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Managed Floating and Intermediate Exchange Rate Systems: The Singapore Experience

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MANAGED FLOATING AND INTERMEDIATE EXCHANGE RATE SYSTEMS: THE SINGAPORE EXPERIENCE*

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ABSTRACT

Monetary policy in Singapore has been centred upon management of the exchange rate since 1981, with the primary objective of promoting price stability as a sound basis for sustainable economic growth. This paper examines the key characteristics of Singapore's exchange rate-centred monetary policy; in particular, its managed float regime which incorporates key features of the basket, band and crawl system popularised by Williamson (1998, 1999). We assess how the flexibility accorded by this framework has been advantageous in facilitating adjustment vis-à-vis previous episodes of heightened volatility, including those occasioned by external shocks such as the Asian financial crisis and the terrorist attacks in 2001. We also review previous econometric evidence that Singapore's managed float system may have helped to mitigate the spillover effects of such increased volatility into the real economy. The track record of Singapore's managed float regime over the past two decades suggests that, contrary to the dominant view during the Asian financial crisis, intermediate regimes can indeed function as a viable alternative to the so-called 'corner solutions', albeit only when coupled with a supporting framework of consistent macroeconomic and microeconomic policies as well as strong institutions.

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1. INTRODUCTION

1.1 The multiple shocks which impacted many economies over the past decade have reinforced the importance of exchange rate systems in ensuring financial stability and sustained economic growth. The 1997-98 Asian financial crisis, in particular, highlighted the potential repercussions of sudden and massive withdrawals of capital from recipient countries, and gave rise to the view that the "soft" pegs (to the US Dollar) adopted by many regional economies were in part responsible for the severity of the macroeconomic crisis. In the wake of the crisis, many commentators were prompted to dismiss intermediate exchange rate regimes, advancing instead a bipolar view, under which only 'corner solutions' – a rigidly fixed exchange rate (often backed up by a currency board) on the one hand, or a cleanly floating exchange rate on the other – were deemed to be sustainable. Typical of this view was Summers' (2000) assertion that "the choice of [the] appropriate exchange rate system, for economies with access to international capital markets, increasingly means a move away from the middle ground".

1.2 In more recent years, however, the persuasive weight of such a consensus within the academic literature has diminished significantly. Indeed, there has since emerged an increasing number of studies, suggesting that intermediate exchange rate regimes might in fact be more robust and resilient than previously thought. Two recent reviews of international exchange rate regimes in the related literature bear this out clearly. The first, by Rogoff *et al* (2003), admits that "the popular bipolar view of exchange rates is neither an accurate description of the past, nor a likely scenario for the next decade", and that "intermediate regimes have shown remarkable durability". Likewise, a second survey by Bordo (2003) arrives at much the same conclusion, suggesting that "intermediate arrangements may still have a role to play", particularly for emerging markets in which financial systems are not sufficiently mature to accommodate a floating regime. It is also telling that the corners hypothesis has, to date, been a poor match with the prevailing reality of international exchange rate systems. In this regard, the seminal paper by Calvo and Reinhart (2000) brought to fore the marked disparity between countries' de jure and de facto exchange rate regimes, demonstrating that most economies in reality continue to adhere to some intermediate position between the corner solutions of rigid fixity and free float.

1.3 This paper offers an overview and assessment of Singapore's exchange rate-centred monetary policy, and seeks to draw some implications

for the viability of intermediate exchange rate systems. Particular emphasis is given to assessing the performance of Singapore's managed float regime – which incorporates key features of the band, basket and crawl system as described by Williamson (1999) – against the bipolar view of fixity or free float.

1.4 Section 2 provides a brief overview of Singapore's unique monetary policy framework, and highlights its key characteristics. Section 3 then examines how the flexibility accorded by the managed float system has been advantageous in facilitating adjustment to various shocks to the economy, as well as in accommodating longer-term structural changes in the economy. A characterisation of the countercyclical nature of Singapore's exchange rate policy is also offered, with reference to recent work on the monetary policy reaction function. Section 4 draws upon recent econometric research work at the Monetary Authority of Singapore (MAS), which demonstrates that Singapore's exchange rate policy framework may have helped to alleviate the negative spillover effects of heightened volatility in the international financial markets into the real economy. To conclude, Section 5 advances the view that the key issue facing policymakers lies not in the particular choice of the exchange rate system *per se*, but rather, in the institutions and supporting policies that underpin it.

2. OVERVIEW OF SINGAPORE'S EXCHANGE RATE FRAMEWORK

2.1 Since 1981, monetary policy in Singapore has been centred on management of the exchange rate. The primary objective of this framework has been to promote price stability as a sound basis for sustainable economic growth. Notably, the framework incorporates several key features of the basket, band and crawl (BBC) regime, as popularised by Williamson (1998, 1999). These may be briefly summarised as follows:

2.2 ***First***, the Singapore Dollar (S$) is managed against a **basket** of currencies of its major trading partners and competitors. The various currencies are assigned different degrees of importance, or weights, depending on the extent of Singapore's trade dependence on that particular country.

2.3 ***Second***, the MAS operates a managed float regime for the Singapore dollar. The trade-weighted exchange rate is allowed to fluctuate within a policy **band**, the level and slope of which are announced semi-annually to the market. The band provides a mechanism to accommodate short-term fluctuations in the foreign exchange markets and flexibility in managing the exchange rate.

2.4 ***Third***, the exchange rate policy band is periodically reviewed to ensure that it remains consistent with the underlying fundamentals of the economy. The policy band thus incorporates a '**Crawl**' feature, which underscores the importance of continually assessing the path of the exchange rate, so as to avoid misalignments in the currency value.

2.5 Notably, the assignment of the exchange rate as the intermediate target of monetary policy in Singapore implies that the MAS cede control over domestic interest rates. In the context of free movement of capital, interest rates in Singapore are determined to a large extent by foreign interest rates

and investor expectations of future movements in the S$.[1] Indeed, domestic interest rates have typically been lower than US interest rates, and reflect market expectations of an appreciation of the S$. (Chart 1a) In addition, the relationship between the interest rate and exchange rate in Singapore is generally well-characterised by the uncovered interest parity relationship. Chart 1b shows that *ex post*, uncovered interest differentials generally lie within the two standard error bounds, except during the volatile period of the Asian financial crisis.

Chart 1a: 3-month US$ SIBOR and 3-month Domestic Interbank Rate

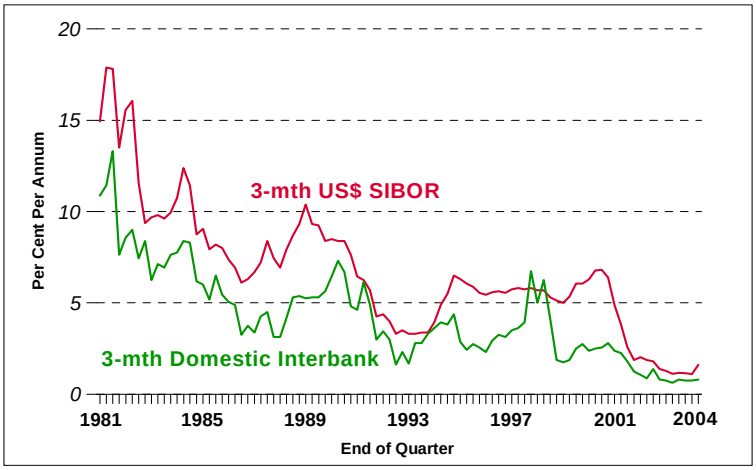
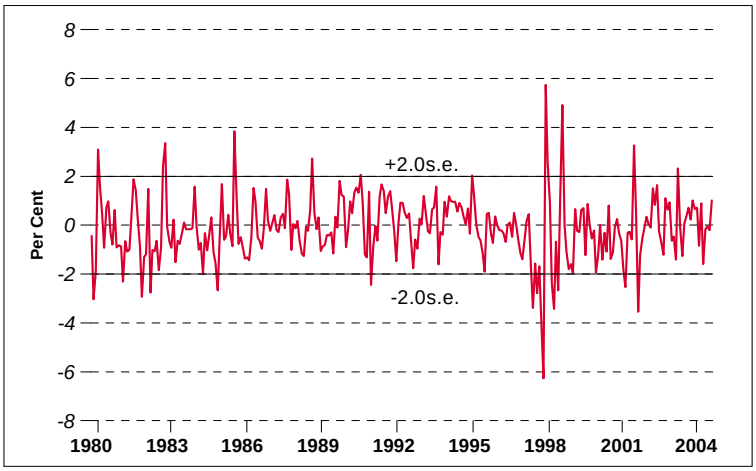


Chart 1b: 3-month Uncovered Interest Differential

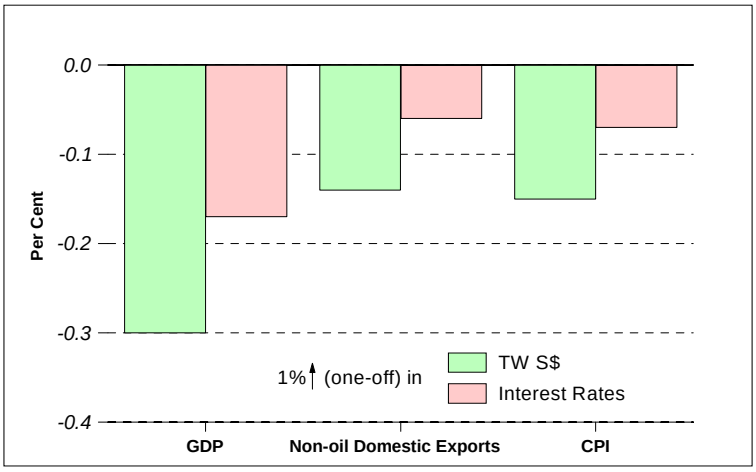


[1] Results from a recent empirical study (MAS 2000) found that various interest parity conditions held during the 1990s prior to the Asian financial crisis, which provides price-based evidence of capital account openness. Not only did covered interest parity hold (as is generally the case with most countries with well-developed money and foreign exchange markets), but the uncovered interest parity condition was also found to have held during this period, unlike most other countries. The parity conditions indicate that Singapore's money market has been fully integrated with international markets.

2.6 The choice of the exchange rate as the intermediate target of monetary policy is predicated on the openness of the Singapore economy to trade and capital flows. Indeed, the small size and high degree of openness of the economy is evidenced by the high ratio of its international trade relative to GDP. Total exports and imports are each well in excess of 100% of GDP, while exports account for approximately two-thirds of total demand. Consequently, changes in the value of the trade-weighted S$ have a significant influence on domestic inflation and GDP outcomes.

2.7 The trade-weighted exchange rate for Singapore is therefore as close to an ideal intermediate target of monetary policy as might be expected. It is relatively controllable by the MAS, and bears a relatively powerful and stable relationship with price stability – the final policy target – over the medium term. Chart 2 shows the relative leverage effects (over one year) of interest rates and exchange rates on the Singapore economy, estimated by simulating the effects of a one-off increase on each variable by 1% in the MAS' Monetary Model of Singapore. As may be observed, the impact of an exchange rate appreciation on GDP, exports and CPI is considerably greater compared to a corresponding increase in the interest rate.

Chart 2: Impact of Policy Instruments on Macro-Variables



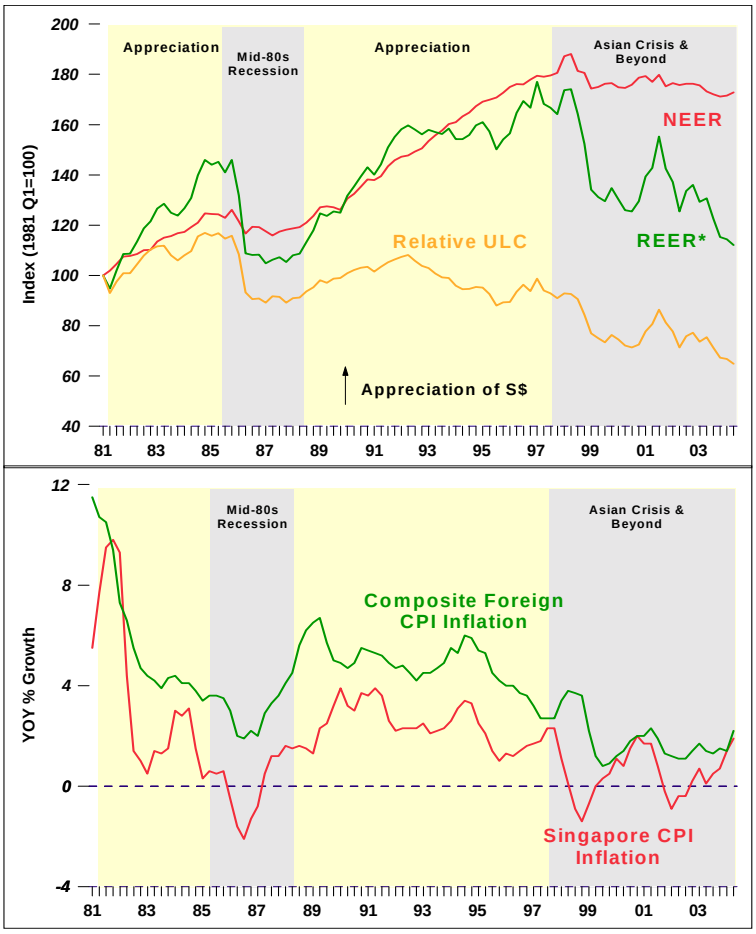
3. CHARACTERISING SINGAPORE'S EXCHANGE RATE POLICY SINCE THE 1980s

3.1 MOVEMENTS IN THE S$ NOMINAL EFFECTIVE EXCHANGE RATE

3.1.1 Chart 3 shows the movements of the domestic currency since 1981. On a trade-weighted basis, the S$ has appreciated against the exchange rates of its major trading partners and competitors since 1981, reflecting rapid economic development, high productivity growth, and a high savings rate. Between end-1980 and Q2 2004, the S$ nominal effective exchange rate (NEER) appreciated by 73%, while the S$ real effective exchange rate (REER) appreciated by 12%. There were four distinct phases in the movement of the NEER and REER, as highlighted in Chart 3. The appreciation of the REER between 1981-85 and 1988-97 coincided with rapid economic growth and a tightening labour market. Given the MAS' policy of keeping inflation low, the nominal exchange rate was allowed to appreciate. In contrast, during the recession in the mid-1980s and the Asian crisis, weakening economic conditions warranted an easing of the NEER to facilitate the recovery of the economy. Chart 3 shows that cost pressures – as proxied by relative unit labour costs – have generally declined since the 1990s, and have facilitated the downward adjustment in the REER after 1997. Over the period since the 1990s, the lower panel in Chart 3 illustrates the relative success with which monetary policy has succeeded in achieving low and stable inflation in Singapore relative to that of our trading partners.

3.1.2 A major advantage of Singapore's exchange rate system has thus been the considerable flexibility which it accords, in facilitating the adjustment process during periods of external shocks and heightened financial market volatility. In this regard, Williamson (1999) provides a useful framework with which to assess the performance of the managed float regime. In guiding and evaluating the choice of exchange rate regime, Williamson distinguished between the two distinct dimensions of exchange rate variability: short-term volatility on the one hand, and longer-term currency misalignments on the other. These are now examined in the context of the Singapore experience in the following sub-sections 3.2 and 3.3 respectively. Sub-section 3.4 characterises the countercyclical stance of Singapore's exchange rate policy with reference to recent research on the monetary policy reaction function.

Chart 3: S$ Exchange Rate Movements, Domestic and Foreign Inflation



* Using export competitiveness weights and deflated by manufacturing unit labour costs

3.2 SHORT-TERM EXCHANGE RATE VOLATILITY

3.2.1 In the short term, managing the S$ within a band provides the flexibility to prevent volatility in the financial markets from adversely affecting the real economy, as evidenced for example, by the Asian crisis episode. (Section 4 below reviews in greater detail, the role of the managed float system in Singapore during periods of heightened market volatility.)

3.2.2 Reflecting the MAS' targeting of the S$ NEER within a band, Singapore's trade-weighted exchange rate has remained fairly stable over the past two decades. Volatility, as measured by the monthly standard deviation of the NEER, was significantly lower for the S$, compared to that of that of the United States Dollar (US$) or Japanese yen. The standard deviation of the

S$ NEER was 1.47% between Q1 1981 and Q2 2004, compared to 3.44% and 4.62% for the US$ and yen respectively.[2]

3.3 LONGER-TERM CURRENCY MISALIGNMENT

3.3.1 Over the longer term, the managed float has provided the flexibility for the MAS to prevent currency misalignments by allowing the equilibrium (real) value of the exchange rate to reflect changes in underlying fundamentals, such as a trend increase in the savings rate and higher productivity in the tradable sector. Notably, the trade-weighted S$ has been on a secularly appreciating trend since 1981, in both nominal and real terms.

3.3.2 This secular appreciation of the S$ exchange rate has helped to keep inflationary pressures in check. Since 1981, domestic inflation has generally been lower than external inflation (as proxied by a trade-weighted average of foreign composite CPI), the former having averaged 1.8%, compared with 4.0% for the latter.

3.3.3 In a recent MAS study (MacDonald 2004)[3], a behavioural equilibrium exchange rate (BEER) methodology was used to assess the equilibrium REER for the Singapore economy. For the Singapore REER, a well-founded measure of the equilibrium value of the currency was established from a relatively small set of real fundamental variables. In particular, a single cointegrating relationship was found among the following variables grouped in the vector x over the sample period Q1 1983 to Q2 2003:

$$x_t = \left(q_t, nfa_t, ltot_t, ltotta_t, lprop_t\right)$$

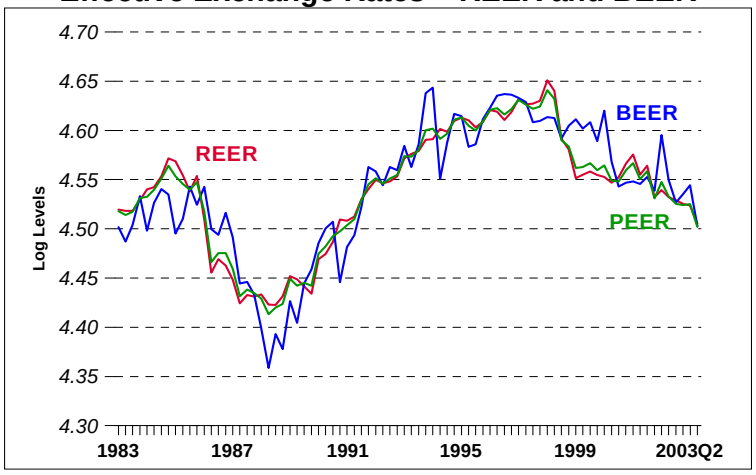
where
q is the real exchange rate;
nfa is the ratio of net foreign assets to GDP;
ltot represents the terms of trade of Singapore;
ltotta is the ratio of total trade to GDP and is a measure of openness; and
lprop is the log of the private residential property price index.

[2] The NEER series for the US$ and yen are based on the quarterly series published by the IMF.

[3] This study was conducted in collaboration with Prof Ronald MacDonald of the University of Strathclyde, when he was visiting the Economic Policy Department, Monetary Authority of Singapore in November 2003. The full research paper is available as an MAS Staff Paper on the MAS internet website at: http://www.mas.gov.sg/masmcm/bin/pt1MAS_Staff_Paper_No_36_Dec_2004.htm.

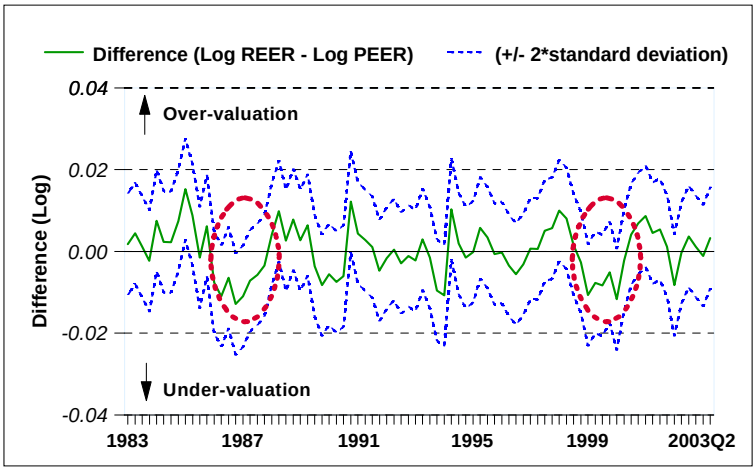
3.3.4 The long-run relationship was estimated using Johansen's cointegration methods. All variables were significant (correctly signed) and the diagnostic testing showed that the specification was robust. On the basis of the estimated cointegrating vector (normalised on q), the analysis found that the REER has generally tracked the long-run equilibrium exchange rate, as estimated by the BEER approach, with the exception of the periods around the 1985 recession and 1998 crisis, when some evidence of undervaluation was apparent. (Chart 4) This shows that the currency has been broadly aligned with evolving underlying fundamentals in the economy.

Chart 4: Measures of Singapore's Equilibrium Effective Exchange Rates – REER and BEER



3.3.5 Chart 4 also graphs the estimates from the permanent equilibrium exchange rate (PEER) theory initially proposed by Clark and MacDonald (2000), which involves a theoretical decomposition of the series into its permanent and transitory components, with the former interpreted as a measure of equilibrium. The inferences from the BEER estimates may be further validated with the estimates from the PEER approach. Chart 5 shows that the differences between the actual REER and the estimated PEER are relatively small, with the exception of episodic undervaluations around the 1985 recession and 1998 crisis periods.

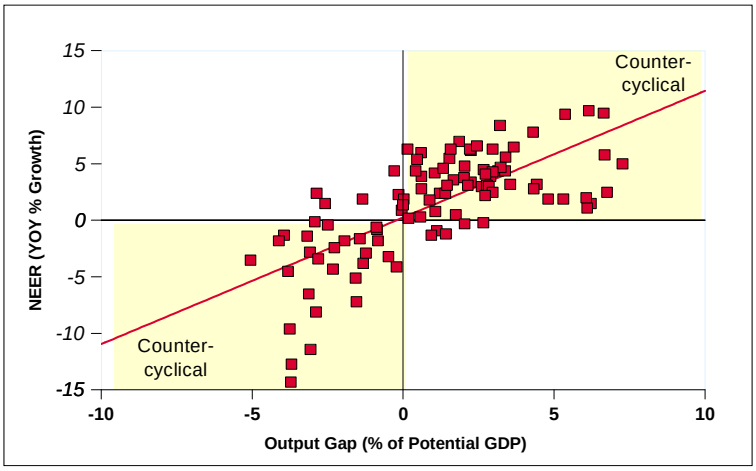
Chart 5: Difference of Log REER and Log PEER



3.4 THE MONETARY POLICY REACTION FUNCTION OF THE MAS

3.4.1 In this sub-section, we attempt to formalise the characterisation of MAS' monetary policy since the 1980s. The countercyclical nature of Singapore's monetary policy over the past three decades is evident in Chart 6, which is a scatter plot of the year-on-year (y-o-y) changes in the S$ NEER against the output gap over the period Q1 1980 to Q3 2004.

Chart 6: S$ NEER Against the Output Gap



3.4.2 The yellow regions correspond to periods when monetary policy is countercyclical, that is, the S$ NEER appreciates (depreciates) from the previous year when the output gap is positive (negative). As shown by the line of best fit, monetary policy in Singapore has been consistently

countercyclical, despite its limited power as a short-run aggregate demand management tool in a small and open economy such as Singapore.

3.4.3 A more formal characterisation of the countercyclicality of Singapore's monetary policy is provided by Parrado (2004). The author specifies and estimates a reaction function for changes in the monetary policy instrument, as proxied by the S$ NEER, which can be summarised as follows.

3.4.4 The reaction function assumes that MAS, within each operating period, has a targeted change in the S$ NEER, Δe_t^*, that is based on the state of the economy. It is also assumed that MAS is concerned with stabilising inflation and output, while allowing for the possibility that MAS adjusts its policy response to anticipated inflation and output. Specifically:

$$\Delta e_t^* = \bar{\Delta} e + \beta(E[\pi_{t+n} \mid \Omega_t] - \pi^*) + \gamma(E[y_{t+m} \mid \Omega_t] - y^*) \quad (1)$$

where $\bar{\Delta} e$ is the long-run equilibrium change in the S$ NEER, π_{t+n} is the rate of inflation between periods t and t+n, y_{t+m} is real output (or industrial production) between periods t and t+m, and π^* and y^* are the targets for inflation and output, respectively. In particular, y^* is defined as the equilibrium level of output that would arise if wages and prices were perfectly flexible. Additionally, E is the expectations operator, and Ω_t is the information available to the policymaker.

3.4.5 To capture concerns about potentially disruptive shifts in the exchange rate, it is assumed that the exchange rate is adjusted only partially to its target level:

$$\Delta e_t = (1-\rho)\Delta e_t^* + \rho \Delta e_{t-1} + v_t \quad (2)$$

where the parameter $\rho \in [0,1]$ captures the degree of exchange rate smoothing. The exogenous random shock to the exchange rate, v_t, is assumed to be *i.i.d.*

3.4.6 To define an estimable equation, let $\alpha = \bar{\Delta} e - \beta\pi^*$ and $x_t = y_t - y^*$, then equation (1) can be written as:

$$\Delta e_t^* = \alpha + \beta E[\pi_{T+n} \mid \Omega_t] + \gamma E[x_{t+m} \mid \Omega_t] \quad (3)$$

3.4.7 So, combining equation (3) with the partial adjustment mechanism (2) and eliminating the unobserved forecast variables yields:

$$\Delta e_t = (1-\rho)[\alpha + \beta\pi_{t+n} + \gamma x_{t+m}] + \rho\Delta e_{t-1} + \varepsilon_t \quad (4)$$

Where the error term ε_t is a linear combination of the forecast errors of inflation and output, and the exogenous disturbance v_t.

3.4.8 Assuming a forward-looking horizon of nine months (n=9), the coefficients associated with expected inflation are positive and significant (Table 1). They indicate that in response to a 1% rise in *expected* inflation, the S$ NEER is appreciated by 1.89%, implying a real exchange rate appreciation of 0.89%, *ceteris paribus*. In other words, the real exchange rate is temporarily altered to affect aggregate demand, and thus inflation. The coefficient associated with the industrial output gap is also positive and significant, suggesting that MAS reacts by appreciating the exchange rate by 0.42% when domestic output is 1% above potential. Finally, the coefficient that captures policy inertia is high ($\rho \cong 0.85$), indicating that monetary policy adjusts the exchange rate slowly to its projected target level.

Table 1: MAS Reaction Function (Q1 1991 – Q4 2002), Baseline

Alternative Inflation Target Horizons	α	β	γ	ρ	R^2	*p-value*	*J-test*
Current Inflation (n=0)	0.005 (0.82)	0.975 (2.56)	0.137 (1.28)	0.838 (32.44)	0.86	0.66	16.87
Expected Inflation (n=6)	-0.006 (-0.79)	1.44 (3.37)	0.235 (2.30)	0.831 (30.27)	0.83	0.75	15.47
Expected Inflation (n=9)	-0.008 (-0.91)	1.891 (3.41)	0.423 (3.07)	0.847 (37.80)	0.86	0.85	13.70
Expected Inflation (n=12)	-0.005 (-0.41)	1.824 (2.34)	0.525 (2.49)	0.871 (40.68)	0.86	0.77	15.06

Note:
1. t-statistics are in parenthesis.
2. The set of instruments includes 1 to 6,9, and 12 lags of CPI inflation, industrial production gap, and the S$ NEER.
3. The target horizon is assumed to be fixed for the output gap (m=0).

3.4.9 The estimates reported in Table 1 suggest that controlling inflation has been the major focus of monetary policy in Singapore. The results support the hypothesis that monetary policy can be described by a forward-

looking policy rule that aims the S$ NEER at stabilising expected inflation and maintaining output at potential. In particular, the reaction function includes an implicit inflation targeting component that Clarida, Gali and Gertler (1999) have argued is a critical feature of good monetary policy management. Moreover, the relative size of the CPI inflation and output coefficients suggest that monetary policy has placed a relatively higher degree of importance on maintaining low and stable inflation.

3.4.10 Notably, the conclusions put forth by Parrado (2004) on Singapore's exchange rate policy are broadly similar to recent comments by Janet Yellen (Feldstein *et al*, 2004), which identified several key elements of the US Federal Reserve's monetary policy under the chairmanship of Alan Greenspan. First, she notes the commitment of the Greenspan-era Fed to price stability as a fundamental goal of monetary policy, which has helped to anchor inflationary expectations. Reflecting this, the coefficient on core inflation in Yellen's econometric estimate of the Greenspan Fed's reaction function is greater than unity (1.68). This is similarly borne out in Parrado's analysis using Singapore data, in which the coefficient on inflation (β) is also well in excess of unity (1.89). Second, the relatively high coefficient in the "unemployment gap" (1.71) in Yellen's estimated reaction function suggests that, since movements in unemployment commonly lead inflation, the Fed has typically acted pre-emptively to curb inflation, by working actively to stabilise the real economy. This compares with a coefficient of 0.42 on Singapore's output gap (γ), which although lower, is positive and significant. In addition, this coefficient estimate indicates that monetary policy in Singapore is also influenced by deviations of output from its estimated potential levels. Third, Yellen notes that the generally predictable and systematic behaviour of the Fed's strategy is reflected by the good fit (above 0.8) of her estimated reaction function. The coefficient of determination (R^2) of 0.86 in Parrado's estimates also compares well in this regard.

3.4.11 The systematic nature of policy notwithstanding, Yellen is nevertheless concerned to point out that formal policy rules played no significant role in the Fed's explanations of policy or internal deliberations. Indeed, she notes that the most important contributions of the Greenspan Fed were actually made during episodes when policy departed from "the rule", in response to "likely structural shifts, unusual economic conditions or large asymmetric risks". Such episodes, she observes, can be characterised by the residuals of the estimated reaction function. Replicating this exercise using Singapore data, Parrado's estimated residual series reveals that there have also been periods during which monetary policy had deviated significantly

from the historically estimated reaction function, to cope with specific negative shocks to the economy. In response to the 1997-98 Asian financial crisis for example, the policy band was widened to accommodate the prevailing volatility in the financial markets. As a result of the sharp depreciation of some of the regional currencies against the US$, the S$ on a trade-weighted basis had strengthened, notwithstanding some weakening of the S$/US$ bilateral exchange rate. It was after some stability had been restored in the financial markets, that the MAS then pursued a more accommodative policy stance. Policy was also exceptionally accommodative, relative to the predictions of the estimated reaction function, during 2001 and 2003, when the economy was hit by the IT slowdown and SARS shock, respectively.[4]

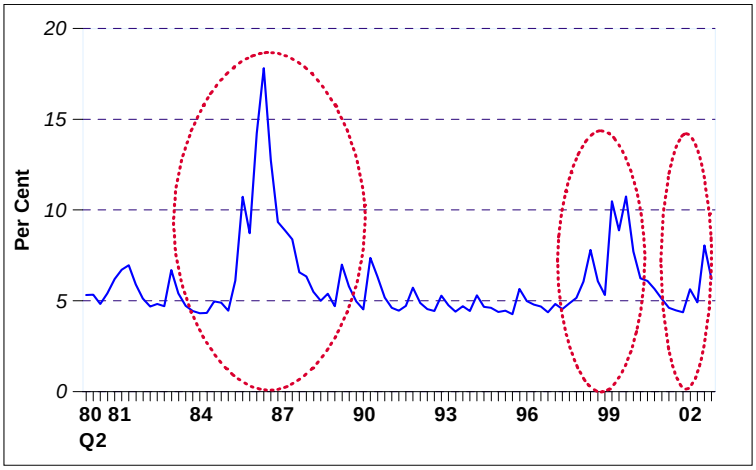
[4] This inference was derived from an internal update of Parrado's (2004) estimated equation.

4. EXCHANGE RATE VOLATILITY AND MACROECONOMIC VOLATILITY IN SINGAPORE

4.1 This section examines in closer detail the relationship between volatility in the exchange rate and volatility in the real economy, drawing in particular upon recent research undertaken at the MAS, by Saktiandi *et al* (2003). Specifically, the authors examine the characteristics of the S$ NEER over the past two decades, and investigate whether short-term movements in the currency have affected the behaviour of key real macroeconomic variables in the Singapore economy.

4.2 Using a GARCH (1,1) specification to estimate the conditional variance or time-varying volatility of the log differences of the S$ NEER, Saktiandi *et al* identify three distinct periods of heightened volatility; during the 1985 recession, the 1998 Asian financial crisis, and the 2001 recession induced by the IT slowdown. (Chart 7)

Chart 7: S$ NEER Conditional standard deviation*, 1980-2002



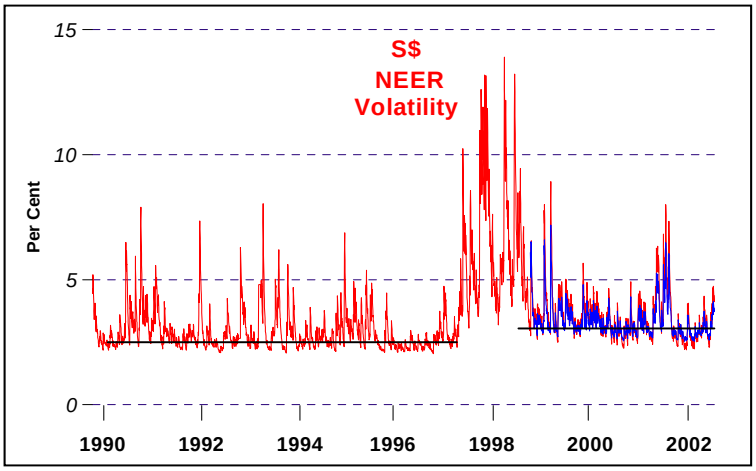
* Annualised basis

4.3 According to their estimates, the volatility of the S$ NEER over the first half of 2003, as measured by its time-varying annualised standard deviation, was found to be around 7.1%, against an average of 5.1% in 2000 and 2001. This also compares with the 20-year historical average of around 5.2%. (This mean excludes periods of heightened volatility, such as those experienced during the Asian financial crisis.) In addition, the daily volatility of the log differences in the S$ NEER between 2 Jan 1990 and 11 Oct 2002 was

also estimated, while controlling for movements in currencies of other countries in the currency basket.

4.4 Chart 8 graphs this daily conditional S$ NEER volatility on an annualised basis. The conditional volatility of the S$ NEER without controlling for movements in the NEER basket of currencies is shown by the red line, while the blue line represents the conditional volatility of the S$ NEER after controlling for the movements of major currencies such as the US$/euro, US$/yen and US$/rupiah. The time series illustrates the familiar cluster pattern around periods of volatility, followed by periods of relative tranquility, for example, during and after the Asian crisis in 1997-98. It was also found that, despite controlling for cross-movements in the major currencies, volatility levels have remained fairly similar.

Chart 8: Volatility of S$ NEER*, 1990 – 2002



* Volatility is on annualised basis. The blue line represents S$ NEER volatility conditional on movements in other currencies in the basket.

4.5 It may also be observed that volatility levels appear to have increased in the post-crisis period. More recently, however, the calculated volatility has declined after the increase following the terrorist attacks in the US on 11 Sep 2001, and appears to have settled around the average mean recorded during the post-Asian crisis period. Chart 8 nevertheless reveals that the volatility of the S$ NEER since 1999 has settled around a new, higher mean, about 1.4 times higher than that recorded over the period 1 Jan 1990 to 31 Jun 1997.[5] There therefore appears to have been a larger permanent upward shift in the mean volatility level of the S$ NEER.

[5] The Z-statistic for differences in mean between the two periods is 21.16, and is above the 5% level of significance of 1.96. It may therefore be concluded that the difference is statistically significant, and could not have arisen by chance.

4.6 Next, the relationship between exchange rate volatility and that of key macroeconomic variables is examined. To this end, Saktiandi *et al* employ a variety of statistical and econometric techniques, the results of which can briefly be summarised as follows. First, scatter plots of volatility trade-offs between the S$ NEER and macroeconomic variables (such as money supply, interest rates, output, and import and export volumes) did not reveal evidence of any such trade-off (save for some weak evidence of a trade-off between exchange rate volatility and interest rate volatility). Second, a single equation 'gravity model', as well as a multivariate error correction model (ECM), both indicated that the impact of exchange rate volatility on Singapore's bilateral trade flows was fairly small, albeit statistically significant.[6] Third, following Flood and Rose (1995, 1999), Saktiandi *et al* construct a flexible-price monetary model to identify different periods of exchange rate volatility and appreciation/depreciation regimes. This allows the changes in volatility in exchange rates and macroeconomic variables over these periods to be examined. Results from this approach likewise suggest that changes in Singapore's exchange rate volatility are not necessarily accompanied by changes in the volatility of real macroeconomic variables.

4.7 A number of explanations could be put forth for these findings. The development of deep and efficient financial markets in Singapore, for instance, has allowed for a freely flexible exchange rate, which plays a key role in minimising fluctuations in underlying domestic economic activity. The increasing depth and sophistication of financial innovations may have also allowed exporters, importers and investors to more efficiently manage the volatility in international currency markets, hence reducing the impact of exchange rate volatility on Singapore's trade flows.

4.8 The results are also consistent with the hypothesis that the flexibility accorded by the presence of policy bands in Singapore's managed exchange rate float system, may have helped to prevent a spillover of volatility in the foreign exchange markets into the real economy. In this regard, the band operated like a filter, shielding the economy from transitory shocks. The band thus provides the flexibility for the exchange rate system to accommodate short-term fluctuations in the foreign exchange markets, as well as transitory shocks emanating from fluctuations in external demand.

[6] Results from the gravity model indicate that a 1% increase in the S$ exchange rate decreases bilateral trade flows between Singapore and her trading partners by 0.055%, *ceteris paribus*. Similarly, the multivariate ECM approach suggests that a 1% rise in exchange rate volatility will decrease Singapore's real export volumes by about 0.012%.

4.9 There may also be occasions when a widening of the policy bands may be warranted, such as during periods of heightened volatility. One instance in which this was done was following the greater uncertainty precipitated by the Asian financial crisis. The MAS adopted a more flexible exchange rate policy, and widened the policy band to accommodate the more volatile fluctuations in the S$ NEER during that period. At the same time, this had to be balanced against the need to maintain confidence in the S$, given the turbulence in the financial markets and the potential for speculative attacks. The policy band was also widened in October 2001, following the terrorist attacks of 11 September in the US. Subsequently, the band was narrowed again when market and economic conditions had stabilised.

4.10 The flexibility accorded by the system has thus allowed the MAS to accommodate changes in the equilibrium value of the S$ and thus prevent the domestic currency from becoming misaligned. At the same time, the system avoids the rigidities of a fixed exchange rate system, which could necessitate greater adjustments, and hence volatility in the real economy in response to shocks in international markets.

5. A MULTI-DIMENSIONAL APPROACH TO EXCHANGE RATE MANAGEMENT

5.1 While the related literature has largely focused on the choice of the optimal exchange rate regime, it is no less important to acknowledge the reality that the challenges posed by the vagaries and dynamics of global financial markets cannot be addressed by the judicious choice of exchange rate regime alone. The latter must be supported by a framework of consistent macroeconomic and microeconomic policies, as well as strong institutions. Increasingly, the key issue facing policymakers lies not in the particular choice of exchange rate system *per se*, but in the institutions and policies underpinning it. The exchange rate system itself should therefore be viewed as a sort of 'monetary overlay' on real economy foundations. Some of these key support factors are identified here as follows.[7]

5.2 ***First***, sound and credible macroeconomic policies are essential in avoiding the build-up of major macro-imbalances in the economy. In particular, they minimise its vulnerability to speculative attacks and pronounced swings in capital flows, by preventing misalignments in the value of the currency. Policy coordination among the relevant agencies is also essential to achieving consistency in promoting conditions in line with the objective policy targets.

5.3 In the Singapore context, prudent fiscal policy has absolved the MAS of the need to finance the government, allowing it to focus on its primary responsibility of maintaining price stability. At the same time, the MAS' track record of low inflation and sustained economic growth over a prolonged period has also earned it considerable credibility with the market. Singapore's large foreign reserves and macro-prudential policy, which limit the extension of credit to offshore financial entities, also discourage speculative attacks on the domestic currency.

5.4 In addition, the public sector in Singapore has no foreign debt, while banks and corporations have generally not borrowed from abroad in foreign currencies given the relatively low domestic interest rates. The lack of balance sheet vulnerabilities has been an important factor in preventing the economy from being pushed into the 'zone of vulnerabilities', and facing the

[7] This section draws on Khor and Robinson (2001) and Robinson (2001).

risks of intense speculative attacks on the currency in times of regional turmoil, market contagion or terms of trade shocks.

5.5 ***Second***, the flexibility of product and factor markets is essential in order to cope with and adjust to shocks arising from the volatility of currency markets and swings in the terms of trade in international product markets. This is especially so for small open economies (such as Singapore), which are heavily dependent on exports of goods and services.

5.6 ***Third***, it is crucial to develop and strengthen financial systems in order to enhance the economy's resilience to shocks. Cooper (1999) makes the pertinent point that countries with small and poorly developed capital markets may face even more limited options within the 'open economy trilemma' of fixed exchange rates, independent monetary policy and free capital movement. In comparison, well managed financial institutions which adhere to sound credit practices and have built up strong capital positions, are better able to withstand business cycle shocks. In addition, a sound and efficient banking system together with deep and liquid capital markets contribute to the efficient intermediation of financial flows. This helps prevent the emergence of vulnerabilities in the financial system by minimising unsound lending practices which could lead to the build-up of excessive leveraging in the corporate sector and exposure to foreign borrowings. Deep and liquid markets also help absorb the effects of external shocks and prevent their spillovers to the rest of the economy.

5.7 Recognising this, the MAS undertook a strategic review of its financial sector policies in 1997 in order to keep pace with the rapid changes in global financial markets. This resulted in measures to develop the bond market, asset management industry and the insurance industry, as well as open up the domestic banking industry to greater competition. The MAS also liberalised its policy on the restriction of credit to non-residents in order to allow foreign investors to issue S$ bonds, and to finance their S$ investments with domestic funds.

5.8 ***Fourth***, it is crucial that regulatory and supervisory capabilities be sufficiently developed to keep pace with financial innovations, the growing complexity of financial institutions' activities and new products and services. Regulators need to ensure that financial institutions have proper risk and credit management systems in place, and that these provide adequately for market and operational risks. This also implies that financial reforms should be managed in a controlled and orderly manner. Countries that have not fully

liberalised their capital accounts should do so at a pace that is commensurate with the strength and efficiency of their financial systems. As noted by Nsouli *et al* (2002), allowing banks to expand their resources via external borrowing can expose the banking sector to greater vulnerabilities, if prudential regulations remain weak. The majority of countries which avoided a crisis after liberalisation of their capital account have also had a sound financial system in place (IMF 2001).

5.9 Concomitantly, regulators need to build up their capabilities to cope with an enlarged supervisory role. In Singapore, for instance, the 1997 policy review also resulted in a shift of the MAS' supervisory regime from a one-size-fits-all regulation to a more risk-based approach.

5.10 ***Fifth***, greater disclosure and transparency is important in fostering market discipline, and in reducing the likelihood of markets over-reacting as a result of a lack of information or information asymmetries. In recent years, the MAS has made a major effort in this regard. In particular, the MAS has provided more data and substantially increased the flow of information to the market and public through various publications and via its internet website. Recent initiatives include the publication of the *Monetary Policy Statement* soon after each semi-annual review of exchange rate policy (Appendix 1). We have found that the greater clarity and understanding among the markets on the policy stance and its rationale have strengthened the effectiveness of monetary policy. Such ongoing efforts go some way to addressing concerns that have been raised in the literature (see for example, Frankel *et al* (2000)) that fixed or floating regimes are more verifiable than the interior solutions. Ultimately however, credibility in monetary policy derives from a track record of adhering to consistent and appropriate policies that are firmly oriented towards achieving price stability over the medium term.

5.11 These underlying supporting factors have underpinned the relative success with which the exchange rate-based monetary policy has worked in Singapore since the early 1980s. Eichengreen (2002) argues that Singapore's good experience with its managed float system is based "not on the design of the exchange rate band but on other characteristics of the economy." He observes that "Singapore has been able to commit credibly to adjusting its monetary policy instruments to limit exchange rate fluctuations because it has had an impeccably strong banking and financial system. It has not had a large stock of non-performing short-term debts in the corporate sector. It has run large fiscal and current account surpluses every year since 1989. It holds large reserves… Its combination of strong growth and flexible

labour markets … means that monetary policy adjustments designed to stabilise the exchange rate have not put undue strain on the real economy. Its political stability means that its commitment to hit those exchange rate targets has political support and therefore credibility."

6. CONCLUSION

6.1 While the issue of the optimal exchange rate regime continues to be the subject of intense debate in the literature, the earlier conventional view that held intermediate solutions to be unviable appears to have softened significantly. Fischer (2001), for instance, suggests that 'the choice between a hard peg and floating depends in part on the characteristics of the economy, and in part on its inflationary history', and admits that 'proponents of what is known as the bipolar view – myself included – probably have exaggerated their point for dramatic effect'. More recently, Rogoff *et al* (2003) have observed that "… the view that intermediate regimes are an endangered species is belied by their persistence, while their performance is not dominated by either of the polar regimes."

6.2 This paper has broadly examined and reviewed the performance of a managed exchange rate float system, in the context of the Singapore economy. The findings of recent research undertaken at the MAS suggest that such a regime has performed well to date, particularly in its ability to cope with the increased volatility in international markets experienced in recent years. Nonetheless, it is important to recognise that the choice of exchange rate regime is very much predicated upon the evolving economic fundamentals, and the particular characteristics of each economy. (In the case of Singapore, the choice of its exchange rate system was to a large extent conditioned by its small size and high degree of openness.) This is aptly summed up by Frankel's (1999) assertion that "no single currency regime is right for all countries or at all times".

6.3 A further contribution of this paper has been to emphasise that a supporting framework of consistent macroeconomic and microeconomic policies, as well as strong institutions, are integral to the success of the chosen exchange rate system. Indeed, as Mishkin and Calvo (2003) have noted, "… the choice of exchange rate regime is likely to be of second order importance to the development of good fiscal, financial and monetary institutions in producing macroeconomic success in emerging market economies… This suggests that less attention should be focused on the general question whether a floating or fixed exchange rate is preferable, and more on these deeper institutional arrangements."

APPENDIX 1

STEPS TAKEN BY THE MAS TOWARDS INCREASING MONETARY POLICY TRANSPARENCY

Apr 1999	First issue of the Economics Department's Quarterly Bulletin
Sep 1999	Launch of Explorer Series, including information on monetary policy (issue #2), and implementation of monetary policy (issue #5)
Feb 2000	Monetary Model of Singapore (MMS) Conference; model formally launched; overview documentation released on webpage
Apr 2000	Introduced Table on prices and yields of Singapore Government Securities (SGS)
Jun 2000	Introduced Table on SGS volume turnover
Jun 2000	Reported Official Foreign Reserves (OFR) based on IMF Template on International Reserves and Foreign Currency Liquidity
Jul 2000	Announced at the Annual Report Press Release for the first time the monetary policy stance [of a gradual and modest appreciation of the S$]
Oct 2000	Included data on Housing Loans in Monthly Statistical Bulletin (MSB)
Feb 2001	First release of semi-annual Monetary Policy Statement (MPS). Conducted a closed-door private sector analyst briefing.
Feb 2001	Release of the Singapore Exchange Rate Policy booklet, which also disclosed for the first time a long time series historical chart on the S$REER and S$ NEER
Mar 2001	Introduced new tables in the MSB on banks' DBU external assets and liabilities, forex market turnover, SGS issuance and redemption
Apr 2001	Introduced new tables in the MSB on various CPI measures, other price indices, government finance, GDP by sector and expenditure, and the balance of payments
Jul 2001	Second MPS, which also disclosed for the first time a graph on the S$ NEER movements over the preceding six months. This graph has also been released in subsequent Monetary Policy Statements
Jan 2002	First issue of the semi-annual Macroeconomic Review, which provides a detailed assessment of recent economic developments and outlook that underlies the monetary policy stance (a revamp of the earlier Quarterly Bulletin)
Jun 2002	Provided more information to counter-parties in money market operations, including the amount of injections and withdrawals, and the average rates of transactions
Jul 2002	First media briefing in conjunction with second publication of Macroeconomic Review
Sep 2002	Publication of "A Guide to Primary Dealer Operations"
Jan 2003	First release of Inflation Monthly Report on the MAS website
Jan 2003	Publication of a monograph on Monetary Policy Operations, highlighting key aspects of MAS' foreign exchange and money market operations and the underlying factors and considerations
Oct 2003	Review of money market operations in FY2002/03 included in the October issue of Macroeconomic Review. A review will be published henceforth in future issues of the Macroeconomic Reviews

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