Q4	1.83	0.60	2.09	0.70	1.69	0.64	1.68	0.70
IT period: 2001 Q1-2003 Q1	1.63	1.05	1.68	1.16	1.53	1.08	1.47	1.15
Forecasted IT period: 2003 Q2 - Q4 2006	1.54	0.92	1.59	1.05	1.44	0.95	1.38	1.04

Case 1: The exchange rate gap is included in both the reaction function and objective function of BSP

Case 2: The exchange rate gap was deleted from the reaction function but retained in the objective function.

Case 3: The exchange rate gap was included in the reaction function but was zeroed out in the BSP objective function.

On another level, the debate becomes irrelevant because of the BSP's assertion that the exchange rate is not included in its reaction function. However, as mentioned earlier, this claim is not supported by empirical evidence (equation [4a]). Moreover, data indicate that the BSP has been conducting sterilized intervention, which has become more pronounced after the 1997 financial crisis.

Apart from the possibility that sterilized intervention may be ineffective—as shown by the IMF study—there may be conditions when sterilized intervention will move the exchange rate opposite the desired direction. This was the case in Colombia when there were conflicting macroeconomic objectives. A recent study by Ho and McCauley [2007] analyses whether the policy of countering foreign exchange inflows with sterilized intervention will result in unintended adverse domestic consequences, particularly in three areas: monetary control, financial stability, and central bank profitability and balance sheet risk. In the case of monetary control, foreign reserve accumulation may lead to a "technical" sterilization problem wherein the central banks are not able to achieve their operating targets whether they be in terms of a quantity or price. Otherwise, foreign reserve accumulation may "compromise the goals" of central banks by inducing them to adopt a more accommodative monetary policy stance than that required by their inflation objective.

Ho and McCauley conclude that, with perhaps the very recent and short-lived exceptions of India and the Philippines, it is difficult to argue that Asian central banks have technical difficulties with sterilization as a result of large-scale foreign exchange purchases. Evidence from interest rate targeting central banks suggests technically effective sterilization. Nevertheless, the BSP should be wary that the Philippines experienced an episode of technical difficulties with sterilization.

A compelling argument against the inclusion of the exchange rate in the reaction function comes from Bayangos [2007]. Following the study of Wollmershäuser [2006], she showed that a policy that reacts to an exchange rate specification other than the UIP cum risk premium does not work much better in stabilizing inflation and real output. Due to exchange rate uncertainty—i.e., uncertainty on how it is determined—the exchange rate should not only be treated as an endogenous variable but also as an important source of shocks. On the one hand, the uncertainty is likely to provoke a more activist stabilization policy than warranted and on the other, this would imply an uncertain transmission of interest rate impulses through the exchange rate channel of monetary policy.

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