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Implications of a managed floating exchange rate system on the interest-rate behavior of Singapore

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Implications of a Managed Floating Exchange Rate System on the Interest-rate behavior of Singapore

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Abstract

Singapore and Hong Kong are two similar economies, but they have rather different monetary systems and exchange-rate regimes. Singapore's managed floating exchange rate regime contrasts with Hong Kong's currency board system (CBS) featured by the Hong Kong–United States dollar peg. In this paper, we appraise the implications of the managed floating exchange rate regimes on the interest-rate behavior of Singapore. We examine the Singapore-US interest differential under the Singapore's exchange-rate regimes during the Asian Financial Crisis (AFC), current Global Financial Crisis and none-crisis periods by using generalized autoregressive conditional heteroscedasticity (GARCH) model. We hope that the good performance of Singapore's exchange rate system and interest rate system, after successfully moving away from a currency board system to a credible managed floating exchange-rate regime, provides a lesson worthy of attention to Hong Kong.

1. Introduction

Singapore and Hong Kong are two Asian economies which share many similar economic characteristics. For example, both are small economies but highly- open in terms of import and export and free capital flows. Both emerged from British governance. Both are currently regional financial centers with relatively developed financial sectors and top- rated public services. Domestic prices and wages are almost flexible with little rigidity (Ding Lu, 1999). Both governments have enjoyed a benign budget surplus during the non-economic-crises times and have accumulated large official foreign reserves. Both Singapore and Hong Kong play more and more active roles in the Sovereign Wealth Fund Market than other similar-sized economies. Because of their limited natural resources, exports in both economies depend mainly on raw materials and on imported parts. However, both economies have fairly different money system and exchange rate regime. Hong Kong has a currency board system (CBS) under which the Hong Kong dollar is pegged to the US dollar at a fixed exchange rate since 1983(Shu-ki Tsang, 1999). In contrast, Singapore has gradually switched from the traditional sterling-based CBS into a managed float monitoring band regime under which the value of the Singapore dollar is managed floating within an undisclosed band based upon a trade-weighted basket of foreign currencies from 1970's (Yip, S. L, 2003). This paper considers the implications of the managed floating exchange rate system on the interest rate behavior of Singapore. We examine the Singapore - U.S. interest differential under the managed floating exchange rate system. We also study whether there is any change in the correlation between the Singapore and U.S. interest rates differential due to the financial crisis by using a GARCH model. Consider Hong Kong' s economic situation in the past years, linked exchange rate regime survived severe attacks on the Hong Kong dollar by those international hedge funds during the Asian Financial Crisis. It is, however, not optimal for Hong Kong to insist on its currency board-type exchange rate regime in the future, especially given that Hong Kong had lost much more on the Mini bond issue than Singapore under this global financial crisis. In this aspect, Singapore's experience of a currency regime that has evolved from a classical CBS offers an alternative for Hong Kong's government.

In today's economy, an exchange rate system and a monetary system are fairly important determinants for an economy's stability and development. This provides us with motivation to study the interactive relationships between these two factors. This paper focuses on one particular aspect of this relationship, namely, the implications of the managed floating exchange rate. The main objectives of this paper are as follows. First, we study whether the monitoring band regime in Singapore is related with a much higher flexibility of the interest-rate policy. The crisis leads to an increase in Singapore-U.S. interest differentials which means a breakdown of the Singapore-U.S. interest link. Second, the volatility of the interest differential in the crisis periods is expected to be higher than that in the non-crisis periods.

This plan of this paper is organized as follows. In section 2, we have a discussion about the Singapore managed floating exchange rate system, with focus on its implication on interest-rate performance and policies. And then, in section 3, we propose the hypotheses to be tested. In section 4, we exhibit the data and the econometric methodology. In section 5, we report the empirical results. Section 6 concluded the paper.

2. Implications of Singapore's managed floating exchange rate system on its interest rate behavior

The currency board system was introduced to the Singapore area in 1897, at that time Singapore was still under British control. In 1967, the pound sterling devalued, the Singapore dollar moved away from the sterling standard and maintained its gold parity and was for a while pegged to the US dollar at US$1/S$2.8196 in 1972. Due to the international monetary uncertainty in 1973, the Singapore government adopted a managed floating system. At the same time, the Singapore authorities continued to relax their foreign exchange controls and finally set free controls by 1978 (Lu & Lee, 1999). In 1971, the Monetary Authority of Singapore (MAS) was established to consolidate all the central banking functions. In recent years, the MAS has played the roles of a monetary policy maker and a financial market regulator. It supervises the financial system and conducts monetary and exchange rate policies. As a full real central bank, the MAS has all the conventional monetary tools available to it. These include open market operations, foreign exchange swaps, reserve requirements, discount policy, and moral persuasion.

Singapore has an undisclosed trade – weighted exchange-rate band system with credibility and strong policy instruments (see Teh & Shanmagaratnum, 1992; Yip, 2002). Rajan and Siregar (2002) pointed out that Singapore's exchange-rate system is basically a monitoring band system in which the MAS in general (except for tactical reasons) refrains from intervening so long as the Singapore dollar lies within the undisclosed and adjustable target band. Yip (2003) also noted that (a) during the normal period in our study, the MAS targeted an undisclosed but gradually appreciating band of Singapore dollar, and the average appreciation turned out to be 2–3% per annum (the actual figure depends on the specific period selected for computation), and (b) when there is evidence that a major depreciation or appreciation is necessary (such as in the case of the AFC), the MAS revises the mean and width of the exchange-rate band. The above suggests that during the non-crisis period, the expected appreciation of the Singapore dollar as well as the relatively low risk and liquidity premium (due to the efficiency of the interbank market) imply that the average Singapore-U.S. interest differential should be at a discount. However, during the crisis period, the discount falls or even reverses to a premium because (a) the usual expected appreciation of the Singapore dollar and (b) there may be an increase in the risk and liquidity premium during the crisis period. During the post-crisis period, the Singapore-U.S. interest-rate differential is expected to be lower than which existed during the crisis periods. Whether the differential is negative, zero or positive depends mainly on the expected depreciation (and partly on the perceived risk and liquidity premium) during the non-crisis period.

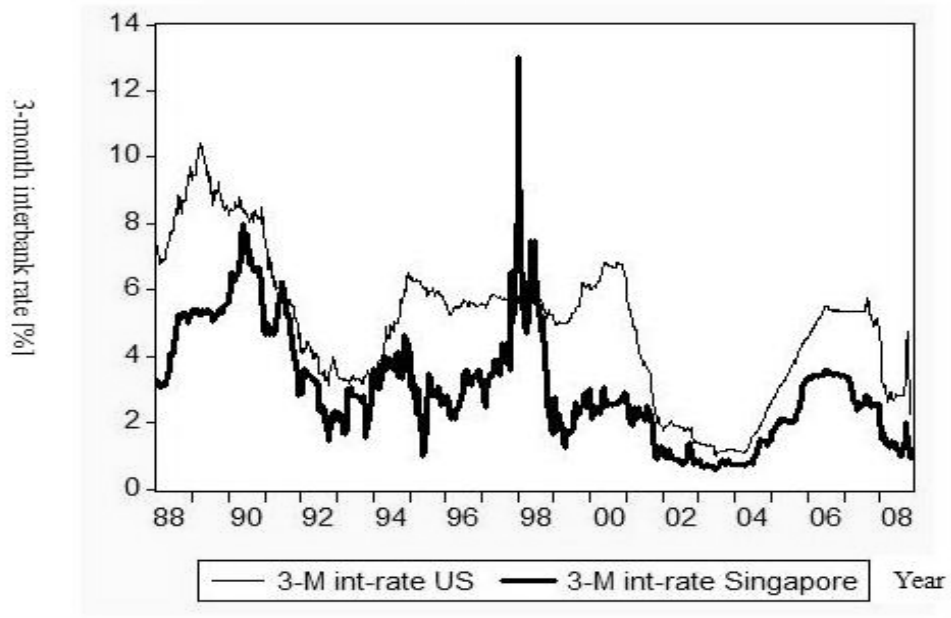
3. Hypotheses to be tested

Summarizing the discussions in the above subsections, we consider the following testable hypotheses:

> During the non-crisis period, the expected appreciation of the Singapore dollar implies that the average Singapore-U.S. interest differential should be at a

discount. During the crisis period, the discount falls or even reverses to a premium.
The crisis leads to an increase in Si interest differentials. A breakdown of the Singapore-US interest link.
The volatility of the interest differential in the crisis period is expected to be higher than which existed in the non-crisis periods.

Figure1 . Three-month interbank rates of Singapore and U.S.

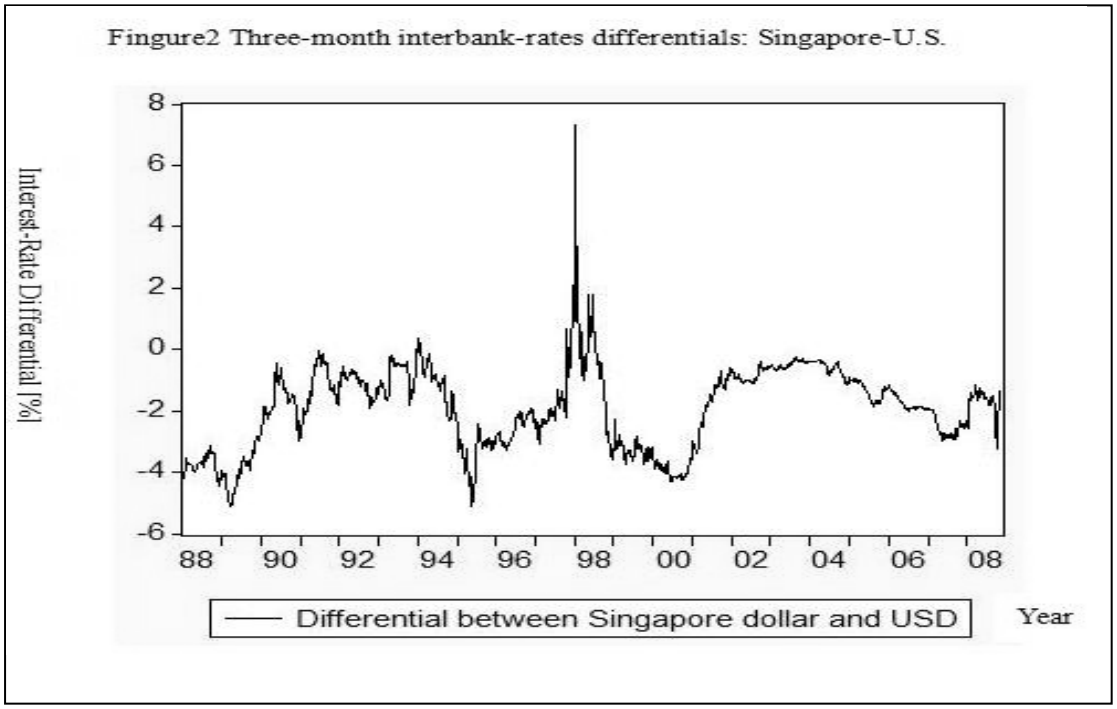


4. The data and the methodology

Our data consist of weekly observations of the Singapore and US 3-month interbank interest rates. The weekly data of Singapore are from MAS. The weekly data of U.S.A are from IMF. The data covered the period from 8 Jan 1988 to 14 Nov 2008, with 1089 observations in total.

Using Eviews, we got Fingure.1, which plots the 3-month interbank rates of the two economies, and Fingure.2 presents the 3-month Singapore-U.S interest-rate differential. Table 1 provides some summary statistics of the data, as well as the tests for unit root using the Augmented Dickey-Fuller (ADF) test.

The ADF test statistics show that the hypothesis that the Singapore and U.S. interbank interest rates are nonstationary, cannot be rejected at the 5% level. Comparatively, the hypothesis that the differenced interest rate is nonstationary is rejected at the 5% level. Therefore, the results indicate that both interbank interest rate series contain a unit root. And then, we check the stationary of the Singapore-U.S. interest-rate differential. The ADF of the Singapore-U.S. interest rate differential is significant. Thus, the evidence proves the interest-rate differentials being stationary.



During the observation term, the major external shocks are the AFC and current Global Financial Crisis. We divide the sample period into the four subperiods of crisis and non-crisis to distinguish the possible structural break in the data as follows: (a) Period 1:1988-1997, (b) Period 2: 1997-1998, (c) Period 3: 1998-2007, (d)Period 4 :2007-2008.

Table.1 Summary statistics of three-month interbank rates

	SP	US
Statistic		
Mean	3.058935	4.959578
Median	2.810000	5.350000
Maximum	13.000000	10.440000
Minimum	0.560000	1.000000
Std Dev	1.67999	2.153881
Std Skewness	0.867163	0.106739
Std Kurtosis	4.016934	2.600183
ADF statistics		
Interest rates	-3.244321	-1.388285
Differenced interest rates	-3.547933	

According to Tse and Yip (2003), the interest-rate differentials of Singapore versus US are modeled using a model with time-varying conditional mean and conditional variance. We denote the Singapore 3-month interbank rate at time t by i_t and the 3-month US interbank rate by i_t^{us} . Let $y_t = i_t - i_t^{us}$ denote the interest rate differential of

Singapore versus US. As i_t and i_t^{us} are found to be nonstationary while y_t is found to be stationary, we model the dynamics of the interest-rate differential y_t using an auto regressive process. Furthermore, we allow the volatility of the interest-rate differentials to be time varying. And dummy variables are introduced in the conditional-mean and conditional-variance equations to capture the effects of the financial crisis for Singapore. We define D_{it} as a dummy variable, such that, D_{it} =1 if t belongs to the period i, and zero otherwise. Thus, the conditional-mean equation for the interest-rate differential is given by:

$$Y_t = \sum_{i=1}^{m} \delta_i D_{it} + \sum_{j=1}^{p} \phi_j Y_{t-j} + \varepsilon_t \quad (1)$$

So that y_t follows an autoregressive (AR) process of order p. The time-varying intercept δ_i determines the average interest-rate differential in each subperiod. For the Singapore-U.S. differential, m=4. In Equation (1) the Singapore of adjustment of the interest-rate differential is determined by the AR coefficients ϕ_j. This model was used by Tse and Yip (2003) for the Hong Kong data, with the assumption that the adjustment process is the same during or outside the AFC. In this paper, we relax this restriction in the empirical model and allow ϕ_j varying in the crisis and non-crisis subperiods for Singapore data. Further details will be given in Section 5. We assume the conditional-variance of the residual ε_t follows a generalized auto regressive conditional heteroscedasticity (GARCH) process. The GARCH model was first suggested by Bollerslev(1986) following the earlier work of Engle (1982), and has since been applied extensively in the empirical finance literature. Thus, by assumption $\varepsilon_t \mid \Phi_{t-1} \sim N(0, \sigma_t^2)$, such that conditional on the information set Φ_{t-1} at time t-1 the residual ε_t is distributed as a normal variable with mean zero and variance σ_t^2. In particular, we assume a GARCH (1, 1) model such that:

$$\sigma_t^2 = \sum_{i=1}^{m} \gamma_i D_{it} + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (2)$$

In this equation the conditional-variance is allowed to shift according to the subperiod. The parameter γ_i determines the shift in the volatility of the interest-rate differential in period i.

5. Empirical results

With the help of Eviews and Math Type, we get the model,

$$y_t = -2.9915 + 0.9982 y_{t-1}$$

$$\sigma_t^2 = -0.0179 D_1 + 0.3696 D_2 - 0.0224 D_3 + 0.1814 \varepsilon_{t-1}^2 + 0.7607 \sigma_{t-1}^2 + 0.02289$$

From Fingure2, we see that during the non-crisis period, the expected appreciation of the Singapore dollar implies that the average Singapore-U.S. interest differential should be at a discount. However, during the crisis period, the discount falls or even reverses to a premium, especially between 1997 and 1998. At present, the interest rate differential is close to zero, have obvious upward pressure.

Table 2. Eviews results

Dependent Variable: DSPUS				
Method: ML -ARCH				
Sample(adjusted): 1/15/1988 11/24/2008				
Included observations: 1088 after adjustments				
Convergence achieved after 52 iterations				
GARCH=C(3)+C(4)*RESID(-1)^2+C(5)*GARCH(-1)+C(6)*D1+C(7)*D2+C(8)*D3				
	Coefficient	Std. Error	z-Statistic	Prob.
C	-2.991521	2.257933	-1.324894	0.1852
AR(1)	0.998162	0.002711	368.2402	0.0000
		Variance Equation		
C	0.022886	9.36E-05	244.5805	0.0000
RESID(-1)^2	0.181370	0.016254	11.15817	0.0000
GARCH(-1)	0.760747	0.010235	74.32562	0.0000
D1	-0.017913	0.000447	-40.10939	0.0000
D2	0.369570	0.040515	9.121847	0.0000
D3	-0.022396	6.64E-05	-337.3973	0.0000
R-squared	0.937807	Mean dependent var	-1.898658	
Adjusted R-squared	0.937404	S.D. dependent var	1.325584	
S.E. of regression	0.331650	Akaike info criterion	-0.657262	
Sum squared resid	118.7911	Schwarz criterion	-0.620556	
Log likelihood	365.5506	F-statistic	2326.481	
Durbin-Watson start	2.441559	Prob(F-statistic)	0.00000	
Inverted AR Roots	1.00			

The original Eviews output table is featured in the appendix (I). The table is recreated here for printing clarity.

The crisis also leads to an increase in Singapore-U.S. interest differentials and a breakdown of the Singapore-U.S. interest link.

The volatility of the interest differential in the crisis period is expected to be higher than that in the non-crisis periods. Because in period 2, during the Asian Financial Crisis, D_1=0, D_2=1, D_3=0, the coefficient of D_2 is positive, which demonstrate, financial crisis increase the volatility of the interest differentials. When D_1=0, D_2=0, D_3=0, it belongs to period 4, the current financial crisis, we have positive constant intercept, which also show that the financial crisis has influence on the volatility of the interest differential.

6 Conclusions

This paper focuses on the effects of the Singapore managed floating exchange rate system on domestic interest-rate behavior. We find the monitoring band system in Singapore has allowed a greater flexibility in the exchange-rate policy, thus relieving the effects of the financial crisis on the level and volatility of the Singapore interest rate. There is empirical support for the hypothesis that greater flexibility in the exchange rate target in Singapore and financial crisis lead to the volatility of interest rate differentials. Compared with the Hong Kong linked exchange rate system, although Hong Kong survived the Asian Financial Crisis, Ho sacrificed too much due to the long-term high interest rate which restrained its economic development. The

current financial crisis also discloses the problem of current money system under the linked exchange rate system. So it's time to consider making a difference.

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APPENDIX I: ORIGINAL EVIEWS OUTPUT

Figure 3 Eviews results

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: DSPUS
Method: ML ARCH (Marquardt) Normal distribution
Date: 11/25/08 Time: 22:03
Sample (adjusted): 1/15/1988 11/14/2008
Included observations: 1088 after adjustments
Convergence achieved after 52 iterations
Variance backcast: ON
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1) + C(6)*D1 + C(7)*D2 + C(8)*D3

	Coefficient	Std. Error	z-Statistic	Prob.
C	-2.991521	2.257933	-1.324894	0.1852
AR(1)	0.998162	0.002711	368.2402	0.0000
Variance Equation				
C	0.022886	9.36E-05	244.5805	0.0000
RESID(-1)^2	0.181370	0.016254	11.15817	0.0000
GARCH(-1)	0.760747	0.010235	74.32562	0.0000
D1	-0.017913	0.000447	-40.10939	0.0000
D2	0.369570	0.040515	9.121847	0.0000
D3	0.022396	6.64E-05	337.3973	0.0000

R-squared	0.937807	Mean dependent var	-1.898658
Adjusted R-squared	0.937404	S.D. dependent var	1.325584
S.E. of regression	0.331650	Akaike info criterion	-0.657262
Sum squared resid	118.7911	Schwarz criterion	-0.620556
Log likelihood	365.5506	F-statistic	2326.481
Durbin-Watson stat	2.441559	Prob(F-statistic)	0.000000

Inverted AR Roots 1.00

APPENDIX II: SAMPLE DATA

	Singapore	U.S.		Singapore	U.S.
1988 Jan 08	3.25	7.31	1989 Jan 06	5.31	9.44
Feb 05	3.19	6.94	Feb 03	5.38	9.44
Mar 04	3.06	6.81	Mar 03	5.38	10.25
Apr 08	3.19	7.13	Apr 07	5.31	10.31
May 06	3.38	7.38	May 05	5.31	10
Jun 03	4.13	7.81	Jun 02	5.38	9.63
Jul 01	4.19	7.94	Jul 07	5.31	9.19
Aug 05	4.94	8.31	Aug 04	5.06	8.56
Sep 02	5.25	8.69	Sep 01	5.19	9
Oct 07	5.31	8.69	Oct 06	5.38	9.13
Nov 04	5.31	8.69	Nov 03	5.31	8.69
Dec 02	5	9.31	Dec 01	5.56	8.5
1990 Jan 05	5.69	8.38	1991 Jan 04	4.75	7.44
Feb 02	6.5	8.38	Feb 01	4.75	7.13
Mar 02	6.25	8.44	Mar 01	4.88	7
Apr 06	6.44	8.56	Apr 05	4.75	6.31
May 04	6.81	8.69	May 03	5.06	6
Jun 01	8	8.44	Jun 07	5.63	6.19
Jul 06	7.69	8.31	Jul 05	6.13	6.19
Aug 03	7	8.13	Aug 02	5.56	5.69
Sep 07	6.63	8.06	Sep 06	5.19	5.69
Oct 05	6.56	8.25	Oct 04	4.5	5.5
Nov 02	6.69	8.13	Nov 01	3.94	5.25
Dec 07	5.63	8.06	Dec 06	3.13	4.75
2007 Jan 05	3.44	5.36	2008 Jan 04	2.13	4.65
Feb 02	3.38	5.37	Feb 01	1.69	3.11
Mar 02	3.31	5.35	Mar 07	1.44	2.99
Apr 05	2.88	5.35	Apr 04	1.38	2.76
May 04	2.63	5.36	May 02	1.38	2.81
Jun 01	2.44	5.36	Jun 06	1.31	2.74
Jul 06	2.5	5.36	Jul 04	1.19	2.81
Aug 03	2.63	5.36	Aug 01	1	2.83
Sep 07	2.81	5.76	Sep 05	1.31	2.83
Oct 05	2.44	5.25	Oct 03	1.75	4.27
Nov 02	2.56	4.88	Nov 07	0.94	2.33
Dec 07	2.56	5.16			

Note: Because of limited space, I just put a sample of part of total 1089 data of U.S. and Singapore 3-mongth interbank interest rate. These weekly data are chosen from 1989, 1989, 1990, 1991, 2007 and 2008. Singapore 3-month interbank interest rate data are collected from MAS. And U.S. data are from IMF.

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