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Achieving price stability

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7 Achieving Price Stability

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Abstract

The aim of delivering medium-term price stability is the stated objective of the Monetary Authority of Singapore. To this end, the central bank has adopted an unusual exchange rate-based monetary policy framework that has served the economy well over the past decades. However, the shift from the phase of catch-up growth to a mature economy raises the question of whether the current monetary policy framework needs reformulation. Moreover, as global financial integration deepens, surges in cross-border capital flows impact our exchange rate and asset prices that have implications on economic dynamism and inclusion. Since a large and persistent deviation of the more recent exchange rate path from its equilibrium level may result in a possible fundamental correction in the future, this chapter attempts to gauge approximately whether the Singapore dollar suffers from any serious misalignment. We estimate a Behavioral Equilibrium Exchange Rate model which suggests the value of the Singapore dollar does, in general, reflect Singapore's medium-term economic fundamentals since the 1990s. While there seems no urgent need for reformulation, monetary policy in Singapore has to be supported by macroprudential policy that mitigates risks to financial stability in Singapore as well as other policies that help maintain confidence in the Singapore economy.

7.1 Introduction

Monetary policy decisions in Singapore are taken with the aim to deliver medium-term price stability. To this end, the Monetary Authority of Singapore (MAS) has since 1981 formally adopted an exchange rate-based monetary policy framework which is centred on managing the Singapore dollar exchange rate. The use of the exchange rate instead of the usual benchmark interest rate as its monetary policy instrument reflects the highly open and trade dependent nature of the Singapore economy. As a price-taker in international markets with a high import content in its final demand means Singapore is highly susceptible to imported inflation. Besides, Singapore openness to capital flows due to its status as an international financial centre hampers its control on the domestic interest rate, see Wilson (2015). Hence, when compared to the interest rate, the exchange rate serves as a more effective policy tool for stabilising inflation, see *inter alia* Chow (2005).

Monetary policy operations are carried out through MAS' intervention in the foreign exchange market. As explained in Khor et al. (2004), the MAS uses a basket-band-crawl system to manage the

Singapore dollar exchange rate. The Singapore dollar is closely monitored against a trade-weighted basket of currencies of its major trading partners that represent the various sources of imported inflation. The Singapore dollar exchange rate is permitted to fluctuate within a policy band, thereby allowing market forces to determine its level within the band. However, MAS may intervene to “lean against the wind” when the Singapore dollar approaches or breaches the band limits. In order to deter currency speculators from having one-way bet on the Singapore dollar as it reaches the boundaries of the policy band, the width of the band, constituent basket currencies as well as their basket weights are all not publicly disclosed.

During MAS’ semi-annual review of its monetary policy stance, the level and/or crawl rate of the policy band may be adjusted whereby monetary policy is tightened (loosened) through an appreciation (depreciation) of the Singapore dollar. The short-to-medium term value of the Singapore dollar is determined based on a modified Taylor rule with the exchange rate set in a counter-cyclical way to changes in inflation and the output gap. In particular, as stated on the MAS website, the path of the policy band is set by the central bank with the aim to “bring core inflation closer to its historical average of just under 2% over the medium term.” Besides, the MAS may widen the policy band when developments lead to a spike in short-term volatility in the foreign exchange markets, such as during the outbreak of a crisis.

The use of the exchange rate as an intermediate target in a small, open economy like Singapore implies the domestic interest rate is endogenous. Nonetheless, the MAS does conduct conventional money market operations daily to ensure an appropriate level of liquidity in the domestic banking system. For the *modus operandi* of the central bank’s monetary policy operations, please refer to its monograph MAS (2013a). Importantly, the money market operations are carried out in such a way that the Singapore dollar exchange rate remains within the policy band so that there is no conflict with the exchange rate-based monetary policy framework.

The current framework has served the economy well over the past decades by providing a low inflationary environment that is conducive for sustainable growth. Nevertheless, the shift from the phase of catch-up growth to a mature economy raises the question of whether the current monetary policy framework needs reformulation. Moreover, as global financial integration deepens, surges in cross-border capital flows impact our exchange rate and asset prices that have implications on economic dynamism and inclusion. For a better understanding of Singapore inflation dynamics, we first conduct a literature review in the next section on the factors determining the domestic inflation rate. The discussion focuses on the relative importance of external factors vis-à-vis internal factors in determining inflation dynamics in Singapore. This is followed by a section providing an empirical assessment of whether the Singapore dollar suffers from any serious misalignment under the current policy framework. Specifically, we estimate a model for Singapore’s equilibrium exchange rate which allows

us to gauge approximately whether the value of the domestic currency reflects Singapore's economic fundamentals. The final section concludes the chapter with some remarks on policy implications.

7.2 Inflation dynamics in Singapore

Singapore's consumer price inflation and core inflation since the early 1990s are plotted in Figure 7.1. The former refers to the year-on-year growth of the Singapore all items consumer price index (CPI) and is commonly referred to as the headline inflation. It is common for central banks including the Monetary Authority of Singapore (MAS) to refer the core inflation when setting monetary policy. The core inflation in Singapore is also derived from the all items CPI index but excludes two volatile components namely the costs of accommodation and private road transport. These two excluded components are also subject to considerable influence by government administrative policies. We see in Figure 7.1 that the core inflation fluctuates less than the consumer price inflation. Apart from the core inflation, the MAS pays close attention to the headline inflation as well. In this chapter, our discussion focuses on the consumer price inflation that considers the whole consumption basket to better reflect the overall price pressures in the Singapore economy.

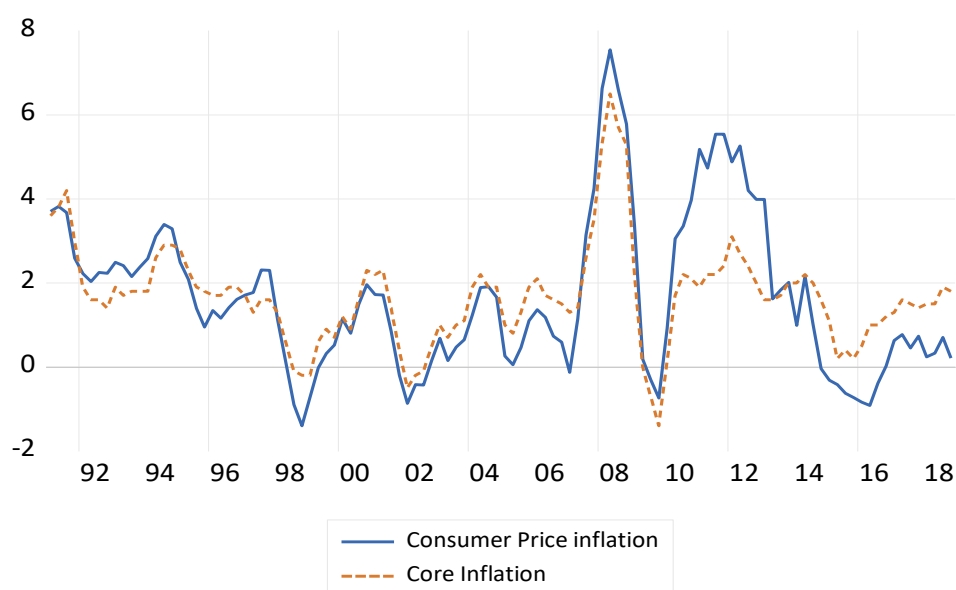


Figure 7.1 Singapore consumer price inflation and core inflation

The average consumer price inflation in the period 1991Q1 to 2018Q4 is at 1.68%. Figure 1 reveals that consumer price inflation in Singapore has been generally low and stable except for the period 2008 to 2012. The spike in inflation in 2008Q2 can be attributed to the sharp rise in commodity prices before the onset of the global financial crisis (GFC) while the escalation of property prices and car prices contributed to inflationary pressures in 2011 to 2012. Studies such as Tillman (2013) and Chow and Xie (2016) provide empirical evidence that the run up in house prices in Asia and in Singapore respectively are due to inward surges of capital flows. A slew of market cooling measures

including macroprudential and capital flow management measures applied to the property market dampened house price appreciations in Singapore. These, along with the tightening of monetary policy and a fall in oil prices, subdued the inflation rate from 2013 onwards.

It is unsurprising that external factors have all along played an important role in shaping inflation dynamics in Singapore given its small open economy and status as an international financial centre. Earlier studies, for instance Abeysinghe and Choy (2007) and Chew et al. (2009) focus on the pass-through of foreign prices to import prices and then to consumer prices. The importance of import prices in determining inflation is assessed by the relative weight of prices in the tradable versus non-tradable sectors in the CPI basket which worked out to exceed 40% in both studies. The significant role played by foreign prices in domestic inflation suggests the use of the exchange rate to manage imported inflation and as an effective monetary policy instrument for achieving stable prices.

More recent empirical research including Auer et al. (2017a) focuses on the “globalisation of inflation” hypothesis which postulates that as economies become more integrated with external markets, they are exposed to greater global competition that exerts downward pressure on prices. For instance, trends in outsourcing and offshoring as well as the participation in global value chains all contribute to a reduction in production costs and consequently, lower prices. Other commonly cited global developments that tend to depress domestic prices include China’s integration into world trade, and technological advances which reduce the price of ICT products and services as well as provide new digital platforms and services (MAS, 2018).

This heightened sensitivity of domestic prices to foreign factors has been used to explain the weaker linkage between an economy’s domestic prices and its aggregate real activity. As observed in the Bank of International Settlements 84th Annual Report, the typical inverse relationship between the inflation rate and the unemployment level or output gap in an economy, as captured by the New Keynesian Phillips curve, is flattened. To reflect the influence of external conditions on domestic inflation, the Philips curve equation is being augmented with the foreign output gap variable or external price pressure variable in various studies. For instance, Auer et al. (2017b) and Bems et al. (2018) show within the augmented Philips curve framework the relevance of external variables in explaining inflation in advanced and emerging market economies respectively.

Has the balance also shifted further from domestic to external factors in driving Singapore’s inflation dynamics? Choy (2016) applied a factor model to two sub-samples of Singapore data to show that after 2005 the regional factor has become more dominant in determining Singapore’s inflation dynamics. The author attributed this to common commodity price shocks hitting the Asian economies, more synchronised business cycles within the region and the emergence of regional production networks. In another study IMF (2016), a short run Philips curve relationship augmented with the import

price inflation that captures external price pressures was estimated with Singapore data. The rolling regressions indicate a weakening of the linkage between Singapore's inflation rate and cyclical unemployment and a possible flattening of the Phillips curve.

Nonetheless, both studies found inflation expectations to be a prominent driver of Singapore's inflation dynamics. Indeed, similar to Parrado (2004) and MAS (2013), forward-looking inflation expectations are found to be more relevant than past inflation in explaining Singapore's current inflation. The strong track record of good macroeconomic management and benign inflation over the past decades help to anchor inflation expectations in Singapore at a low level. This in turn plays an important role in stabilising domestic inflation at a lower level amidst the prevalence of external cost-push shocks.

7.3 Singapore's equilibrium exchange rate

Given its status as an international financial hub and the deepening of global financial integration, the Singapore economy experiences increasingly intense financial spillovers to and from the external environment.¹ As the exchange rate is buffeted by surges in cross-border capital flows, a key question is whether it is appropriate to use the exchange rate as monetary policy instrument to deliver good inflation performance. One approach to answer this question is to investigate whether the Singapore dollar suffers from any serious misalignment from its equilibrium value under the current exchange rate-based policy framework. After all, the presence of a large and persistent misalignment would mean the real exchange rate behaviour is not consistent with economic fundamentals. This can lead to a fundamental correction further down the road that may result in macroeconomic instability including price instability. For instance, Goldfajn and Valdes (1999) provides evidence on overvaluations of the real effective exchange rate (REER) ending abruptly whereby nominal devaluations resulted in substantial adjustments in prices and a fall in economic growth.

To assess whether the Singapore dollar is misaligned, we need to compute the difference between the observed REER and its equilibrium level. However, the equilibrium REER level is not observable and needs to be estimated. There are various methods for estimating a country's equilibrium exchange rate. The behavioural equilibrium exchange rate (BEER) method posits that the equilibrium REER varies with changes in real factors (see Clark and MacDonald, 1999). Hence, models based on the BEER approach allow us to determine the exchange rate that a currency converges towards in the intermediate horizon. Such data-determined equilibrium value is more useful for assessing currency misalignment over different time periods as compared to the internal-external balance approach

¹ For instance, Chow (2017) shows both inward and outward volatility spillovers between Singapore and other Asian stock markets indexes increased from pre-crisis levels not only during the global financial crisis but that the heightened volatility persisted post crisis.

whereby the equilibrium exchange rate does not change so long as there is macroeconomic balance. In any case, the BEER approach has been extensively used in empirical studies in international finance.

The equilibrium level of Singapore's exchange rate was estimated using the BEER method for period from 1983Q1 to 2003Q2 by MacDonald (2004). The author found that the Singapore dollar was close to its equilibrium value at the end of the sample period i.e. in mid-2003. In this study, we also adopt the BEER approach to estimate Singapore's equilibrium exchange rate but our sample incorporates data up to the end of 2018. The two-step approach first involves identifying a long run relationship between the REER and its fundamental determinants. This is followed by the second step where the equilibrium levels of the fundamental variables are used to estimate the equilibrium exchange rate. The difference between the estimated equilibrium REER and the actual REER value provides an approximate gauge of the degree of misalignment of the Singapore dollar, if any.

Following Toulaboe (2017) and MacDonald (2004), the equilibrium exchange rate is expressed as a linear function of a set of macroeconomic fundamental variables:

$$\bar{q}_t = f(tot_t, nfa_t, inv_t, lgcon_t, lprod_t, openness) \quad (1)$$

where \bar{q}_t is the equilibrium real effective exchange rate, tot_t is the terms of trade computed as the ratio of export to import price indices; nfa_t is the ratio of net foreign assets to GDP; inv_t is domestic investment as a share of GDP; $lgcon_t$ is the log of real government consumption and $lprod_t$ is the log of productivity index and $openness$ is the trade openness as reflected by the ratio of total trade volume to GDP. For a discussion on how the individual macroeconomic variables can affect the REER based on theoretical considerations, see Toulaboe (2017).

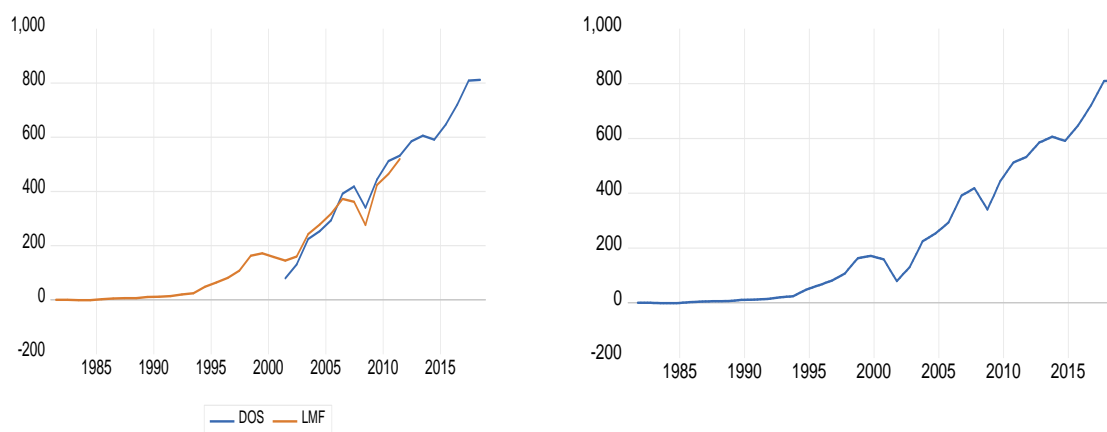
All the seven data series are obtained from the CEIC Database with the exception of the net foreign assets variable.² Our sample period is from 1982Q1 to 2018Q4, and the time plots of the seven data series are displayed in Figure 7.2. We note that the exchange rate variable is defined such that a rise in its value denotes an appreciation of the domestic currency. Singapore's net foreign assets data, published by the Department of Statistics (DOS) Singapore, are not available on a quarterly basis and the annual series starts only from 2001. Hence, we combine the data series from DOS with the net foreign assets series constructed in Lane and Milesi-Ferretti (2007), henceforth referred to as LMF. This paper provides a reliable dataset generally accepted in empirical literature, as the methodology in constructing the data is well documented for replication.

² The data series for the net foreign assets variable used in MacDonald (2004) is from MAS internal estimates which are not published.



Figure 7.2 Fundamental determinants of equilibrium exchange rate

Figure 7.3 displays in the left panel the LMF series which spans 1970 to 2011 along with data from DOS. It is evident the patterns in the two series appear to be very similar in the overlapping period between 2001 and 2011. Hence, we construct a quarterly net foreign asset series for Singapore by extending the data series from DOS backwards from 2004 with the LMF series and then interpolate the combined annual series into quarterly frequency. Interpolation is carried out with the “Denton” method in the Eviews computer package which is recommended in IMF publications as “relatively simple, robust, and well-suited for large-scale applications.” The interpolated series is shown in the right panel of Figure 7.3 which appears to capture the movement in the annual net foreign assets reasonably well.



(a) NFA data from LMF and DOS

(b) Interpolated NFA data

Figure 7.3 Singapore net foreign assets

We begin our empirical analysis by testing for unit roots in the individual data series. Results from the Phillips-Perron unit root tests indicate that without exception the individual variables are all integrated of order one. The p-values for the Phillips-Perron unit root test for the levels of the series are 0.50; 0.61; 0.72; 0.37; 0.33; 0.20; and 0.09 for the variables $lreer_t$; tot_t ; nfa_t ; inv_t ; $lgcon_t$; $lprod_t$; and $openess_t$ respectively while those for first difference of the series are all almost 0.00 for all the variables. Since all the individual series are of the same order of integration, we can test for common trends amongst the variables using the Phillips-Ouliaris cointegration test.³ The test results (p-value is 0.00) provides very strong statistical evidence of the existence of a long-run relationship between the REER and four macroeconomic variables, namely terms of trade, net foreign assets, domestic investment and government consumption. Previous empirical studies have shown that it is not uncommon for only a subset of variables in equation (1) to be applicable for explaining the long term movements of REER for any particular country. A possible reason for the exclusion of trade openness as a determinant of Singapore's REER is the extreme openness of Singapore's economy prevailed throughout the sample period. Concurring with our findings, the labour productivity variable which was initially considered in MacDonald (2004) was upon further testing excluded from the estimation of Singapore's BEER in that study as well.

We estimate the long-run relationship between the real effective exchange rate and the four macroeconomic variables namely terms of trade, net foreign assets, domestic investment and

³ Unlike MacDonald (2004), we do not use the VECM model but adopt a more parsimonious approach. The advantage of this single equation approach is it gives rise to a higher degree of freedom that tends to result in more accurate coefficient estimates.

government consumption over our sample period and the estimated cointegrating equation is recorded in Table 7.1.

Table 7.1 Long-run equation of real effective exchange rate

	Coefficient		Std. err.
Terms of trade	0.289 ***		0.096
NFA/GDP	-0.022 ***		0.004
Domestic Investment	1.703 ***		0.126
Govt Consumption	-0.065		0.050
constant	3.794 ***		0.432
trend	0.007 ***		0.001
No. of obs.	149		

As in the vast majority of related empirical studies, the terms of trade variable is found to have a positive and statistically significant impact on the real effective exchange rate. This can be explained by a dominant income effect arising from an improvement in the terms of trade which leads to an appreciation in the REER. Likewise, the impact of domestic investment is positive, as higher domestic investment implies higher expected national income through the multiplier effect. The net foreign assets variable has an expected negative relationship with REER over the long term. An increase in the net foreign assets corresponds to net capital outflow which exerts downward pressure on spending and inflation, resulting in a depreciation in the REER. Finally, the coefficient for government consumption is statistically insignificant at the conventional levels of significance (p-value is 0.20). Nonetheless, the coefficient turns out to be negative, so that an increase in government spending is associated with a depreciation in the REER which could have resulted from a greater share of that spending in the tradable sector.

Having identified the long run relationship between the REER and its fundamental determinants, we use the equilibrium levels of these macroeconomic fundamentals to estimate the equilibrium exchange rate. We first apply the Hodrick-Prescott filter to the four individual explanatory variables in order to smooth out their short term fluctuations and extract their long term trend-cycle components. The estimated equilibrium exchange rate, denoted by *beer*, is then computed from the long run cointegrating equation but replacing each explanatory variable by its smoothed values. A caveat is in order here. It is pertinent to note that the ability of the *beer* estimates to reflect the equilibrium real exchange rate depends on the extent smoothed values of the fundamental variables used in its estimation, are at their respective equilibrium levels. Hence, we highlight that the *beer* estimates

obtained here provide only an approximate estimate of the equilibrium value of Singapore's REER. Figure 7.4 plots the actual REER and the approximate estimate of its equilibrium value *beer*.

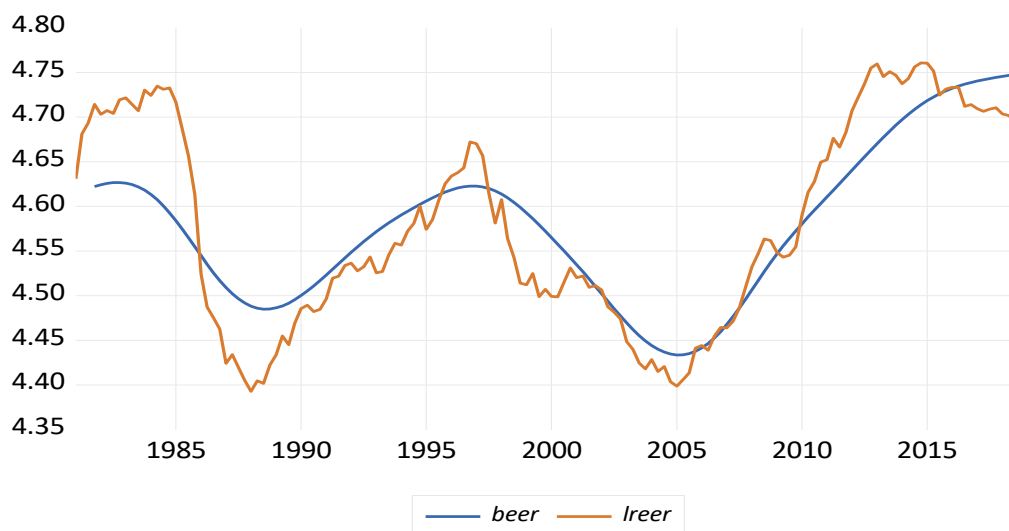


Figure 7.4 Singapore real effective exchange rate and its estimated equilibrium value

The difference between the estimated equilibrium REER and the actual REER value provides a rough gauge of the degree of misalignment in the Singapore dollar. We observe from the figure that the REER was overvalued in the early 1980s, which could have been a contributing factor to the recession that hit the Singapore economy in the mid-1980s. The cost-cutting measures adopted in the aftermath of the recession reversed the situation and the REER became undervalued in the latter half of 1980s. Thereafter, the actual REER seems to track its estimated equilibrium value quite closely, suggesting that the Singapore dollar does not appear to suffer from any serious misalignment from 1990s onwards. This concurs with the findings in MacDonald (2004) and Lee (1999) on the absence of a prolonged deviation of the Singapore dollar from its equilibrium level. To the extent that the real exchange rate behaviour is consistent with Singapore's economic fundamentals, we do not expect price instability resulting from a future fundamental correction.

7.4 Policy Implications

Using data from the beginning of 1980s, we estimate a behavioural equilibrium exchange rate model for Singapore, relating its REER to a set of macroeconomic fundamentals. We find very strong empirical evidence of a long run relationship between REER and its fundamental determinants, namely terms of trade, net foreign assets, domestic investment and government spending. By applying the smoothed values of the individual fundamental determinants to this long run relation, we obtain an approximate estimate of the equilibrium exchange rate. Singapore's REER appears to cycle closely around the estimated equilibrium value so that there is no large or persistent misalignment in the Singapore dollar since the 1990s. In other words, our empirical analysis tentatively indicates that MAS'

intervention operations carried out in the foreign exchange market have not resulted in a sustained deviation of the Singapore dollar from its equilibrium level.

We infer that the exchange rate-based framework adopted by the MAS to maintain price stability seems to be still working well in the sense that the real exchange rate path is found to reflect Singapore's medium-term economic fundamentals. However, managing the nominal exchange rate has become more challenging as it is subject to greater ebbs and flows of foreign capital instead of just being an important relative price determined largely by trade in goods and services. Indeed, exchange rate fluctuations are impacted more recently by fickle capital flows arising from the surge in global liquidity and regional developments like the internationalization of the Chinese renminbi. A more connected world and stronger spillovers means macro-prudential policies are useful to complement monetary policy in Singapore.

We end with the question of the circumstances under which the exchange rate-based monetary policy framework would become irrelevant for Singapore. Chow et al. (2014) showed through a DSGE-VAR model that overall inflation volatility in Singapore is reduced when the export-price shock is dominant in the economy. A floating exchange rate with Taylor rule would become more appropriate for Singapore only when the domestic productivity shock is a major source of real volatility. The authors show that export price shocks have been a major source of output volatility in Singapore so that the exchange rate system at work would have a comparative advantage over Taylor rule in terms of reducing inflation volatility. Another key consideration is that exchange rate management works better in an environment where there is a high level of confidence in the Singapore economy. Hence, the support of a consistent framework of macroeconomic and microeconomic policies that help maintain confidence in Singapore would greatly facilitate the smooth functioning of the exchange rate-based framework to achieve price stability.

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