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The Scope for Monetary Autonomy in Hong Kong and Singapore

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This dissertation has been duly read, reviewed, and critiqued by the Committee listed below, which hereby approves the manuscript of **Shan Xue** as fulfilling the scope and quality requirements for meriting the degree of Doctor of Philosophy in Economics.

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Abstract

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The monetary trilemma autonomy has been at the heart of a great deal of international monetary analysis. It implies that countries with fixed exchange rates and no capital controls will lose monetary autonomy. What is often not recognized, however, is that the trilemma need not hold in the short run. If capital mobility is less than perfect, then countries can sterilize reserve flows and maintain a degree of monetary autonomy in the short run. Hong Kong is a natural case to test this possibility since it has a credibly fixed exchange rate against the dollar and no major capital controls. We investigate this issue using two approaches. One is to estimate the effects of changes in U.S. interest rates on those in Hong Kong. As with earlier literature, we find that the pass-through, while considerable, is substantially less than one, indicating imperfect capital mobility. The second is to estimate whether Hong Kong has been able to engage in some degree of sterilization. This has not been done before. An important issue here is how to measure Hong Kong's monetary base. Because of the particular institutional arrangements in Hong Kong, the Monetary Authority uses a measure of the monetary base that differs from the standard IMF definition. By both measures, we find that Hong Kong has been able to practice partial sterilization of international reserve flows in the short run and hence does have some degree of monetary autonomy.

Another challenge the standard trilemma analysis faces focuses on the effectiveness of flexible exchange rates in monetary insulation. Rey (2013) argued that "dilemma not trilemma"—an economy could not have monetary autonomy unless capital controls are used regardless of exchange rate regimes. The argument can be usefully examined with the cases of Singapore and Hong Kong. Both economies are small and open, but they choose different exchange rate regimes—the Monetary Authority of Singapore (MAS) uses a managed floating exchange rate. We also estimate the interest rate pass-through from the U.S. to Singapore and Singapore's offset and sterilization coefficients. Our results show that Singapore's economy is insulated from oversea monetary shocks to a more considerable extent than Hong Kong. It suggests that the trilemma has not become a "dilemma" and that flexible exchange rates are effective in helping a small open economy to maintain a degree of monetary independence.

Dedication

To my beloved parents, Zhang, Xiaofeng and Xue, Ning,
and grandmother, Yang, Fengzhen

In memory of my grandfather, Zhang, Peiyi

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Chapter 1 Introduction

The standard trilemma analysis is typically presented in the form that if a country has a credibly fixed exchange rate and no capital controls, then it cannot also have an independent monetary policy. This is clearly true for the long term because in the long-term countries must have a balance of payments adjustment mechanism and these are the three main methods of adjustment.[1] The trilemma is sometimes described as being an implication of the standard Mundell-Fleming open economy macro model. This is correct, however, for the short run only if capital mobility is perfect so that any attempt at independent monetary policy will be offset by sufficient capital flows to keep the money supply unchanged. If capital mobility is imperfect, however, then sterilized intervention in the foreign exchange market can loosen the trilemma constraint in the short term. This is especially true for economies that have considerable international reserves so that they can finance short term payments imbalances. See Aizenman (2013) and Steiner (2017).

While international capital mobility is certainly high for many countries this does not necessarily imply that it is so high that a number of countries cannot engage in considerable short term sterilization and indeed there is a sizeable literature that finds that this is often done.[2] However,

[1] There is also the option of varying a countries monetary-fiscal mix as proposed by Mundell Mundell, R. A. (1962). The appropriate use of monetary and fiscal policy for internal and external stability. *Staff Papers*, *9*(1), 70-79. , however, this strategy is likely to be effective only in the short term and thus is more a way of financing deficits than of adjusting them. See, for example, Willett and Forte Willett, T. D., & Forte, F. (1969). Interest rate policy and external balance. *The Quarterly Journal of Economics*, *83*(2), 242-262. .

[2] See, for example, Ouyang and Rajan Ouyang, A. Y., & Rajan, R. S. (2011). Reserve accumulation and monetary sterilization in Singapore and Taiwan. *Applied Economics*, *43*(16), 2015-2031. , Khemraj and Pasha Khemraj, T., & Pasha, S. (2011). Monetary sterilization and dual nominal anchors: some Caribbean examples. , Cavoli and Rajan Cavoli, T., & Rajan, R. S. (2015). Capital inflows and the interest premium problem: The effects of monetary sterilisation in selected Asian economies. *International Review of Economics & Finance*, *39*, 1-18. , and Lim and

these studies have typically not taken into account the extent of these countries' capital controls and degree of exchange rate flexibility, thus they are not direct tests of whether the trilemma constraints can be violated in the short run.

Hong Kong presents us with a rare opportunity to analyze this possibility directly. As He and McCauley (2013) describe it, "Hong Kong has an exchange rate link to the dollar and capital account openness" (p. 9.) Of course, a pegged rate may not meet the trilemma requirements if it is not credible, but Hong Kong has followed a hard rather than soft peg and there have been few occasions in which the credibility of the peg has been seriously questioned. Furthermore, Hong Kong has a well-developed financial market and is clearly well integrated into global financial markets. Its "natural" rate of capital mobility is clearly quite high and its monetary and financial conditions are clearly heavily affected by international developments. This does not logically imply that the capital mobility facing Hong Kong is so high that it has no potential for any degree of monetary autonomy. This is an empirical question which this dissertation is designed to address.

A number of studies have found that despite the absence of significant capital controls there is a less than one to one pass through from changes in interest rates in the U.S. to those in Hong Kong indicating that capital mobility is less than perfect. Some studies, however, have found pass-through to be close to 1. Thus, based on the previous literature it is an open question whether there is sufficient imperfect asset substitutability to give Hong Kong scope for some degree of short-run monetary autonomy.

Goh Lim, E. G., & Goh, S. K. (2016). Is Malaysia exempted from the impossible trinity? An empirical analysis for an emerging market. *Macroeconomics and Finance in Emerging Market Economies*, *9*(2), 131-147. .

Even if there is some scope for sterilization, the monetary authorities might still be institutionally constrained from using it such as in a pure currency board. Furthermore, even if it is not so constrained, a country might choose not to use this option. In a strict currency board arrangement sterilization is not allowed and changes in the monetary base automatically follow from changes in international reserves. Like many currency boards, however, Hong Kong's currency board arrangements are not so strict. The level of international reserves acts as a constraint on how much the monetary base can be expanded so that full convertibility is assured, but reserve increases do not automatically force expansions of the monetary base. Indeed, currently international reserves substantially exceed the monetary base.[3] Thus, at present and throughout most of its experience with a currency board, Hong Kong's reserve constraint has not been binding and the effective constraint on sterilization is the degree of capital mobility.

One measure of international capital mobility is the extent to which changes in interest rates in a core country affect interest rates in other countries, i.e, the extent to which there is interest rate pass-through. Consistent with most of the previous studies for Hong Kong we find that most of our estimates suggest that there is substantial but less than full pass-through, suggesting high but less than perfect capital mobility.

[3] As of April 2020, international reserves stood at US$ 441.2 billion, which is approximately HK$ 3419.7412 billion with the spot exchange rate at HK$ 7.751=US$1 in April 2020 while the monetary base was HK$ 1,708.652 billion. Source: https://www.hkma.gov.hk/eng/data-publications-and-research/data-and-statistics/economic-financial-data-for-hong-kong/#externalSector

Unlike studies on interest rate interdependence, we are not aware of studies that have looked directly at the ability of Hong Kong to sterilize the effects of international reserve changes on its monetary base. We find robust estimates that the Hong Kong Monetary Authority (HKMA) has been able to undertake partial monetary sterilization and thus enjoys some degree of monetary autonomy, thus allowing it to operate outside of the trilemma constraints in the short run.

Another challenge the monetary trilemma faces is the effectiveness of flexible exchange rates in helping countries insulate the domestic economy from overseas monetary shocks. Rey (2013) argued, "The global financial cycle transforms the trilemma into a 'dilemma' or an 'irreconcilable duo': independent monetary policies are possible if and only if the capital account is managed." This dissertation examines the argument by comparing Hong Kong and Singapore's monetary autonomy. Hong Kong and Singapore are comparable small and open economies. However, they choose different exchange rate regimes – Hong Kong adopts a hard peg against the U.S. dollar while Singapore carries on a managed floating exchange rate regime. Suppose there is no significant difference in the monetary autonomy scope between Hong Kong and Singapore. In that case, it means that flexible exchange rates are not effective in helping small open economies to maintain monetary autonomy. We estimate the responses of Singapore interest rates to changes in their U.S. counterparts in the periods between Jan. 1998 through Feb. 2021 and the extent to which foreign exchange interventions are sterilized between Jan. 1992 and Jun. 2021. As predicted by the trilemma, the estimated interest rate pass-through from the U.S. to Singapore is lower than that to Hong Kong, and international reserve flows in Singapore are sterilized more intensively than those in Hong Kong. The findings suggest that Singapore has more scope for monetary autonomy than Hong Kong, implying that the weak form of the monetary trilemma still holds.

The remainder of this dissertation is organized as follows. The theoretical framework is presented in Chapter 2. The past literature on the measures of monetary autonomy is reviewed in Chapter 3. The economic backgrounds and monetary and exchange rate policies of Hong Kong and Singapore are introduced in Chapter 4. The methodology is shown in Chapter 5. The estimated interest rate pass-through is presented and explained in Chapter 6. The estimated offset and sterilization coefficients are shown and explained in Chapter 7. The robustness check is presented in Chapter 8. The concluding remarks are made in Chapter 9.

Chapter 2 Theoretical Framework

This dissertation studies monetary insulation in small open economies based on the international interest rate pass-through model and the offset and sterilization coefficients model. They are presented, respectively, in the following subsections.

Section 2.1 The Interest Rate Pass-Through Model

The domestic interest rates of a small open economy are determined by foreign interest rates, market expectations on the local currency depreciation and the degree of capital mobility. The model is written as follows.

$$\Delta R = \Delta R^* + \frac{E^e - E}{E} + \rho \qquad (2.1)$$

where

ΔR = the change in the domestic interest rate from last period;

ΔR^*= the change in the foreign interest rate from last period;

E^e = the expected exchange rate of the home currency against the foreign currency;

E = the spot exchange rate of the home currency against the foreign currency;

ρ = the degree of capital mobility.

In the case of fixed exchange rates, the market expects no change in the exchange rate of the local currency against the base currency.[4] Thus, $E^e = E$, and the term $\left(\frac{E^e - E}{E}\right) = 0$.

[4] In practice rates are not perfectly fixed but rather are kept within a very narrow band. These are so narrow that we can safely treat these regimes as completely fixed.

When the home and foreign assets can substitute with each other perfectly, there is no risk premium between the domestic and foreign interest rates. In this case, $\rho = 0$.

Therefore, the domestic interest rates are dominated by foreign interest rates under fixed exchange rates ($\frac{E^e - E}{E} = 0$) and perfect capital mobility ($\rho = 0$). Theoretically, there is no monetary autonomy in this case.

If the capital mobility is not perfect ($\rho \neq 0$), the international interest rate pass-through will be less than one for one even under a hard peg.

Given the degree of capital mobility, the interest rate pass-through to an economy with floating exchange rates is lower than that to a hard peg. There are more scopes for monetary autonomy under a floating exchange rate than that with a fixed regime.

Section 2.2 The Offset and Sterilization Coefficients Model

The domestic money supply of an open economy is endogenous to cross-border capital flows under pegged exchange rates. The interactions between domestic monetary policy and capital flows are modelled with capital flows equation (eq. 2.2) and policy reaction function (eq. 2.3) simultaneously. They are shown as follows.

$$\Delta NFA = \alpha_0 + \alpha_1 \Delta NDA + Z'A \qquad (2.2)$$

$$\Delta NDA = \beta_0 + \beta_1 \Delta NFA + X'B \qquad (2.3)$$

where

ΔNFA = the change in the net foreign assets on the balance sheet of the economy's central bank;

ΔNDA = the change in the net domestic assets on the balance sheet of the economy's central bank.

α_1 is the offset coefficient. It measures the degree of capital mobility. When capital mobility is perfect, any discretionary monetary policy that leads to a change in the net domestic assets will result in an interest rate differential between home and foreign economies. The capital flows driven by the interest rate differential can offset the effect of the independent monetary policy on the domestic money supply completely. In this case, $\alpha_1 = -1$. When capital is completely immobile across border, there will be no change in the net foreign assets and the independent monetary policy will be fully effective. In this case, the offset coefficient is zero.

β_1 is the sterilization coefficient. It measures the extent to which the monetary effect of foreign exchange interventions is sterilized. The success of sterilization is subject to imperfect capital mobility. The sterilization coefficient is supposed to be zero when capital mobility is perfect ($\alpha_1 = -1$).

The simultaneous equations indicate that the net foreign and domestic assets are endogenous to each other. If each coefficient is estimated with a single equation, the result can be biased due to an endogeneity issue. Thus, the offset and sterilization coefficients are estimated together by previous empirical work with instrumental variables that affect one variable and are exogenous to another one, such as the lags of the variable, to address the problem. Nevertheless, the sterilization coefficient is a more reliable estimate than the offset coefficient as previous literature has found.

Chapter 3 Literature Review

This chapter summarizes the important empirical literature that has estimated the parameters relevant to testing various aspects of the monetary trilemma.

Section 3.1 The Interest Rate Pass-Through under Fixed Exchange Rates and No Capital Controls

Previous literature has examined the corner solution of the monetary trilemma. Borenzstein et al. (2001) have investigated 8 economies for the period between 1994 and 2000 and used the vector autoregression model. They estimated the reaction of Hong Kong interest rates to US monetary policy shocks. Although they argued that the response is one for one, the equality has not been tested. We choose the least squares model to emphasize the causal-effect relationship between the US and Hong Kong interest rates and finds the pass-through less than one for one.

Frankel et al. (2004) used the monthly 91-day interest rates of 46 countries and the US from Jan. 1970 to Mar. 1999 and estimated the interest rate pass-through with the autoregressive distributed lag (ARDL) model. They estimated that the level relationship between the US and Hong Kong interest rates is 0.91. Frankel's study uses levels which are subject to serious problems of common determinants of the interest rates. This study estimates the first-differenced interest rate pass-through to measure the response of local rates to changes in the US rates which is more appropriate and finds that the interest rate pass-through is lower than the past work.

Previous literature also has used different samples for the estimation. Cheng and Rajan (2020) have investigated 88 countries for the period from 1973 to 2014. They found that the interest rate pass-through under peg and no capital controls is 0.94. But it has not been tested whether the coefficient is statistically equal to one. Besides, the sample comprises both advanced and emerging market economies with pegged exchange rate regimes, which can bias the result.

Empirical studies have found that the interest rate pass-through to advanced economies (AEs) is higher than that to emerging market/developing economies (EMEs). Klein and Shambaugh (2015) have used a sample of 44 countries from 1973 to 2011 and estimated interest rate pass-through from the US to these countries. They found the pass-through is 0.94 to pegged AEs but 0.72 to pegged EMEs. Albagli et al. (2019) have investigated the 2-year Treasury yield pass-through from the US to 12 AEs and 12 EMEs between 2003 and 2016 and estimated that the pass-through is 0.263 to AEs but 0.160 to EMEs. Obstfeld et al. (2015) have used both short- and long-term interest rates of 34 countries during the period from 1989 to 2013 to estimate the pass-through. Their results find that the pass-through to pegged AEs can be higher than 0.9 while it is not significant to pegged EMEs. Caceres et al. (2016a) have used a sample of 43 emerging and advanced economies between 2000 and 2015 and estimated both short- and long-term interest rate pass-through with a VAR model. They found that the short-term interest rate pass-through is 0.23 to AEs but 0.14 to EMEs. The difference becomes smaller in terms of long-term interest rates—the long-term rate pass-through is 0.67 to AEs and 0.65 to EMEs. The pass-through to AEs is slightly higher than that to EMEs though.

The higher interest rate pass-through to AEs than that to EMEs can be explained with the co-movement of the US and other advanced economies' monetary policy as the economies are interdependent to a higher extent than with EMEs and capital mobility is likely to be higher than with EMEs. The endogeneity issue makes the interest rate pass-through overestimated with the samples comprising advanced economies.

This study focuses on small open economies (Hong Kong and Singapore) which have negligible influence over the world economy. The US interest rate is exogenous to the local rates in Hong Kong and Singapore. Therefore, the endogeneity issue is addressed. We find that the estimated interest rate pass-through to the small open economies is less than one for one.

Bleaney et al. (2013) have used the annual data of 126 countries from 1990 to 2005 and found that although the interest rate pass-through is 0.4 and statistically less than one for general pegs without capital controls, the pass-through is statistically equal to one for credible pegs. The credibility is defined as low inflation differential in one way, and hard pegs in another way. The authors used an interaction term of the foreign interest rate and a dummy variable for pegs to examine the effect of credible pegs on the interest rate pass-through compared to non-pegs. The result is puzzling as the coefficient on the foreign interest rate is statistically less than one and the coefficient on the interaction term is not statistically significant—it fails to reject the hypothesis that the coefficient is zero, but the combination of the coefficients on the foreign interest rate and the interaction term, which represents the pass-through to credible pegs, is statistically equal to one. It is puzzling that the interest rate pass-through is estimated to be one for one under credible pegs that include both hard and soft pegs with low inflation. This study estimates the pass-through to Hong Kong and Singapore and finds distinct responses of the two economies to foreign monetary policy. The pass-through to a soft peg is significantly lower than one for one.

The earlier work that found the interest rate pass-through to economies is one for one under fixed exchange rates and no capital controls has not distinguished the influence of conventional monetary policy from the unconventional monetary policy that has been implemented since the Global Financial Crisis. Takats and Vela (2014) have estimated the policy rate responses of 20 emerging market economies to US monetary policy for the periods from the first quarter of 2000 to the third quarter of 2013 and from the first quarter of 2008 to the third quarter of 2013, respectively, and found significant and different changes in the interest rate pass-through between the full sample period and the subperiod of the GFC and its aftermath across different countries. The estimated interest rate pass-through declines from 1.08 to 0.66 but remains significant in the case of Brazil; it increases from insignificant 0.07 to significant 0.3 in the case of Hungary; and the pass-through decreases from significant 0.53 to -0.14 but insignificant in the case of Russia. The author has not examined the policy rate response under a hard peg to the unconventional monetary policy. This study estimates and compares the interest rate pass-through from the US to Hong Kong before and after the GFC, and finds that the policy rate pass-through is estimated to decline from one for one to 0.577.

Unlike previous literature that all used short-term interest rates to examine the corner solution of the monetary trilemma, the long-term bond yields have been used to examine the change in the interest rate pass-through before and after the GFC. Gilchrist et al. (2016) have used the 2-year and 10-year nominal government bond yields of 12 countries to estimate the response of local government bond yields to the US monetary policy shocks during the periods from Feb. 6, 1992 to Nov. 24, 2008, and from Nov. 25, 2008 to Apr. 30, 2014. They found changes in the interest rate pass-through to emerging market economies but the changes do not have a clear direction. The magnitude of the response increases in Brazil, Mexico and Thailand but decreases in Singapore. The study did not examine the effect of exchange rate regimes on the interest rate pass-through under the unconventional monetary policy. Curcuru et al. (2018) have estimated the 10-year government bond yield pass-through from the US to 3 advanced economies and 3 emerging market economies from Jan. 2002 to Dec. 2017. Their results show an increase in the pass-through to Germany, U.K., Korea, Mexico and Brazil and a slight decrease in the response of Canada. Albagli et al. (2019) have found the 2- and 10-year interest rate pass-through declines to developed economies and increases to emerging market economies from the pre-Oct. 2008 period to the post-Oct. 2008 period. Miyajima et al. (2014) have estimated the responses of domestic short- and long-term interest rates to changes in the US 10-year bond yield using the monthly data of five Asian economies for two periods between Jan. 2003 and Dec. 2007 and between Jun. 2009 and Dec. 2013. Their estimates show a positive and more persistent response in the post-GFC period than that prior to the GFC.

The past work shows unclear direction of changes in the interest rate pass-through before and after the GFC. It is attributed to the absence of exchange rate regime variable in the models. This study estimates both short- and long-term interest rate pass-through to Hong Kong and finds a decrease in the monetary transmission in the aftermath of the GFC to the small open economy under fixed exchange rates.

Bluedorn and Bowdler (2010) have used the daily and monthly overnight money market rates of 37 countries, including the Eurozone, from 1973 to 2000 to estimate the response of domestic interest rates to unanticipated and exogenous US monetary policy changes versus expected policy changes. They used the market prices of the federal funds futures and calculated a FOMC meeting-based series of unanticipated and exogenous US monetary policy changes and found that the interest rate pass-through is one for one when the policy is unanticipated but less than one when the policy change is expected. As the measurement is based on market expectations, it may underestimate the scope for monetary autonomy that a local monetary authority has with policy rates and sterilization. This study uses the 3-month government bond yields to test for the corner solution and finds that the 3-month interest rate pass-through is less than one for one during the period from 1991 throughout 2023.

Previous literature has shown that domestic interest rates respond to US monetary tightening and easing differently. Han and Wei (2018) have considered the asymmetry exists only under flexible exchange rates. Azad and Serletis (2020) also have shown the asymmetric responses of 6 emerging market economies with inflation targets with a VAR model. Cheng and Rajan (2020) have estimated the asymmetry under different exchange rate regimes and financial openness. They have found that the interest rate pass-through under pegs and no capital controls is one when the US rate rises and 0.87 when the US rate decreases. But the difference has not been tested statistically. This study estimates the interest rate pass-through to Hong Kong in subperiods each of which is identified with a particular US monetary policy and finds that Hong

Kong interest rates do not necessarily respond to the US monetary tightening to a greater extent than to monetary easing.

The following sections summarize the literature with respect to their findings on each of the most important aspects of this dissertation.

Section 3.2 The Interest Rate Pass-Through across Different Exchange Rate Regimes under No Capital Controls

Flexible exchange rates have been questioned regarding their effect on the scope for monetary autonomy under free capital flows. Rey (2015) has observed the correlations of different types of capital flows among different regions all over the world and argued for a "global financial cycle" due to which an economy cannot have monetary autonomy without capital controls no matter what exchange rate regime the economy chooses. The international interest rate pass-through was not estimated by the author for her argument. But there has been previous literature estimating the interest rate pass-through to examine the effect of pegged exchange rates on the loss of monetary autonomy, which are with or against the argument.

Peg vs. Non-Peg

The earlier work has employed a binary classification of exchange rate regimes into pegs and non-pegs and created a dummy variable that takes a value of 0 for non-pegs and 1 for pegs to examine the effect of a pegged exchange rate regime versus a floating exchange rate regime on the international interest rate pass-through. Different models have been constructed with the dummy variable.

Shambaugh (2004) has used the monthly interest rates of 155 countries from 1973 to 2000 and segmented the sample into four subsamples with respect to exchange rate regime and capital controls. The interest rate pass-through is estimated to be 0.67 under pegged exchange rates and 0.56 under non-pegged regime, given no capital controls. The difference between the estimates is not tested but the effect of pegs is examined in another model with the dummy variables of pegs and no capital controls. The coefficient on the dummy variable of pegs is around .3 and statistically significant. However, the effect may be underestimated because the model does not include an interaction term of the dummy variables of pegs and no capital controls. Without the interaction term, the model assumes that the difference in the interest rate pass-through between pegs and non-pegs remains the same between with and no capital controls. An interaction term of the dummy variables is employed to explain the response to base interest rates and the coefficient on the term is 0.45 and statistically significant.

Miniane and Rogers (2007) have used the monthly interest rates of 26 countries from Jan. 1975 to Dec. 1998 and a vector autoregressive (VAR) model to estimate the response of domestic interest rates to the US monetary policy shocks under fixed versus floating exchange rates following the binary classification of exchange rate regimes by Shambaugh (2004). They found that fixers have a greater and more persistent interest rate response to the US monetary policy changes than floaters. As discussed in the last subsection, the VAR model has an endogeneity issue that the domestic and US rates are assumed to be endogenous to each other.

Han and Wei (2018) have used the monthly policy rates and 10-year government bond yields of 28 countries and the US between Jan. 1990 and Jun. 2014 to estimate the interest rate pass-through under fixed versus flexible exchange rates and with versus without capital controls. They found the pass-through is the highest under fixed exchange rates and no capital controls and the pass-through under flexible exchange rates without capital controls is the second highest in the four categories. Although the magnitudes of the interest rate pass-through are different between fixed and flexible exchange rates under no capital controls, the difference has not been tested. Besides, the model have all four dummy variables that identify observations in terms of exchange rate regimes and the existence of capital controls. As there is not a category excluded from the specification, there is multicollinearity issue in the estimation.

In contrast to the literature that has found evidence that substantiates the effect of pegged exchange rates on the loss of monetary autonomy, Hofmann and Takats (2015) have used the short- and long-term interest rates of 30 emerging market and small advanced economies from the first quarter of 2000 to the fourth quarter of 2014 and found significant but less than one for one interest rate spillovers from the US to the economies under non-pegged exchange rates. The effect of pegs which is examined with an interaction term of a dummy variable of peg and the US interest rate is not statistically significant. The degree of capital controls is not controlled for in the estimation, which can make the spillover underestimated.

Obstfeld (2015) has used the 3-month and 10-year government bond yields of 34 countries between the third quarter of 1989 and the fourth quarter of 2013 and estimated the short- and long-run interest rate pass-through with developed and developing economy subsamples. An interaction term of the dummy variable of pegs and the US interest rate is employed to examine the effectiveness of pegs on the interest rate pass-through. The author found that the coefficients on the US rate and the interaction term are not significant for developing countries but significant for advanced economies. Similar with Hofmann and Takats (2015), capital controls are not controlled for in the work.

Previous literature has found inconclusive evidence on the effect of exchange rate flexibility on the scope for monetary autonomy with the binary classification of exchange rate regimes. The classification does not measure the exchange rate flexibility precisely and may bias the results as both hard and soft pegs are classified into the category of pegs. In that case, the interest rate pass-through can be overestimated and the loss of monetary autonomy is overstated under a soft peg.

This problem has been addressed by earlier work creating an additional category for soft pegs to the binary classification of exchange rate regimes.

Hard Peg vs. Soft Peg

In the comparison between hard and soft pegs, previous literature has presented inconclusive evidence.

The first strand of literature has found that managed floating limits the scope for monetary autonomy as strictly as hard pegs. Frankel et al. (2004) have estimated the 90-day interest rate pass-through from the US or Germany to 46 countries under fixed versus intermediate regimes by decade from Jan. 1970 to Mar. 1999. They found that the US T-bill rate pass-through to developing countries in 1990s is statistically equal to one regardless of exchange rate regimes. Besides, the authors have estimated the pass-through to individual economies. They found both Hong Kong under a fixed regime and Singapore with an intermediate regime have statistically unity level interest rate relationship with the US in the 1990s. On the other hand, Frankel et al. (2004) have estimated that the local interest rate responsiveness to US T-bill rate is statistically equal to one but less than one under intermediate regimes. As explained in the earlier subsection, the level interest rate relationship can overestimate the interest rate pass-through.

The second strand of literature has found significant differences in the interest rate pass-through between hard and soft pegs. Obstfeld and Taylor (2004) and Obstfeld, Shambaugh, and Taylor (2005) have estimated the interest rate pass-through to multiple countries under gold standard, the Bretton Woods system, and in the post-Bretton Woods period. They found the average interest rate pass-through in the post-Bretton Woods period is 0.68 under occasional pegs and 0.93 under pegs. But the authors have not tested difference in the pass-through between pegs and occasional pegs.

Ricci and Shi (2016) have estimated the policy rate pass-through is 0.799 under pure peg to the US and 0.1867 under mixed exchange rate regimes. Both are statistically significant. But there is no evidence for open financial accounts since capital controls are not controlled in their work.

Georgiadis and Zhu (2019)[5] estimated that the interest rate pass-through under limited exchange rate flexibility and capital controls is 0.76. And Klein and Shambaugh (2015) have estimated that the interest rate pass-through under soft pegs is 0.32 and significantly lower than pegs by 0.19.

The past work shows the distinct scope for monetary autonomy under intermediate regimes from that under pegs or non-pegs, but the estimates are divergent. The divergence could be accounted for by the different exchange rate classifications employed by the previous literature to distinguish pegs, soft pegs, and free floats.

The measure of exchange rate flexibility has been developed by Ahmed (2021), finding the coexistence of significant and insignificant interest rate pass-through under intermediate regimes by constructing an index of peg intensities with six categories[6]. The author has estimated the interest rate pass-through in each category and found that the US monetary shocks statistically significantly impact the interest rates of countries with peg intensities of 0.7 or higher but do not significantly impact countries with peg intensities of .5 or less. In the subsample of advanced economies, the interest rate pass-through remains statistically significant except with the peg intensity of .3. In contrast to advanced economies, emerging market economies are unaffected by US monetary shocks except those with peg intensities of .9 and 1.

The earlier work has provided inconclusive evidence on the scope for monetary autonomy with an exchange rate regime on the middle ground. The models used by the previous literature have

[5] Georgiadis and Zhu (2019) have used the monthly data of 47 countries from Jan. 2002 to Dec. 2018 which excludes the global financial crisis period from Jul. 2007 to Dec. 2009.
[6] Ahmed (2021) has classified observations into six categories with respect to peg intensity and assign a value range to each category. A value between 0 (free floats) and 1 (hard pegs) indicates an intermediate regime.

assumed that exchange rate flexibility remains constant under an exchange rate regime or that the exchange rate stability (the variation in spot exchange rates) is equivalent to the peg intensity.

This study, however, finds that given a managed floating exchange rate regime/crawling band, the degree of exchange rate flexibility is low when the currency is under depreciation pressure and foreign exchange interventions (FXIs) are intensive. It is high when there is no depreciation pressure on local currency and foreign exchange interventions are not intensive. The scopes for monetary autonomy under intermediate regimes can change as the intensity of foreign exchange interventions changes. Earlier literature has not captured the effect of FXIs on the interest rate pass-through.

The third strand of literature has found no loss of monetary autonomy under the intermediate regimes. Shambaugh (2004)[7] have found that occasional pegs have a lower interest rate relationship with the US interest rate than pegged and non-pegs. Klein and Shambaugh (2015)[8] have found that the influence of changes in base interest rates is not statistically significant on the interest rates of emerging market economies with soft pegs. Ahmed (2021)[9] have found that the monetary spillover from the US to emerging market economies is not statistically significant. These empirical results show that countries do not lose any monetary autonomy with managed floats and open financial accounts.

The past work used panel data from multiple countries with different measures on international capital transactions.

[7] Shambagugh (2004) has used the error correction model and the monthly data of 155 countries from 1973 to 2000.
[8] Klein and Shambaugh (2015) have used the least square model and the sample of 44 countries during the period from 1973 throughout 2011.
[9] Ahmed (2021) have used the quarterly data of 46 countries between 2000Q1 and 2018Q4.

Case Studies

Goh and McNown (2015)[10] have found no integration between Malaysia and the US interest rates in the managed floating eras, suggesting no loss of monetary autonomy in the long run under managed floating.

Keil et al. (2004) have investigated the interest rate pass-through from the US to Korea before and after Asian Financial Crisis (AFC) and found that the pass-through is 1.736 prior to the AFC with a pegged exchange rate regime and 0.179 in the post-AFC period with a floating regime. Capital mobility in the cases of Malaysia and Korea is generally thought to be not so high as for Hong Kong and Singapore, which can underestimate the difference in the interest rate pass-through between a hard peg and a managed floating.

This study focuses on Singapore with no significant capital controls and finds that the interest rate pass-through is statistically significant from the US to Singapore. It suggests that the interest rate of Singapore is affected by changes in the US monetary policy. The small open economy does not have complete monetary independence under managed floating exchange rates.

[10] Goh and McKnown (2015) have investigated the case of Malaysia from Jan. 1991 to Nov. 2012.

Hong Kong vs. Singapore

The VAR Model

Previous literature that estimated the impulse responses of Hong Kong and Singapore to the US monetary shocks with VAR models has found that both economies respond to the foreign monetary shocks and Hong Kong has a greater and more persistent response than Singapore.

Borensztein (2001) has found that the response of Hong Kong is three times larger than that of Singapore to US monetary shocks. The response is 0.2-0.4 bps and later rises to 0.6 for a 1bp shock in the case of Singapore but it is unity and later rises to 1.5 in the case of Hong Kong.

Bowman et al. (2015) have investigated 10-year sovereign bond yields between Jan. 2006 and Dec. 2013 and found that in response to a 25-bp decrease in the US 10-year yield, Hong Kong lowers its interest rates by 13 bps after around 45 days and Singapore interest rates decline by 9 bps after 90 days. This is equivalent to a passthrough coefficient of .54 for HK and .36 for Singapore.

Fong et al. (2015) have estimated that the interest rate pass-through is 0.74 to Hong Kong and 0.46 to Singapore. Caceres et al. (2016a) have estimated that Hong Kong short-run interest rate rises by 65 bps in response to a 100-bp rise in the federal funds rate, and Singapore short-run rate rises by 46 bps in response to the same shock. The interest rate pass-through for long term assets is higher than pass through for short term assets. The long-term interest rate pass-through is estimated to be 1.05 to Hong Kong and 0.74 to Singapore.

The Least Squares Model

Valente (2009) has estimated the interest rate response of Hong Kong and Singapore to the US monetary policy announcements using 3-month, 1-, 5-, and 10-year government debt security yields between Oct. 1996 and Jun. 2004. The results show that the pass-through is higher to Hong Kong than that to Singapore, and the short-run rate pass-through is higher than the long-run interest rate pass-through. This study extends the sample coverage and includes the period after the 2008 Global Financial Crisis. We find that in contrast to the previous literature, the interest rate pass-through increases as the maturity increases.

Takats and Vela (2014) have estimated the policy rate pass-through from the US to Singapore is 0.49 during the period from the first quarter of 2000 throughout the third quarter of 2013 and 0.05 for the period from the first quarter of 2008 to the third quarter of 2013. The latter is estimated with the US shadow rate. The long-term interest rate pass-through is 1.28 to Hong Kong and 0.67 to Singapore from Jan. 2000 to Sep. 2013 and declines in the post-GFC period. The long-term pass-through is 0.88 to Hong Kong and 0.58 to Singapore between Jan. 2008 and Sep. 2013. All estimated pass-throughs are statistically significant. This study, however, finds that Singapore does not have a policy rate but carries an exchange-rate-centered monetary policy framework that have domestic interest rates adjusted to foreign rates through managing a policy band for the Singapore dollar nominal effective exchange rate (S$NEER). Thus, we use the government bond yields to estimate the interest rate pass-through to Singapore instead of policy rates.

The case studies of the offset and sterilization coefficients are reviewed in the following subsections.

Section 3.3 The Offset Coefficients under Free Capital Flows

Previous literature has estimated the offset coefficient for economies without major capital controls. Gilal et al. (2016) have investigated the case of Pakistan from Jan. 1982 to Dec. 2013 and estimated that the offset coefficient of Pakistan is -0.8155. The authors argued for perfect asset substitutability with the estimate.

Akikina and AI-Hohan (2003) have studied the case of Saudi Arabia without capital controls during the period between 1960 and 1994 and estimated that the offset coefficient of Saudi Arabia is -1.22 and statistically equal to -1.

Trinh (2018), Ouyang et al. (2008) and Ouyang and Rajan (2011) also have found that the offset coefficients are almost -1 in the cases of Vietnam, Taiwan, and Singapore, respectively, but they argued that the capital mobility is not perfect.

The estimates for perfect capital mobility are biased due to an endogeneity issue. The net domestic assets, which are the independent variable, are endogenous to the net foreign assets, which are the dependent variable, in a reduced-form capital flow equation. Previous literature has pointed out the issue and addressed it by using the two-stage-least-square (2SLS) approach. The offset coefficient is estimated with the sterilization coefficient in simultaneous equations. However, the estimates of the offset coefficient from the 2SLS model can be biased as instrumental variables seem not to fix the endogeneity issue perfectly. For instance, one of the instrumental variables that have been commonly used in the estimation of the offset coefficient is the net domestic assets for the last period. The instrumental variable can be endogenous to expectations on the net foreign assets for the current period and thus make the offset coefficient overestimated. Therefore, this study uses both interest rate pass-through and the offset coefficient to measure the capital mobility in Hong Kong and finds that although the capital mobility is not perfect, the offset coefficient is close to one. The coefficient does not measure the degree of capital mobility precisely.

Section 3.4 The Sterilization Coefficients under Free Capital Flows

General Models

There have been three models constructed by previous literature to estimate the sterilization coefficient. The first model is the reduced-form approach which estimates the sterilization coefficient with the capital flows equation. The approach has been used by Herring and Marston (1977), Obstfeld (1983), Kwack (2001), Cavoli and Rajan (2006), Aizenman and Glick (2009), Khemraj and Pasha (2011), and Hassan et al. (2013). As discussed in Chapter 2, there is an endogeneity issue in this approach. The second model is the simultaneous equations which estimate the offset and sterilization coefficients with the 2SLS or 3SLS approach. The model has been discussed by Roubini (1988) and Brismiss et al. (2001) on the loss function of central banks. This study employs the second model and modifies the loss function for a monetary authority under pegged exchange rates based on reviews on the previous literature. Our review is shown in the chapter of methodology. The last model is the VAR model. It has been employed by Cavoli and Rajan (2006).

Under Fixed Exchange Rates

Earlier literature has estimated the sterilization coefficient for economies under fixed exchange rate regimes and without major capital controls. Gilal et al. (2016) and Akikina and AI-Hohan (2003) have found sterilization at a low level with high capital mobility in Pakistan and Saudi Arabia but Khemraj and Pasha (2011) and Hassan et al. (2013) found intensive sterilization in Caribbean economies and Gulf Corporation Council (GCC) countries without capital controls.

Under Managed Floating Rates

Past work has investigated Singapore regarding sterilization. Ouyang, Rajan, and Willett (2008) have modified the BGT model by taking money multipliers into account and used the panel data of eight Asian economies for the period between the first quarter of 1990 and the third quarter of 2005 during which the crisis period from the second quarter of 1997 to the that of 1998 is excluded. The authors estimated that with the assumption of perfect foresight, the sterilization coefficient is -0.796 for the pre-crisis period and -0.601 for the post-crisis period; for static expectations, the sterilization coefficient is -0.838 for the pre-crisis period and -0.514 for the post-crisis period. The sterilization coefficient of each individual economy was not estimated.

There has been previous literature focusing on case studies of Singapore with respect to sterilization (Kwack, 2001; Aizenman and Glick, 2009; Ouyang and Rajan, 2011; Cavoli and Rajan, 2015 & 2017). They have found almost full sterilization in the case of Singapore in the 1990s or earlier and the first decade of 2000s. This study extends the sample coverage to 2021 and the sterilization after the 2008 Global Financial Crisis is investigated.

Overall Summary

There is considerable previous literature relevant to various aspects of the monetary trilemma. They use a range of methodologies and samples. The results tend to differ considerably resulting from differences in samples, methodologies and whether exchange rate regimes and capital controls are included and, when they are, how they are measured.

Given the difficulties in getting good classifications for exchange rate regimes this dissertation has chosen to focus on two countries that have absence of significant capital controls and their exchange rate regimes are clear cut to test some important aspects of the international monetary trilemma.

Appendix

Table 3.1 Details of the Least Squares Model Literature (Relevant Variables to the Review)

Author(s)	Country(s)/Frequency & Sample Coverage	Interest Rates	Other Variables
Frankel et al. (2004)	46 countries (18 industrial and 28 developing) and the U.S. M[11]: 1970M1-1999M3	90-day money market rates and U.S./German 90-day T-bill rate	Inflation rate
Keil et al. (2004)	Korea M: 1990M1-2003M6	Money market rate	
Obstfeld and Taylor (2004)	15 countries[12] Y: 1870-2000	Short-term interest rates	Dummy: Peg
Shambaugh (2004)	155 countries M: 1973-2000	Money market (overnight) or (3-month) Treasury bill rates	Dummy: Peg
Di Giovanni and Shambaugh (2008)	152 countries 1973-2002		Base GDP growth; Inflation; Dummy: peg
Valente (2009)	Hong Kong, Singapore, and the US M: 1994M2-2004M6	3-month, 1-, 5-, and 10-year sovereign bond yields	
Bluedorn and Bowdler (2010)	37 countries (including the Eurozone) M and D: 1973:M2-2000:M12	Overnight money market rate	Dummy: peg
Takats and Vela (2014)	20 EME countries Q: 2000Q1-2013Q3	Policy rates; long-term rates	Inflation rate; output gap
Hofmann and Takats (2015)	22 emerging market economies and 8 smaller open advanced economies Q: 2000Q1-2014Q4	Policy rate; three-month interbank rate; and 10-year government bond yield	VIX; domestic and U.S. macroeconomic variables: year-on-year inflation and real GDP growth; Dummy: peg
Klein and Shambaugh (2015)	44 countries, consistent with Klein (2012) Y: 1973-2011		Output growth; Inflation; Dummy: peg
Obstfeld (2015)	34 countries Q: 1989Q3-2013Q4	Three-month Treasury bill rates and 10-year government bond yields	VIX; Dummy: peg

[11] D denotes "Daily"; M indicates "Monthly"; Q stands for "Quarterly"; And Y represents "Yearly".
[12] They are Austria, Belgium, Denmark, France, Germany, India, Italy, Netherlands, Norway, Portugal, Russia, Spain, Sweden, Switzerland, and the United States.

Gilchrist et al. (2016)	12 countries[13] D: Feb. 6, 1992 – Apr. 30, 2014 (143 FOMC announcements)	Federal Funds Rate; market interest rates; 2- and 10-year bond yields	
Ricci and Shi (2016)	Advanced and emerging market economies M: not found	Policy rate; 3-month, 2-year, and 10-year government bond yields; interbank rates; bank deposit and lending rates	VIX; inflation
Curcuru et al. (2018)	Germany, Canada, UK, Korea, Mexico and Brazil D: 2002M1-2017M12	10-year government bond yields	
Han and Wei (2018)	28 countries and the US M: 1990M1-2014M6	Policy rate; 10-year bond yields	GDP growth; Inflation; VIX
Albagli et al. (2019)	12 developed countries and 12 emerging market economies[14] M: 2003M1-2016M12	2- and 10-year Treasury yields	

Table 3.2 Details of Results in the Least Squares Model Literature (Relevant Results to the Review)

Author(s)	LR/SR (interest rates)	Pre-crisis/post-crisis	AE/EME	Pegs/non-pegs	Open/closed financial accounts	Results
Frankel et al. (2004)	SR		Both	Both		-0.52—1.26
Keil et al. (2004)	SR	Both		Both		0.179—1.736
Obstfeld and Taylor (2004)	SR			All	Both	-0.05—0.61
Shambaugh (2004)	SR		Both	All	All	0.27—0.67
Di Giovanni and Shambaugh (2008)				Both		0.172—0.4

[13] They are six advanced countries, Australia, Canada, Germany, Italy, Japan, the United Kingdom, and six emerging market economies, Brazil, India, South Korea, Mexico, Singapore, and Thailand.
[14] The developed economy (DEV) sample includes Australia, Canada, Czech Republic, France, Germany, Italy, Japan, New Zealand, Norway, Sweden, Switzerland, and the UK. The emerging market economy (EME) sample includes Chile, Colombia, Hungary, India, Indonesia, Israel, Mexico, Poland, South Africa, South Korea, Taiwan, and Thailand.

Valente (2009)	Both					0.162—0.657
Bluedorn and Bowdler (2010)	SR			Both		0.08—0.78
Takats and Vela (2014)	Both	Full/post-crisis	EME			-0.84—1.52
Hofmann and Takats (2015)	Both			Both		0.34—0.59
Klein and Shambaugh (2015)			Both	All	All	0.18—0.94
Obstfeld (2015)	Both		Both	Both		0.26—0.938
Gilchrist et al. (2016)	Both	Both	Both			0.364—1.733
Ricci and Shi (2016)	SR			Both	Both	0.1363—0.799
Curcuru et al. (2018)	LR	Both	Both			0.156—0.692
Han and Wei (2018)	Both			Both	Both	0.251—0.796
Albagli et al. (2019)		Both	Both			0.1—0.318

Table 3.3 Details of the ECM Literature (Relevant Variables to the Review)

Author(s)	Country(s)/Frequency & Sample Coverage	Interest Rates	Other Variables
Frankel et al. (2004)	46 countries (18 industrial and 28 developing) and the U.S. M: 1970M1-1999M3	90-day money market rates and U.S./German 90-day T-bill rate	Inflation rate
Keil et al. (2004)	Korea M: 1990M1-2003M6	Money market rate	
Obstfeld and Taylor (2004)	15 countries[15] Y: 1870-2000	Short-term interest rates	Dummy: Peg
Shambaugh (2004)	155 countries M: 1973-2000	Money market (overnight) or (3-month) Treasury bill rates	Dummy: Peg

[15] They are Austria, Belgium, Denmark, France, Germany, India, Italy, Netherlands, Norway, Portugal, Russia, Spain, Sweden, Switzerland, and the United States.

Edwards (2015)	Chile, Colombia, and Mexico M: 2000M1-2008M6	Policy rate (level, change)	Inflation variables; Exchange rate expectation; global perceptions of country risk
Goh and McNown (2015)	Malaysia M: 1991M1-2012M11	The US Federal Funds rate and Malaysian interbank rates	
Ricci and Shi (2016)	Advanced and emerging market economies M: not found	Policy rate; 3-month, 2-year, and 10-year government bond yields; interbank rates; bank deposit and lending rates	VIX; inflation

Table 3.4 Details of Results in the ECM Literature (Relevant Results to the Review)

Author(s)	LR/SR (interest rates)	Pre-crisis/post-crisis	Pegs/non-pegs	Open/closed financial accounts	Level relationship	Adjustment Coefficient
Frankel et al. (2004)	SR		All		0.72—24.5	0.05[16]—0.78
Keil et al. (2004)	SR	Post-crisis			0.236	-0.241
Obstfeld and Taylor (2004)	SR		Both		-1.15—1.1	-0.7-- -0.03
Shambaugh (2004)	SR		All	All	-1.65—1.36	-0.26-- -0.05
Edwards (2015)	SR				0.32—0.74	
Goh and McNown (2015)	SR		Pegs	Open	-0.44	-0.62
Ricci and Shi (2016)	SR					-0.05

[16] Although the adjustment coefficient is supposed to be negative, Frankel et al. (2004) report positive values of the coefficients.

Table 3.5 Details of the VAR Model Literature (Relevant Variables to the Review)

Author(s)	Country(s)/Frequency & Sample Coverage	(Local) Interest Rates	Endogenous Variables	Foreign Factors
Borensztein (2001)	8 economies[17] D and M: 1994-2000	3-month T-bill rate, interbank rate, bank bill rate, Pre-1 rate, deposit rate, and CETES rate.	Domestic interest rates, Emerging Market Bond Index (EMBI), log of the exchange rate	U.S. monetary policy (the US federal funds futures rates or 90-day Treasury Bill rate)
Canova (2005)	8 Latin American countries[18] Q: 1990:Q1-2002:Q4	90-day market rates (or lending/deposit 90-180-day rates)	Output, inflation, trade, competitiveness, interest rate variables	U.S. monetary policy, index of world commodity prices, EMBI, EMEI
Miniane and Rogers (2007)	26 countries[19] M: 1975M1-1998M12	Domestic interest rates	Price, output, interest rate, exchange rate, and reserve variables	US monetary policy shocks
Moreno (2008)	10 countries[20] D: 2001:01:01-2006:09:30	Short-term (overnight or interbank) rates and 1-, 3-, 5- and 10-year rates	Domestic long- and short-term rates	Foreign (U.S.) rate of similar maturity
Jain-Chandra and Unsal (2014)	8 emerging Asian economies[21] M: 2000:M1-2010:M11	3-month, 1-year, and 10-year government bond yields	Output, inflation, exchange rate, capital flows variables	The 10-year US Treasury yield, VIX, foreign demand

[17] Countries studied in Borensztein (2001) include three industrialized countries: Australia, Canada, New Zealand, emerging market economies: Hong Kong, Singapore, Argentina, Mexico, and South Africa.
[18] Canova (2005) investigates the international monetary transmission in Mexico, Argentina, Brazil, Peru, Uruguay, Chile, Ecuador, and Panama.
[19] These countries are Australia, Austria, Belgium, Canada, Chile, Colombia, Denmark, Finland, France, Germany, Greece, India, Italy, Japan, Korea, Malaysia, Mexico, The Netherlands, Norway, The Philippines, Portugal, South Africa, Spain, Sweden, Turkey, and the United Kingdom.
[20] Moreno (2008) studies international monetary transmission in India, Korea, Malaysia, Philippines, Thailand, Brazil, Mexico, Czech Republic, Hungary, and Poland.
[21] The countries studied in Jain-Chandra and Unsal (2014) include China, India, Indonesia, Korea, Malaysia, the Philippines, Taiwan Province of China, and Thailand.

Miyajima et al. (2014)	5 small open Asian economies[22] M: 2003M1-2007M12 and 2009M6-2013M12	Domestic overnight and 5-year bond yield	Output, inflation, and domestic interest rates variables	The US 10-year Treasury yield
Bowman et al. (2015)	17 Emerging Market Economies (EMEs)[23] M: 2006M1-2013M12	10-year sovereign bond yields	Sovereign bond yields, exchange rates, and headline stock indexes	US monetary policy shocks
Fong et al. (2015)	11 largest Asia-Pacific economies[24] M: 2004M10-2014M2	10-year local sovereign bond yields	The domestic 3-month interbank interest rate, the 5-year domestic sovereign CDS spread, the risk reversal of the US dollar against the local currency	The 10-year US Treasury yield
Caceres, Carriere-Swallow, Demir, et al. (2016) a	43 emerging and advanced countries[25] M: 2000M1-2015M10	The short-term and long-term government bond yields in local currency	Domestic interest rates in the small open economies	The US federal funds rate or 10-year Treasury bond yield, VIX
Caceres, Carriere-Swallow and Gruss (2016) b	6 advanced small open economies with highly flexible exchange rates[26] and 40 advanced and emerging economies[27]	The 3- and 6-month Treasury bill rates	Domestic interest rates, inflation and output	The US federal funds rate

[22] The countries investigated in Miyajima et al. (2014) include Indonesia, Korea, Malaysia, the Philippines, and Thailand.

[23] The 17 EMEs in the sample of Bowman et al. (2015) include Brazil, China, the Czech Republic, Hong Kong, Hungary, India, Indonesia, Korea, Malaysia, Mexico, the Philippines, Poland, Singapore, South Africa, Taiwan, Thailand, and Turkey.

[24] The 11 Asian economies studied in Fong et al. (2015) include Australia, China, Hong Kong, Indonesia, Japan, Malaysia, New Zealand, the Philippines, Singapore, South Korea, and Thailand.

[25] The 43 economies investigated in Caceres et al. (2016a) include Argentina, Armenia, Australia, Bolivia, Brazil, Bulgaria, Cananda, Chile, China, Colombia, Costa Rica, Croatia, Czech Republic, Denmark, Egypt, Guatemala, Hong Kong SAR, Hungary, India, Indonesia, Israel, Japan, Latvia, Malaysia, Mexico, New Zealand, Nigeria, Norway, Pakistan, Peru, Philippines, Poland, Romania, Russia, Saudi Arabia, Singapore, Slovenia, South Africa, South Korea, Sweden, Switzerland, Taiwan POC, Thailand, Turkey, United Kingdom, and Uruguay.

[26] The six economies studied in Caceres et al. (2016b) include Australia, Canada, New Zealand, South Korea, Sweden and the United Kingdom.

[27] The 40 countries in the sample of Caceres et al. (2016b) for the panel VAR estimation are covered by the sample used in Caceres et al. (2016a) additionally with Vietnam.

	M: 1998M1-2009M6			
Belke et al. (2018)	12 economies[28] D: 2003:05:14-2016:09:02	10-year government bond yields	Logs of daily VIX (CBOE Volatility Index) and oil prices	Long-term interest rates in core countries
Azad and Serletis (2020)	12 emerging economies[29] M: 1994M2-2018:M4	Monetary policy rates	The policy rate of the emerging economy	The monetary policy rate in the United States and the logged change in the exchange rate of the emerging economy

Table 3.6 Details of Results in the VAR Model Literature (Relevant Results to the Review)

Author(s)	LR/SR (interest rates)	Pre-crisis/post-crisis	AE/EME	Pegs/non-pegs	Open/closed financial accounts	Results
Borensztein (2001)	SR		Both			0.2—1.5 bps/1 bp change in the base rate
Canova (2005)	SR					5% -- 68% of variability in domestic rates explained by the U.S. shocks
Miniane and Rogers (2007)				Both	Both	5 – 20 bps/25 bps increase in the US rate
Moreno (2008)	LR		EME			-5 – 5 (units and shocks unknown)
Jain-Chandra and Unsal (2014)	LR		EME			Contemporaneous correlation: 0.65 Variance explained: 10%--70%

[28] Belke et al. (2018) study the international monetary transmission from three base countries, the United States, the euro area, and Japan, to nine Asian economies, Indonesia, Korea, the Philippines, India, China, Thailand, Taipei China, Malaysia, and Hong Kong China.

[29] The twelve economies investigated in Azad and Serletis (2020) include the countries with inflation targeting: Brazil, Chile, Mexico, Romania, Serbia, and South Africa and other 6 countries with exchange rate targets: Herzegovina, Bulgaria, Comoros, Croatia, the Former Yugoslav Republic of Macedonia, and Montenegro.

Miyajima et al. (2014)	LR	Both				-0.2%--0.4%/1% point increase in U.S. 10-year bond yield
Bowman et al. (2015)	LR		EME			14 bps—19 bps/25 bps decrease in the U.S. 10-year yield
Fong et al. (2015)	LR					-0.5—1.5 (units unknown)
Caceres et al. (2016a)	Both		Both			0.05—2.31 bps/ 1 bp change in the U.S. rate
Caceres et al. (2016b)	SR			Both		20-60 bps/100 bps increase in the U.S. policy rate.
Belke et al. (2018)	LR					0.03%--34.94%
Azad and Serletis (2020)	SR		EME			-15%--15% (units and impulse unknown)

Table 3.7 Previous Literature on the Sterilization Coefficient

Author(s)	Country(s) Frequency & Sample Coverage	Model	Variables	Objective Functions	Offset Coefficient (on d.NDA) Capital Flow Equation	Sterilization Coefficient (on d.NFA) Monetary Policy Reaction Function
Wang et al. (2019)	China M: 2000M1—2017M12	BGT, Ouyang	Table 3	P5/19	Tables 6—7 -0.188—-.222	Tables 6—7 -0.813—-1.054
Trinh (2018)	Vietnam Q: 2000Q3—2014Q4	Ouyang and Rajan (2011)	P10/21 Eq. 3-4 Table 4		Table 6 -0.903	Table 6 -0.775
Lim and Goh (2016)	Malaysia M: 1991M1—2009M12	BGT, Ouyang	Eq. 4 and 5 P9/18 Appendix 1	Eq. 3a P5/18	Table 2 -0.5583	Table 3 -0.7794

Ouyang and Rajan (2011)	Singapore and Taiwan Q: 1990Q1—2008Q4	BGT, 2SLS, 3SLS	Eq. 2a and 2b Table 1	A1 P17/18	Tables 3 and 4 -0.922—-0.861	Tables 3 and 4 -1.09—-1.049
Ouyang et al. (2010)	China M: 2000M6—2008M9	Modified BGT	Eq. 4 and 5 Table 1	A1	Tables 4 and 5 -0.721—-0.517	Tables 4 and 5 -1.001—-1.234
Ouyang et al. (2008)	Eight Asian economies[30] Q: 1990Q1—2005:Q3	BGT	Eq. 15 a and b Table 4	Eq. 4	Table 8 -0.838—-0.514	Table 8 -1.265—-0.846
Djedaiet and Ayad (2017)	Algeria M: 2002M1—2016M12	ARDL approach	P7/14 Eq. 6			Table 3 -0.994
Cavoli (2017)	Six Asian economies[31] Q: 1994Q1—2012Q1	Kalman Filter Estimates	Appendix Table	Annex 1: Simple Stylized Model A8		Figure 4 Table 2 0.89—1.02
Gilal et al. (2016)	Pakistan M: 1982M1—2013M12	Cumby and Obstfeld (1981) 2SLS. GMM	Eq. 2 and 3		Table 2 -0.8155—1.632	Table 1 -0.3754—0
Cavoli and Rajan (2015)	Six Asian Economies (same with Cavoli, 2017) 1994-2012					Table 1 0.89—1.02 Figure 3
Hassan et al. (2013)	GCC countries[32] Q: 1990:2—2008:3	Reduced-form approach (using reaction functions of central banks.)	Eq. 6		Estimate interest rate differentials	Tables 3 and 4 -0.96—-0.17

[30] The economies include ASEAN-4 (Indonesia, Malaysia, Philippines, Thailand), India, Korea, Singapore, and Taiwan.
[31] Those countries include Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand.
[32] Those countries are Bahrain, Kuwait, Oman, Oatar, Saudi Arabia and the United Arab Emirates (UAE).

Khemraj and Pasha (2011)	Eight Caribbean economies[33] Q: 1993:Q1—2008:Q2	Reduced-form approach. Huang (1995)	Eq. 1	Table 1 Fixed exchange rate regimes Dual nominal anchors		Table 3 -1.03—-0.16
Aizenman and Glick (2009)	15 countries[34] in Asia and Latin America Q: 1984Q2—2007Q2	Reduced-form approach	Eq. 1 P8/41			Tables 1-2
Cavoli (2007)	Five Asian countries[35] M: 1990:M1—1997M5	VAR Interest rate model OLS, TSLS	Eq. 9		Table 4	Table 3.
Cavoli and Rajan (2006)	Same with Cavoli (2007)	Reduced-form approach, VAR	Eq. 10			Table 4
Akikina and Al-Hoshan (2003)	Saudi Arabia A: 1960-1994	Modified monetary approach to the BoP: DC=BP+…	Eq. 10		-1.22 (-1) (CF=DC…)	-0.31 (DC=BP…)
Kwack (2001)	Seven Asian Countries[36] 1985-1996	Herring and Marston (1977), Obstfeld (1983) Reduced form approach	Eq.s 11-13, Table 2			Table 2 -0.9 or higher

[33] Those countries include The Bahamas, Barbados, Belize, ECCU, Guyana, Jamaica, Suriname, Trinidad and Tobago.
[34] Those countries are China, Korea, Thailand, Malaysia, Singapore, India, Indonesia, Pakistan, and the Philippines in Asia, Argentina, Brazil, Mexico, Chile, Colombia, and Peru in Latin America.
[35] Those countries are Korea, Thailand, Indonesia, Malaysia, Philippines.
[36] Indonesia, Korea, Malaysia, Philippines, Singapore, Thailand, Taiwan.

Chapter 4 Monetary Policy and Exchange Rate Configurations of Hong Kong and Singapore

The monetary policy configurations of Hong Kong and Singapore are discussed in this chapter. Both Hong Kong and Singapore are small open economies and emphasize exchange rate stability. In spite of the similarities, the two economies manage exchange rates differently: Hong Kong chooses a hard peg against the U.S. dollar while Singapore employs a managed floating exchange rate regime. Given the exchange rate policy setting, Hong Kong and Singapore have monetary autonomy in different degrees.

Section 4.1 Economic Backgrounds of Hong Kong and Singapore

Hong Kong and Singapore make up a negligible proportion of the world economy. The GDP of each economy accounts for 0.41% of the world GDP in 2020. The low impact determines that there does not exist a substantial endogeneity issue in the estimation of interest rate pass-through to measure monetary independence for the two economies.

Hong Kong and Singapore have high trade and financial openness. The sum of exports and imports was 360% of GDP for Hong Kong and 338.3% for Singapore in 2021. They do not impose major controls on international capital transactions[37]. Trade and financial liberalization means that the economies are highly affected by external monetary shocks.

[37] According to the IMF Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER), Hong Kong simply applies a stamp duty to foreign residents' purchases of local properties, and Singapore only limits financial credits to nonresidents and imposes stamp duties on foreign residents' purchases of local properties.

The major difference between the two economies is that Singapore has greater domestic products and firms proportion in international trade and finance. The exports of domestic products made up less than 2%[38] of total exports for Hong Kong but 45.56%[39] for Singapore in 2021. Over 80% of the total market capitalization was attributed to foreign companies on the Hong Kong Exchange (HKEX) in 2021[40]. Foreign companies, however, accounted for less than 20% of the total market capitalization on the Singapore Exchange (SGX) in 2021[41]. This difference helps explain why Hong Kong simply focuses on exchange rate stability while Singapore additionally takes inflation stability into account in their monetary policy configurations.

Section 4.2 The Exchange Rate Regimes of Hong Kong and Singapore

The Hong Kong Monetary Authority (HKMA) carries on a Linked Exchange Rate System (LERS) to the U.S. dollar. Under the LERS, the spot exchange rate of Hong Kong dollars is allowed to fluctuate within a very narrow band between HK$7.75/US$ and HK$7.85/US$. If the spot exchange rate reaches the upper or lower limit, the HKMA will intervene in the foreign exchange market. The variation in the spot exchange rate of Hong Kong dollars against U.S. dollars is less than 2% throughout the period from May 2005 to Feb. 2021.

[38] Data source: Trade and Industry Department of the Government of the HK SAR. https://www.tid.gov.hk/english/aboutus/publications/tradestat/rxori.html
[39] Data source: Singapore Department of Statistics. https://www.singstat.gov.sg/find-data/search-by-theme/trade-and-investment/merchandise-trade/latest-data
[40] Data source: HKEX Fact Book 2021.
[41] Data source: SGX Market Statistics Report December 2021.

Figure 4.1 The Spot Exchange Rate of Hong Kong Dollar against US dollar between Dec. 1973 and May 2022

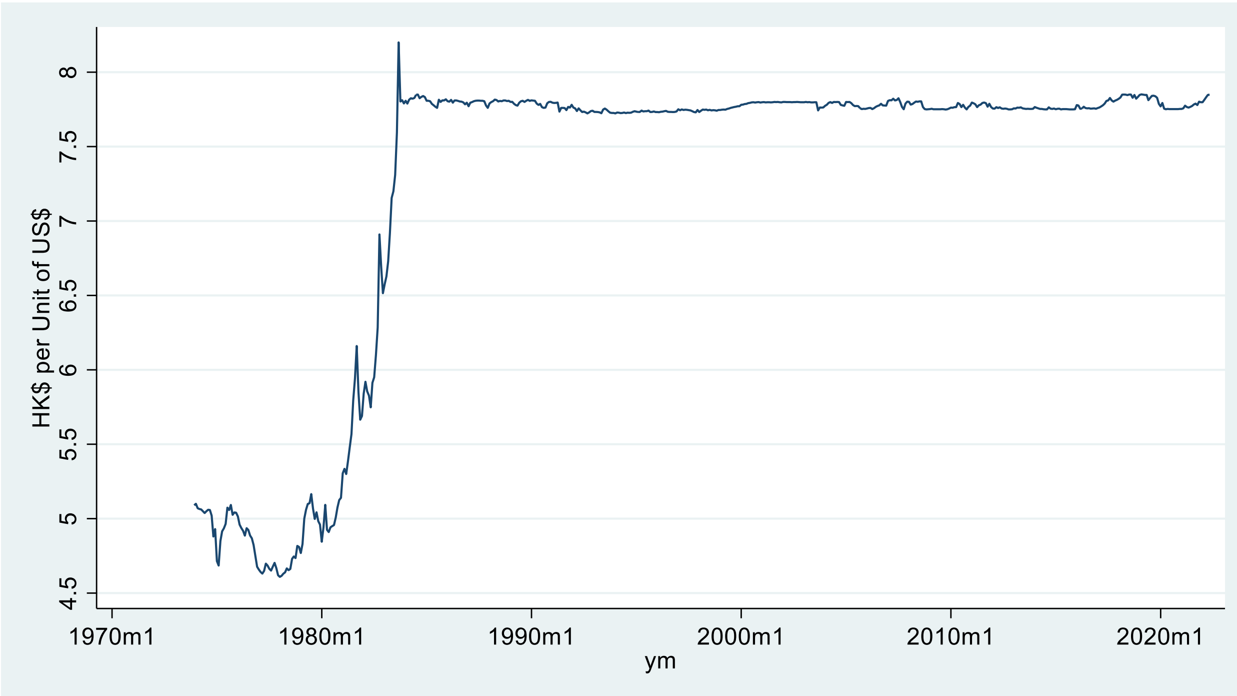
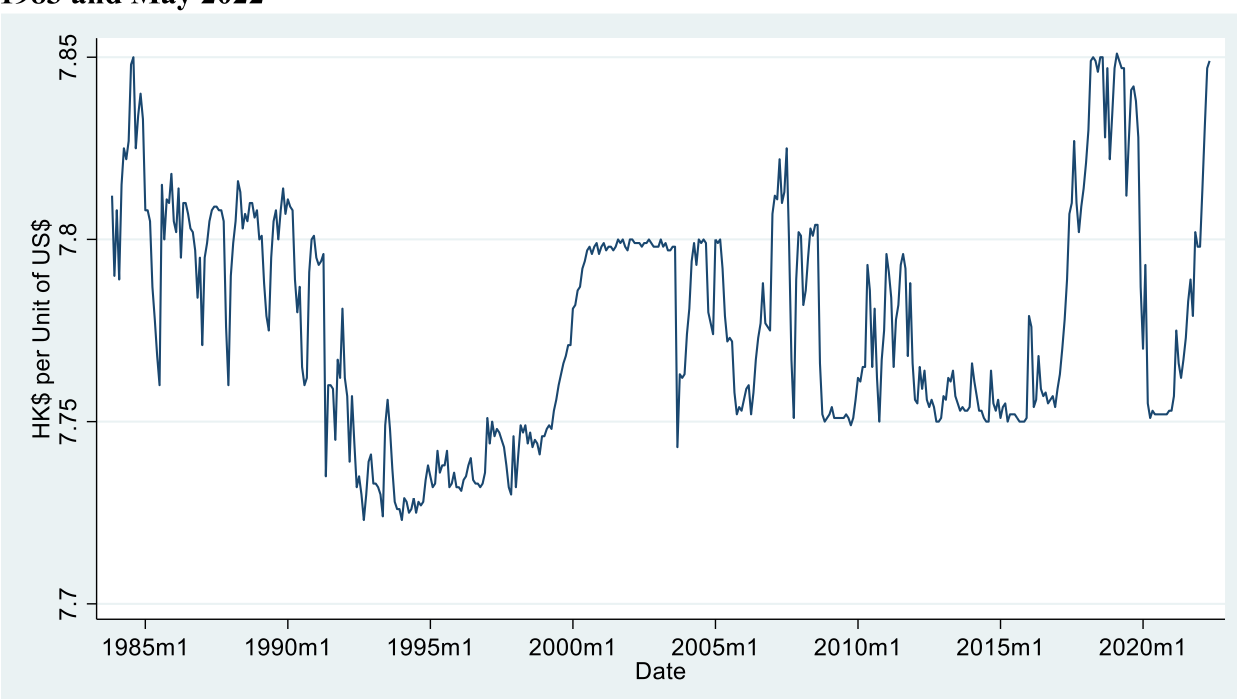


Figure 4.2 The Spot Exchange Rate of Hong Kong Dollar against US dollar between Nov. 1983 and May 2022



The LERS is a type of currency board arrangement. It requires the monetary base of Hong Kong dollars to be fully backed by the U.S. assets. Although there is a minimum requirement on reserves held by the HKMA, it is not required that the monetary base and money supply change one for one with changes in international reserves as is required with a full currency board. The backing ratio of reserve assets to the monetary base is over 100% and varies over time. The outstanding Exchange Funds Bills and Notes, which are debt securities issued by the HKMA, are included in the monetary base, which makes reserve money comprising cash in circulation and bank liquidity change differently from the monetary base.

The Monetary Authority of Singapore (MAS) chooses a managed floating exchange rate regime. The Singapore Dollar Nominal Effective Exchange Rate (S$NEER) is managed against a basket of currencies and moves within a policy band. That is much wider than the narrow band of the Hong Kong fixed rate. The band is reviewed semi-annually. The MAS adjusts the center, slope, and width of the policy band as necessary: when the economic uncertainty increases, the band will be widened; when there is a rapid increase (decrease) in economic growth or an abrupt increase (decrease) in the inflation rate, the band center will rise (drop); and when a tightening (easing) monetary policy is needed, the band will be steeper (flatter). The slope of the band will not be negative. If a devaluation is needed, the MAS will lower the band's center point instead of making it downward sloping. Thus, the managed floating exchange rate regime could be classified as a crawling band. See a summary of announced changes in the policy band setting in appendix.

Figure 4.3 Singapore Dollar Nominal Effective Exchange Rate (S$NEER) (Jan. 1999 = 100)

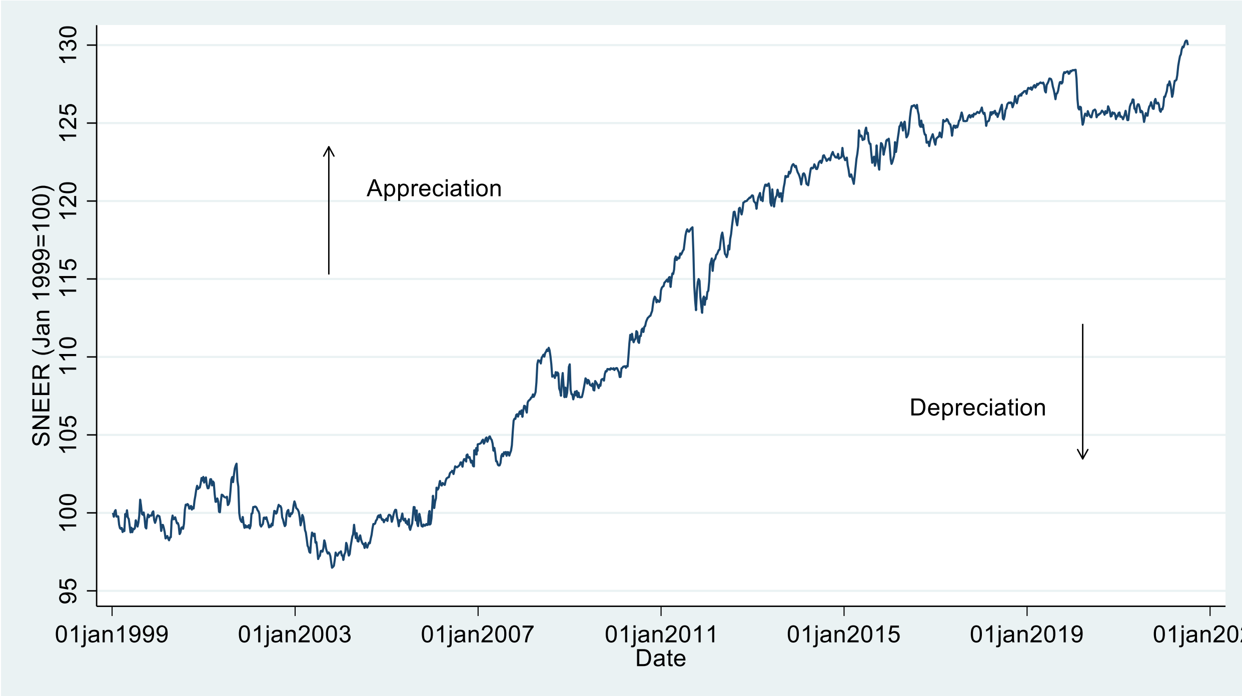
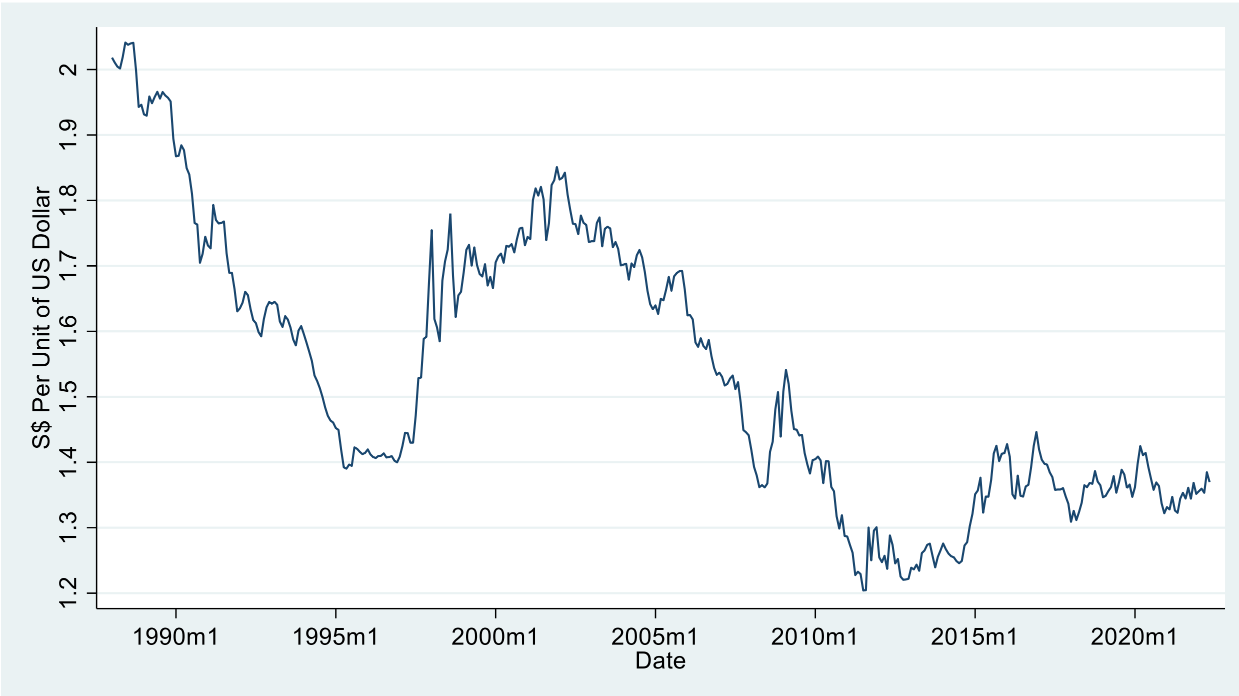


Figure 4.4 The Spot Exchange Rate of Singapore Dollar against US dollar[42]



[42] Monthly data, end of period figure.

The exchange rate regime of Singapore dollars is thus much more flexible than that of Hong Kong dollars. The coefficient of variation in spot exchange rates is 0.21 for Hong Kong and 0.27 for Singapore. The average ratio of percentage change in foreign exchange reserves to percentage change in spot exchange rate is -1.01 for Singapore with the standard deviation of 14.98 while the average ratio is -56.70 with the standard deviation of 438.76 for Hong Kong as calculated with monthly data from Jan. 1997 to Dec. 2022.

Appendix

A. Singapore Exchange Rate Policy Band

Table 4.3 The Exchange-Rate Policy Band Changes over Time (S$NEER, End of Period Figure, Jan. 1999=100)

Date[43]	Slope	Width	Center
Jul. 2001	Horizontal[44] (neutral policy stance, 0% of appreciation)		
Oct. 2001		Wider[45]	
Jan. 2002		Narrower[46]	Dropped to around 99.22.[47] (depreciation)
Jul. 2003			Dropped to 97.04[48]
Apr. 2004	Upward[49]		
Oct. 2007	Steeper and upward sloping[50]		

[43] The earliest Monetary Policy Statement released by the MAS was for Feb. 2001. Before Jul. 2001, the MAS maintained a policy stance of allowing a modest and gradual appreciation. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2001/monetary-policy-statement-22-feb-01

[44] The MAS announced, "MAS has therefore shifted to a neutral exchange rate policy stance, with a policy band centered on a zero percent appreciation of the S$NEER." in the Monetary Policy Statement for Jul. 2001. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2001/monetary-policy-statement-12-jul-01

[45] The MAS announced, "...widen the policy band to allow greater flexibility in managing the exchange rate." in the Monetary Policy Statement for Oct. 2001. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2001/mas-press-statement-on-monetary-policy-10-oct-2001

[46] The MAS announced, "We are also restoring a narrower policy band, as market and economic conditions have become less volatile." in the Monetary Policy Statement for Jan. 2002. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2002/monetary-policy-statement-2-jan-02

[47] The MAS announced, "…[the policy band will be] centered on the current level of the S$NEER." in the Monetary Policy Statement for Jan. 2002. Since there was depreciation pressure on the Singapore dollar in 2001, the center was lowered. The S$NEER was 99.22 on Dec. 28, 2001, which was the last observation of S$NEER released by the MAS before Jan. 2, 2002 on which the monetary policy statement was published. Thus, the center of the policy band is estimated to decrease to around 99.22. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2002/monetary-policy-statement-2-jan-02

[48] The MAS announced, "… re-center the exchange rate policy band at the current level of the S$NEER." in the Monetary Policy Statement for Jul. 2003. Since there was depreciation pressure on the Singapore dollar in the first few months of 2003, the center was lowered at this review. The S$NEER was 97.04 on Jul. 4, 2003 which was the last observation of the S$NEER before Jul. 10, 2003 on which the Monetary Policy Statement was released. Thus, the center of the policy band is estimated to decrease to around 97.04. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2003/monetary-policy-statement-10-jul-03

[49] The MAS announced, "…shifting from a zero percent appreciation path to a policy of modest and gradual appreciation of the S$NEER…" in the Monetary Policy Statement for Apr. 2004. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2004/monetary-policy-statement-12-apr-04

[50] The MAS announced, "…will increase slightly the slope of the S$NEER policy band." in the Monetary Policy Statement for Oct. 2007. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2007/monetary-policy-statement-10-oct-07

Apr. 2008			Rose to 107.75[51]
Oct. 2008	Horizontal [52]		
Apr. 2009			Dropped to 107.43[53]
Apr. 2010	Upward[54]		Rose to 109.39[55]
Oct. 2010	Steeper and upward sloping[56]	Wider[57]	
Apr. 2011			Rose to somewhere below 115.32[58]
Oct. 2011	Flatter and upward sloping[59]		

[51] The MAS announced, "… re-center the exchange rate policy band at the prevailing level of the S$NEER." in the Monetary Policy Statement for Apr. 2008. Since the S$NEER stayed in the upper half of the policy band, the center was raised at this review. The S$NEER was 107.75 on Apr. 4, 2008 which was the last observation of the S$NEER before Apr. 10, 2008 on which the Monetary Policy Statement was released. Thus, the center of the policy band is estimated to increase to around 107.75. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2008/monetary-policy-statement-10-apr-08

[52] The MAS announced, "…is shifting its policy stance to a zero percent appreciation of the S$NEER policy band." in the Monetary Policy Statement for Oct. 2008. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2008/monetary-policy-statement-10-oct-08

[53] The MAS announced, "… re-center the exchange rate policy band to the prevailing level of the S$NEER." in the Monetary Policy Statement for Apr. 2009. Since the S$NEER had stayed in the lower half of the policy band since Oct. 2008, the center was lowered at this review. The S$NEER was 107.43 on Apr. 9, 2009 which was the last observation of the S$NEER before Apr. 14, 2009 on which the Monetary Policy Statement was released. Thus, the center of the policy band is estimated to drop to 107.43. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2009/monetary-policy-statement-14-apr-09

[54] The MAS announced, "…will shift the policy band from that of a zero percent appreciation to one of modest and gradual appreciation." in the Monetary Policy Statement for Apr. 2010. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2010/monetary-policy-statement-14-apr-10

[55] The MAS announced, "… re-center the exchange rate policy band at the prevailing level of the S$NEER." in the Monetary Policy Statement for Apr. 2010. Since the S$NEER stayed in the upper half of the policy band in the past six months before the announcement, the center was raised. The S$NEER was 109.39 on Apr. 9, 2010 which was the last observation of the S$NEER before Apr. 14, 2010 on which the Monetary Policy Statement was released. Thus, the center of the policy band is estimated to increase to around 109.39. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2010/monetary-policy-statement-14-apr-10

[56] The MAS announced, "…the slope of the policy band will be increased slightly..." in the Monetary Policy Statement for Oct. 2010. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2010/monetary-policy-statement-14-oct-10

[57] The MAS announced, "The policy band will at the same time be widened slightly in view of the volatility across international financial markets." in the Monetary Policy Statement for Oct. 2010. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2010/monetary-policy-statement-14-oct-10

[58] The MAS announced, "… re-center the exchange rate policy band upwards. The exchange rate policy band will be re-centered below the prevailing level of the S$NEER." in the Monetary Policy Statement for Apr. 2011. The S$NEER was 115.32 on Apr. 8, 2011 which was the last observation of the S$NEER before Apr. 14, 2011 on which the Monetary Policy Statement was released. Thus, the center of the policy band is estimated to rise to somewhere below 115.32. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2011/monetary-policy-statement-14-apr-11

[59] The MAS announced, "…the slope of the policy band will be reduced..." in the Monetary Policy Statement for Oct. 2011. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2011/monetary-policy-statement-14-oct-11

Apr. 2012	Steeper and upward sloping[60]	Narrower[61]	
Oct. 2015	Flatter and upward sloping[62]		
Apr. 2016	Horizontal[63]		
Apr. 2018	Upward[64]		
Oct. 2019	Flatter and upward sloping[65]		
Apr. 2020	Horizontal [66]		
Oct. 2021	Upward[67]		
Apr. 2022	Steeper and upward sloping[68]		Rose to 128.06[69]
Jul. 2022			Rose to 130[70]

[60] The MAS announced, "The slope will be increased slightly..." in the Monetary Policy Statement for Apr. 2012. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2012/monetary-policy-statement-13-apr-12

[61] The MAS announced, "...restoring a narrower policy band." in the Monetary Policy Statement for Apr. 2012. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2012/monetary-policy-statement-13-apr-12

[62] The MAS announced, "...the rate of appreciation will be reduced slightly." in the Monetary Policy Statement for Oct. 2015. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2015/monetary-policy-statement-14oct15

[63] The MAS announced, "...set the rate of appreciation of the S$NEER policy band at zero percent..." in the Monetary Policy Statement for Apr. 2016. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2016/mas-monetary-policy-statement-14apr16

[64] The MAS announced, "...increase slightly the slope of the S$NEER policy band, from zero percent previously." in the Monetary Policy Statement for Apr. 2018. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2018/mas-monetary-policy-statement-13apr18

[65] The MAS announced, "...reduce slightly the rate of appreciation of the S$NEER policy band." in the Monetary Policy Statement for Oct. 2019. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2019/mas-monetary-policy-statement-14oct19

[66] The MAS announced, "...will adopt a zero percent per annum rate of appreciation of the policy band starting at the prevailing level of the S$NEER." in the Monetary Policy Statement for Apr. 2020. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2020/mas-monetary-policy-statement-30mar20

[67] The MAS announced, "...raise slightly the slope of the S$NEER policy band, from zero percent previously." in the Monetary Policy Statement for Oct. 2021. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2021/mas-monetary-policy-statement-14oct21

[68] The MAS announced, "...increase slightly the rate of appreciation of the policy band to exert a continuing dampening effect on inflation." in the Monetary Policy Statement for Apr. 2022. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2022/mas-monetary-policy-statement-14apr22

[69] The MAS announced, "…further tighten monetary policy… re-center the mid-point of the exchange rate policy band at the prevailing level of the S$NEER." in the Monetary Policy Statement for Apr. 2022. The S$NEER was 128.06 for Apr. 14, 2022 on which the Monetary Policy Statement was released. Thus, the center of the policy band is estimated to rise to around 128.06. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2022/mas-monetary-policy-statement-14apr22

[70] The MAS announced, "… re-center the mid-point of the S$NEER policy band up to its prevailing level." in the Monetary Policy Statement for Jul. 2022. The S$NEER was 130.00 for Jul. 8, 2022 which was the last observation of the S$NEER before Jul. 14, 2022 on which the Monetary Policy Statement was released. Thus, the center of the policy band is estimated to increase to around 130.00. Source: https://www.mas.gov.sg/news/monetary-policy-statements/2022/mas-monetary-policy-statement-14jul22

B. An Analysis of the Monetary Base Elements of Hong Kong Dollars

In the case of Hong Kong, if the change in the monetary base (MB) is dominated by the change in the net foreign assets (NFA) and the change in the net domestic assets (NDA) counters the monetary effect, it suggests partial sterilization. If the NDA changes in the same direction with the NFA and MB, the foreign monetary influence will be amplified in domestic sectors. If the change in the MB is dominated by the change in the NDA, it implies that the monetary authority makes an independent monetary policy from the foreign monetary policy. Table 4 shows the different categories for observations with respect to monetary autonomy.

Table 4.4 Three Categories with Respect to Monetary Autonomy for Hong Kong

		$\Delta MB \times \Delta NDA$	
		< 0	> 0
$\Delta MB \times \Delta NFA$	> 0	Category I: Partial Sterilization	Category II: Foreign Policy Amplifier
	< 0	N.A.	Category III: Independent Monetary Policy

Table 4.5 The Distribution of Periods between Jan. 2000 and May 2022 across three Categories

	$\Delta NFA > 0$	$\Delta NFA < 0$	**Total**
Category I	95	35	130
Category II	36	15	51
Category III	56	44	100

Chapter 5 Methodology

This chapter shows models, data, and variables we use to estimate the interest rate pass-through and the offset and sterilization coefficients.

Section 5.1 Estimation of Interest Rate Pass-Through

The interest rate pass-through is estimated with the least squares model, and the autoregressive distributed lags model.

First-Differenced Regression Model

The least squares model is expressed as follows:

$$\Delta r_t = \alpha_0 + \alpha_1 \Delta r_{us,t} + \varepsilon_t \quad (5.1)$$

where r_t is an economy's interest rate at time t. $r_{us,t}$ is the U.S. counterpart interest rate at time t. Δ indicates the change in a variable from the last period t-1. The coefficient α_1 measures the degree of interest rate pass-through from the U.S. to the economy in the current period. If the coefficient lies between zero and one, it suggests that the domestic interest rate follows the movement of the U.S. counterpart but is not fully adjusted to the U.S. rate.

In addition to the effect of the U.S. rate in the prevailing period, the influence of lagged U.S. interest rates on the domestic interest rate is estimated using the following specification:

$$\Delta r_t = \alpha_0 + \sum_{i=0}^{p} \alpha_{i+1} \Delta r_{us,t-i} + \varepsilon_t \quad (5.2)$$

where p is the lag length of the U.S. interest rate.

If the domestic interest rate is under the influence of the U.S. interest rate from the previous periods, at least one coefficient in $\alpha_2, \dots, \alpha_{t-p}$ is statistically significant.

The interest rate pass-through is estimated with eq. 5.2 for robustness check.

Error Correction Model

The error correction model assumes that there is an equilibrium level relationship between the domestic and U.S. interest rates, and estimates how fast the domestic interest rate is adjusted to the equilibrium. Frankel et al. (2004) have constructed an autoregressive distributed lag (ARDL) model, which is written as follows:

$$r_t = \gamma_0 + \sum_{p=1}^{P+1} \gamma_{1p} r_{t-p} + \sum_{q=0}^{Q+1} \gamma_{2q} r_{us,t-q} + v_t \qquad (5.3)$$

where (P+1) is the lag order of an economy's interest rate and (Q+1) is the lag order of the US interest rate, $P \geq 1\ and\ Q \geq 1$. γ_{2q} measures the long-run level relationship in interest rates between an economy and the US.

Rewriting equation (3) yields the following error correction model:

$$\Delta r_t = \sum_{p=1}^{P} \Upsilon_{1p} \Delta r_{t-p} + \sum_{q=0}^{Q} \Upsilon_{2q} \Delta r_{us,t-q} - \delta\left(r_{t-1} - \theta_0 - \theta_1 r_{us,t-1}\right) + v_t \qquad (5.4)$$

where $\delta = 1 - \sum_{p=1}^{P} \gamma_{1p}$. $\theta_0 = \frac{\gamma_0}{\delta}$ and $\theta_1 = \frac{\sum_{q=1}^{Q} \gamma_{2q}}{\delta}$. δ is the adjustment coefficient measuring the speed of the interest rate relationship deviation in the short run converging to the long-run equilibrium.

In addition, Shin et al. (2014) developed a non-linear ARDL (NARDL) model. The model is employed to examine the effects of the U.S. rate on the domestic rate in upward and downward trends, separately. The specification reads:

$$\Delta r_t = \sum_{p=1}^{P} \Upsilon_{1p} \Delta r_{t-p} + \sum_{q=0}^{Q} (\Upsilon_{2q}^{+\prime} \Delta r_{us,t-q}^{+} + \Upsilon_{2q}^{-\prime} \Delta r_{us,t-q}^{-}) - \delta\left(r_{t-1} - \theta_0 - \theta_1 r_{us,t-1}\right) + v_t \qquad (5.5)$$

Let $\sum_{q=0}^{Q} \Upsilon_{2q}^{+\prime} = \theta^{+}$ and $\sum_{q=0}^{Q} \Upsilon_{2q}^{-\prime} = \theta^{-}$.

Where θ^{+} represents the long-run relation between the domestic rate the US rate in an upward trend and θ^{-} denotes the long-run relation between the domestic rate and the US rate in a downward trend.

We use the NARDL model to estimate the interest rate pass-through for robustness checks.

Data and Variables

Daily and monthly data of interest rates are used to estimate the models presented in equations (1), (2), (4), and (5). Since HK and SGP are one day ahead of the US, the time variable for HK and SGP's daily data is adjusted from "t" to "t-1". The monthly data is the interest rate for the last day with data available in a month. The full sample period from Jun. 10, 1991 to Feb. 26, 2021 is divided into six phases: the pre-AFC, AFC, pre-GFC, GFC, ZLB, and post-ZLB periods. The corresponding time periods to these subsamples are shown in the following table:

Table 5.1 Subperiods for the Estimation of Interest Rate Pass-Through

	Pre-AFC	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
Daily	Jun. 30, 1997 and Before	Jul. 1, 1997—Dec. 31, 1999	Jan. 1, 2000—Jul. 31, 2007	Aug. 1, 2007—Dec. 16, 2008	Dec. 17, 2008—Dec. 16, 2015	Dec. 17, 2015—Feb. 26, 2021
Monthly	Jun. 1997 and before	Jul. 1997—Dec. 1999	Jan. 2000—Jul. 2007	Aug. 2007—Nov. 2008	Dec. 2008—Nov. 2015	Dec. 2015—Feb. 2021

Hong Kong Interest Rates

The interest rate pass-through estimation uses the yields of Exchange Fund Bills and Notes (EFBNs) and Government Bonds of maturities from 1 month to 10 years. The data of the debt securities yields are available in the Monthly Statistical Bulletin of the Hong Kong Monetary Authority. The earliest period with data availability is Jun. 10, 1991, and the sample end period is Feb. 26, 2021. See the interest rates in the following list:

Table 5.2 Hong Kong Interest Rate Variables and Labels

Interest Rate	Label
EFB_30day	30-day Exchange Fund Bill Rate
EFB_91day	91-day Exchange Fund Bill Rate
EFB_182day	182-day Exchange Fund Bill Rate
EFB_364day	364-day Exchange Fund Bill Rate
EFN_2yr	2-year Exchange Fund Note Rate
EFN_3yr	3-year Exchange Fund Note Rate
EFN_5yr	5-year Exchange Fund Note Rate
EFN_7yr	7-year Exchange Fund Note Rate
EFN_10yr	10-year Exchange Fund Note Rate
gb_2yr	2-year Government Bond Yield
gb_3yr	3-year Government Bond Yield
gb_5yr	5-year Government Bond Yield
gb_10yr	10-year Government Bond Yield

The interest rates are available in different time periods as shown in the following table.

Table 5.3 Data Availability in the Subperiods for Interest Rate Pass-Through Estimation for Hong Kong

	Pre-AFC	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
Daily	Jun. 30, 1997 and Before	Jul. 1, 1997—Dec. 31, 1999	Jan. 1, 2000—Jul. 31, 2007	Aug. 1, 2007—Dec. 16, 2008	Dec. 17, 2008—Dec. 16, 2015	Dec. 17, 2015—Feb. 26, 2021
Monthly	Jun. 1997 and before	Jul. 1997—Dec. 1999	Jan. 2000—Jul. 2007	Aug. 2007—Nov. 2008	Dec. 2008—Nov. 2015	Dec. 2015—Feb. 2021
EFB_30day	Jun. 10, 1991--	X	X	X	X	X
EFB_91day	Jun. 10, 1991--	X	X	X	X	X

EFB_182day	Jun. 10, 1991--	X	X	X	X	X
EFB_364day	Jun. 10, 1991--	X	X	X	X	X
EFN_2yr	Nov. 19, 1991--	X	X	X	X	X
EFN_3yr	Oct. 26, 1993--	X	X	X	--Feb. 27, 2015	N.A.
EFN_5yr	Sep. 27, 1994--	X	X	X	--Feb. 27, 2015	N.A.
EFN_7yr	Nov. 28, 1995--	X	X	X	--Feb. 27, 2015	N.A.
EFN_10yr	Oct. 29, 1996--	X	X	X	--Feb. 27, 2015	N.A.
gb_2yr	N.A.	N.A.	N.A.	N.A.	Sep. 2, 2009— Mar. 10, 2015	N.A.
gb_3yr	N.A.	N.A.	N.A.	N.A.	Nov. 2, 2011--	X
gb_5yr	N.A.	N.A.	N.A.	N.A.	Nov. 2, 2009--	X
gb_10yr	N.A.	N.A.	N.A.	N.A.	Jan. 11, 2010--	X

Note: "X" represents available. "N.A." is the abbreviation of "Not Available".

Singapore Interest Rates

The yields of Singapore Government Securities (SGS) are used to estimate the US-SGP interest rate pass-through. The sample includes the securities whose maturities range from 3 months to 10 years. The data is available on the website of the Monetary Authority of Singapore. The earliest date for available data of the SGP interest rates is Jan. 2, 1998. The end date for the sample is Feb. 26, 2021. The labels and availabilities of the interest rates are shown in the following tables.

Table 5.4 Singapore Interest Rate Variables and Labels

Interest Rate	Label
sgs_3m	3-month Singapore Government Security Yield
sgs_6m	6-month Singapore Government Security Yield
sgs_1yr	1-year Singapore Government Security Yield

sgs_2yr	2-year Singapore Government Security Yield
sgs_5yr	5-year Singapore Government Security Yield
sgs_7yr	7-year Singapore Government Security Yield
sgs_10yr	10-year Singapore Government Security Yield

Table 5.5 Data Availability in the Subperiods for Interest Rate Pass-Through Estimation for Singapore

	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
Daily	Jan. 2, 1998—Dec. 31, 1999	Jan. 1, 2000—Jul. 31, 2007	Aug. 1, 2007—Dec. 16, 2008	Dec. 17, 2008—Dec. 16, 2015	Dec. 17, 2015—Feb. 26, 2021
Monthly	Jan. 1998—Dec. 1999	Jan. 2000—Jul. 2007	Aug. 2007—Nov. 2008	Dec. 2008—Nov. 2015	Dec. 2015—Feb. 2021
sgs_3m	X	X	X	-- Sep. 18, 2013	N.A.
sgs_6m	N.A.	N.A.	N.A.	Jul. 9, 2012—Jun. 26, 2014	Jun. 27, 2019--
sgs_1yr	X	X	X	X	X
sgs_2yr	X	X	X	X	X
sgs_5yr	X	X	X	X	X
sgs_7yr	X	X	X	--Jan. 31, 2011	N.A.
sgs_10yr	Jun. 29, 1998--	X	X	X	X

Note: “X” represents available. “N.A.” is the abbreviation of “Not Available”.

The U.S. Interest Rates

We use the U.S. Treasury bond yields in the estimation of the interest rate pass-through. The Federal Funds Target Rate is employed to estimate the policy rate pass-through from the U.S. to Hong Kong for robustness checks. The policy rate pass-through is not presented as main results because Singapore does not have the policy rate for its monetary policy framework and there is not policy rate pass-through for Singapore estimated and compared to the case of Hong Kong. Previous literature also used the 3-month money market rate in addition to short-run and long-run government bond yields. But the money market rate is not considered in this study focusing on the government bond yields. The data source of the U.S. interest rates is Federal Reserve Economic Data (FRED). The interest rates are listed as follows:

Table 5.6 The U.S. Interest Rate Variables and Labels

Interest Rate	Label
TCM_1m	1-month Treasury Constant Maturity
TCM_3m	3-month Treasury Constant Maturity
TCM_6m	6-month Treasury Constant Maturity
TCM_1yr	1-year Treasury Constant Maturity
TCM_2yr	2-year Treasury Constant Maturity
TCM_3yr	3-year Treasury Constant Maturity
TCM_5yr	5-year Treasury Constant Maturity
TCM_7yr	7-year Treasury Constant Maturity
TCM_10yr	10-year Treasury Constant Maturity

To estimate the interest rate pass-through, the start date of the U.S. interest rate sample is consistent with those of the HK and SGP interest rate samples, respectively.

The period for available data of the U.S. interest rates is longer than that for the HK and SGP interest rates. Thus, the start date of the U.S. interest rate sample is the earliest date of the available HK and SGP data.

Table 5.7 Data Availability in the Subperiods for Interest Rate Pass-Through Estimation for the U.S.

	Pre-AFC	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
Daily	Jun. 10, 1991—Jun. 30, 1997 and Before	Jul. 1, 1997—Dec. 31, 1999	Jan. 1, 2000—Jul. 31, 2007	Aug. 1, 2007—Dec. 16, 2008	Dec. 17, 2008—Dec. 16, 2015	Dec. 17, 2015—Feb. 26, 2021
Monthly	Jun. 1991—Jun. 1997	Jul. 1997—Dec. 1999	Jan. 2000—Jul. 2007	Aug. 2007—Nov. 2008	Dec. 2008—Nov. 2015	Dec. 2015—Feb. 2021
TCM_1m	N.A.	N.A.	Aug. 1, 2001--	X	X	X
TCM_3m	X	X	X	X	X	X

TCM_6m	X	X	X	X	X	X
TCM_1yr	X	X	X	X	X	X
TCM_2yr	X	X	X	X	X	X
TCM_3yr	X	X	X	X	X	X
TCM_5yr	X	X	X	X	X	X
TCM_7yr	X	X	X	X	X	X
TCM_10yr	X	X	X	X	X	X

Section 5.2 Estimation of the Offset and Sterilization Coefficients

The offset and sterilization coefficients are estimated with simultaneous capital flows equation and monetary policy reaction function under a joint framework developed by Brissimis, Gibson, and Tsakalotos (2002) and modified by the author.

The Original BGT Model

Brissimis, Gibson, and Tsakalotos (2002) developed the following model to estimate the offset and sterilization coefficients. It assumes that a monetary authority has the following loss function with exchange rate stability as the only policy objective:

$$L_t = \alpha(s_t - s_t^T)^2 + \varepsilon\left(\sigma_{s,t}\right)^2 \qquad (5.6)$$

where s_t denotes the spot exchange rate of home currency per unit of a foreign currency at time t. s_t^T represents the target exchange rate. $\sigma_{s,t}$ stands for the exchange rate volatility at time t. α *and* ε are parameters.

The monetary authority tends to minimize the loss function in equation (5.6). The minimization problem is subject to the following constraints:

$\Delta NFA_t = CA + \Delta NK_t \qquad (5.7)$

$\Delta NK_t = (1/c)\Delta(s_t - E_t s_{t+1} + r_t - r_t^*) \qquad (5.8)$

$$\Delta r_t = -\psi \Delta NDA_t \quad \psi > 0 \qquad (5.9)$$

$$\sigma_{s,t} = \kappa \sigma_{s,t-1} - \zeta(\Delta NFA_t - d_2 \Delta NFA_t) \qquad \kappa,\ \zeta > 0 \qquad (5.10)$$

where CA represents the current account and is assumed to be exogenous. NK_t denotes net capital inflows at time t. The capital inflows are determined by the degree of capital mobility measured by 1/c and the uncovered interest rate parity deviation. $E_t s_{t+1}$ stands for the expectations for the spot exchange rate of period t+1 at time t. r_t is the domestic interest rate. r_t^* indicates the foreign interest rate. d_2 is a dummy variable with the value of 2 when $\Delta NFA_t < 0$ and 0 when $\Delta NFA_t > 0$. That is, $(\Delta NFA_t - d_2 \Delta NFA_t)$ indicates the absolute value of ΔNFA_t.

Using equations (5.7)-(5.9) yields

$$s_t = c\Delta NFA_t - cCA + s_{t-1} + \psi \Delta NDA_t + \Delta(E_t s_{t+1} + r_t^*) \qquad (5.11)$$

Substituting equations (5.10) and (5.11) for s_t and $\sigma_{s,t}$ in eq. (5.6) and taking derivatives of the loss function with respect to NDA and NFA yield the following capital flow equation and monetary reaction function:

$$\Delta NFA_t = -\left[\frac{\alpha\psi c}{(\alpha c^2 + \varepsilon\zeta^2)}\right]\Delta NDA_t + \left[\frac{\alpha c^2}{(\alpha c^2 + \varepsilon\zeta^2)}\right]CA - \left[\frac{\alpha c}{(\alpha c^2 + \varepsilon\zeta^2)}\right](s_{t-1} - s_t^T)$$
$$- \left[\frac{\alpha c}{(\alpha c^2 + \varepsilon\zeta^2)}\right]\Delta(E_t s_{t+1} + r_t^*) - \left[\frac{\kappa\varepsilon\zeta}{(\alpha c^2 + \varepsilon\zeta^2)}\right](d_2 - 1)\sigma_{s,t-1} \qquad (5.12)$$

$$\Delta NDA_t = -\left[\frac{c}{\psi}\right]\Delta NFA_t + \left[\frac{c}{\psi}\right]CA - \left[\frac{1}{\psi}\right](s_{t-1} - s_t^T) - \left[\frac{1}{\psi}\right]\Delta(E_t s_{t+1} + r_t^*) \qquad (5.13)$$

where $-\left[\frac{\alpha\psi c}{(\alpha c^2+\varepsilon\zeta^2)}\right]$ on ΔNDA_t in eq. (5.12) is the offset coefficient measuring the degree of capital mobility. $-\left[\frac{c}{\psi}\right]$ on ΔNFA_t in eq. (5.13) is the sterilization coefficient, measuring the effectiveness of the short-term monetary policy.

The parameter of each control variable in the equations (5.12) is explained as follows: Holding the other things constant, 1) the current account balance has a positive effect on the net foreign assets. When the current account is in surplus, there is appreciation pressure on the local currency. The monetary authority will buy foreign assets with the home currency in the foreign exchange market to prevent the home currency from appreciating. Therefore, the net foreign assets increase with a current account surplus; 2) the deviation of the spot exchange rate from the official pegged rate has a negative effect on the net foreign assets. A depreciation pressure can reduce the net foreign assets.

The Modified Model for Hong Kong and Singapore

As analyzed in Chapter 2, it is possible that small open economies have some room for short-term monetary autonomy with the objective of exchange rate stability. Therefore, the loss function for Hong Kong and Singapore is modified as follows:

$$L_t = \alpha(\Delta s_t)^2 + \delta\left(\sigma_{r,t}\right)^2 \qquad (5.14)$$

where Δs_t denotes the change in spot exchange rate of home currency per unit of a foreign currency from last period at time t. $\sigma_{r,t}$ stands for domestic interest rate volatility at time t. α *and* δ are parameters.

Constraints follow the BGT model with a modification for the current account variable. In the original model, the current account is assumed to be exogenous. We assume this variable to be a function of spot exchange rate against the dollar, cyclical income, and domestic prices. With its limited fluctuations we do not expect the exchange rate to be important but have included it for completeness. The constraints are as follows:

$$\Delta NFA_t = CA_t + \Delta NK_t \qquad (5.15)$$

$$CA_t = -\theta s_t + \kappa Y_{c,t} + \lambda \Delta p_t, \quad \theta, \kappa, \lambda > 0 \qquad (16)$$

$$\mathrm{Y_{c,t}} = \varphi_1(\Delta\mathrm{NFA_t} + \Delta\mathrm{NDA_t}) + \varphi_2 \mathrm{Y_{c,t-1}}, \quad \varphi_1, \varphi_2 > 0 \qquad (5.17)$$

$$\Delta\mathrm{p_t} = \pi_1(\Delta\mathrm{NFA_t} + \Delta\mathrm{NDA_t}) + \pi_2 \Delta\mathrm{p_{t-1}}, \quad \pi_1, \pi_2 > 0 \qquad (5.18)$$

$$\Delta NK_t = (1/c)\Delta(s_t - E_t s_{t+1} + r_t - r_t^*) \qquad (5.19)$$

$$\Delta r_t = -\psi \Delta NDA_t \quad \psi > 0 \qquad (5.20)$$

$$\sigma_{r,t} = \eta \sigma_{r,t-1} - \xi(\Delta NDA_t - d_1 \Delta NDA_t) \quad \eta, \xi > 0 \qquad (5.21)$$

where $\mathrm{Y_{c,t}}$ denotes cyclical income at time t. $\Delta\mathrm{p_t}$ represents inflation rate. d_1 is a dummy variable with the value of 2 when $\Delta NDA_t < 0$ and 0 when $\Delta NDA_t > 0$. That is, $(\Delta NDA_t - d_1 \Delta NDA_t)$ the absolute value of ΔNDA_t.

Deriving capital flows equation and monetary reaction function yields

$$\Delta NFA_t = \frac{(c\kappa\varphi_1 + c\lambda\pi_1 - \psi)}{c(1-\kappa\varphi_1-\lambda\pi_1)}\Delta NDA_t - \frac{c\theta}{c(1-\kappa\varphi_1-\lambda\pi_1)} s_{t-1} + \frac{c\kappa\varphi_2}{c(1-\kappa\varphi_1-\lambda\pi_1)}\mathrm{Y_{c,t-1}}$$
$$+ \frac{c\lambda\pi_2}{c(1-\kappa\varphi_1-\lambda\pi_1)}\Delta\mathrm{p_{t-1}} - \frac{1}{c(1-\kappa\varphi_1-\lambda\pi_1)}\Delta(E_t s_{t+1} + r_t^*) \qquad (5.22)$$

$$\Delta NDA_t = \frac{-c\alpha(c\kappa\varphi_1 + c\lambda\pi_1 - \psi)(1-\kappa\varphi_1 - \lambda\pi_1)}{[\xi^2\delta(1-d_1)^2(1-c\theta)^2 - \alpha(c\kappa\varphi_1 + c\lambda\pi_1 - \psi)^2]}\Delta NFA_t$$

$$- \frac{c\theta\alpha(c\kappa\varphi_1 + c\lambda\pi_1 - \psi)}{[\xi^2\delta(1-d_1)^2(1-c\theta)^2 - \alpha(c\kappa\varphi_1 + c\lambda\pi_1 - \psi)^2]}s_{t-1}$$

$$+ \frac{c\kappa\varphi_2\alpha(c\kappa\varphi_1 + c\lambda\pi_1 - \psi)}{[\xi^2\delta(1-d_1)^2(1-c\theta)^2 - \alpha(c\kappa\varphi_1 + c\lambda\pi_1 - \psi)^2]}\mathrm{Y}_{\mathrm{c,t-1}}$$

$$+ \frac{c\lambda\pi_2\alpha(c\kappa\varphi_1 + c\lambda\pi_1 - \psi)}{[\xi^2\delta(1-d_1)^2(1-c\theta)^2 - \alpha(c\kappa\varphi_1 + c\lambda\pi_1 - \psi)^2]}\Delta \mathrm{p}_{\mathrm{t-1}}$$

$$- \frac{\alpha(c\kappa\varphi_1 + c\lambda\pi_1 - \psi)}{[\xi^2\delta(1-d_1)^2(1-c\theta)^2 - \alpha(c\kappa\varphi_1 + c\lambda\pi_1 - \psi)^2]}\Delta(E_t s_{t+1} + r_t^*)$$

$$+ \frac{\xi\delta(1-c\theta)^2\eta}{[\xi^2\delta(1-d_1)^2(1-c\theta)^2 - \alpha(c\kappa\varphi_1 + c\lambda\pi_1 - \psi)^2]}(1 - d_1)\sigma_{r,t-1} \qquad (5.23)$$

In summary, the capital flow equation is written as follows:

$$\Delta \mathrm{NFA_t} = \varphi_0 + \varphi_1 \Delta \mathrm{NDA_t} + \varphi_2 Y_{c,t-1} + \varphi_3 \Delta \mathrm{p_{t-1}} + \varphi_4 e_{t-1} + \varphi_5 \Delta(E_t e_{t+1} + r_t^*) \qquad (5.24)$$

where e_t stands for the spot exchange rate in the unit of home currency per foreign currency. φ_1 is the offset coefficient. Its value ranges between -1 and 0. The value of 0 indicates complete capital immobility and -1 denotes perfect capital mobility. The closer the coefficient is to -1, the higher the estimated capital mobility.

The monetary reaction function is

$$\Delta \mathrm{NDA_t} = \phi_0 + \phi_1 \Delta \mathrm{NFA_t} + \phi_2 Y_{c,t-1} + \phi_3 \Delta \mathrm{p_{t-1}} + \phi_4 e_{t-1} + \phi_5 \Delta(E_t e_{t+1} + r_t^*) + \phi_6 (1-d_1)\sigma_{r,t-1} \qquad (5.25)$$

where ϕ_1 is the sterilization coefficient with the value range of [-1, 0]. The value of -1 suggests full sterilization and 0 implies no sterilization. The extent of sterilization increases from 0 to -1.

3SLS Model for Robustness Check

We also the Three-Stage-Least-Squares (3SLS) to estimate the offset and sterilization coefficients for a robustness check. The model is written as follows:

For the capital flow equation,

$$\Delta \mathrm{NFA_t} = \varphi_0 + \varphi_1 \Delta \mathrm{NDA_t} + \varphi_2 Y_{c,t-1} + \varphi_3 \Delta \mathrm{p_{t-1}} + \varphi_4 e_{t-1} + \varphi_5 \Delta (E_t s_{t+1} + r_t^*) \qquad (5.26)$$

$$\Delta \mathrm{NDA_t} = \Delta \mathrm{NFA_t} + \sum_{i=1}^{4} \Delta \mathrm{NFA_{t-i}} + \sum_{i=1}^{3} \Delta \mathrm{NDA_{t-i}} \qquad (5.27)$$

For the monetary reaction function,

$$\Delta \mathrm{NDA_t} = \phi_0 + \phi_1 \Delta \mathrm{NFA_t} + \phi_2 Y_{c,t-1} + \phi_3 \Delta \mathrm{p_{t-1}} + \phi_4 e_{t-1} + \phi_5 \Delta (E_t s_{t+1} + r_t^*) +$$

$$\phi_6 (1 - d_1) \sigma_{r,t-1} \qquad (5.28)$$

$$\Delta \mathrm{NFA_t} = \Delta \mathrm{NDA_t} + \sum_{i=1}^{3} \Delta \mathrm{NDA_{t-i}} + \sum_{i=1}^{4} \Delta \mathrm{NFA_{t-i}} \qquad (5.29)$$

Data and Variables

Monthly data in a sample from Jan. 1999 to Jun. 2021 are collected to estimate the offset and sterilization coefficients of Hong Kong. The source of data is the Economic & Financial Data for Hong Kong on the website of the HKMA and the Census and Statistics Department of Hong Kong. The Singapore sample covers the period from Jan. 1992 to Jun. 2021. The monthly data of SGP are collected from the Singapore Department of Statistics and the Monetary Authority of Singapore. The 3-month U.S. Treasury Bill rate is collected from the FRED. Since the 3-month Singapore Inter-Bank Offered Rate (SIBOR) discontinued from Jan. 2014, the Singapore Overnight Rate Average (SORA) is instead used in the estimation for the period after 2013.

Measures of Net Domestic Assets

With the balance sheet structure, we derive the following equation:

$$MB = (FA - FL) + (DA - DL) \qquad (5.30)$$

Rewriting equation (5.30) yields:

$$MB = NFA + NDA \qquad (5.31)$$

where NFA indicates net foreign assets and NDA represents net domestic assets.

Net domestic assets is derived using the following equation:

$$NDA = MB - NFA \qquad (5.32)$$

When conducting sterilization studies, it is important, however, to look carefully at the institutional characteristics of the countries being studied. For example, for some countries changes in reserve requirements can be an important method of sterilization, not just open market operations.[71] However, changes in reserve requirements are not important in Hong Kong. For Hong Kong, the important unusual characteristic of the monetary authorities' operations is that for the HKMA the monetary base of HK dollars includes the Exchange Fund Bills and Notes (EFBN) outstanding[72], which is different from standard definition of reserve money[73]. These central bank-issued debt securities are purchased by banks and become domestic liabilities for the HKMA.

[71] See, for example, Wang et, al. (2019).
[72] Source: https://www.hkma.gov.hk/eng/key-functions/money/linked-exchange-rate-system/components-of-the-monetary-base/exchange-fund-bills-notes-programme/
[73] The IMF's definition of monetary base reads "currency in circulation, other depository corporation's deposit holdings at the central bank, and those deposits of money-holdings sectors at the central bank that are also included in broad money." Source: Monetary and Financial Statistics Manual and Compilation Guide by International Monetary Fund.

While we place primary weight on the HKMA's definition of the base we also provide estimates using the conventional definition. The monetary base of HK dollars according to the conventional definition is comprised of cash, bank reserves, and the outstanding debt securities repurchased by the HKMA, which is written as follows:

$$RM = Cash + AB + EFBN_{HKMA} \tag{5.33}$$

where RM stands for the reserve money defined by the IMF. Cash represents the currency in circulation including the indebtedness of certificates and coins issued by the SAR government. AB stands for the aggregated balance of banks in Hong Kong with the HKMA. $EFBN_{HKMA}$ indicates the Exchange Fund Bills and Notes held by the HKMA.

Using the conventional definition to calculate the NDA variable, we have the following equation:

$$NDA + NFA = Cash + AB + EFBN_{HKMA} \tag{5.34}$$

That is,

$$NDA_{ns} = Cash + AB + EFBN_{HKMA} - NFA \tag{5.35}$$

In addition to the components of reserve money under the IMF definition, the HKMA includes the rest of outstanding Exchange Fund Bills and Notes in its monetary base, which is expressed as follows:

$$MB = Cash + AB + EFBN_{HKMA} + EFBN_{banks} \tag{5.36}$$

where MB denotes the whole monetary base of HK dollars as measured by the HKMA. $EFBN_{banks}$ denotes the Exchange Fund Bills and Notes held by institutions other than HKMA. We have "banks" in the subscript because available data for this variable is the amount of outstanding EFBNs held by banks. We assume that the outstanding debt securities not held by the HKMA are held by banks.

Table 5.8 The Simplified Balance Sheet of the Hong Kong Monetary Authority

Assets	Liabilities
Foreign Assets (FA)	Monetary Base (MB)
	Certificate of Indebtedness + Coins ($Cash$)
	Aggregate Balance ($Bank\ Reserves$)
	Outstanding Exchange Fund Bills and Notes repurchased by the HKMA ($EFBN_{HKMA}$)
	Outstanding Exchange Fund Bills and Notes held by banks ($EFBN_{banks}$)
Domestic Assets (DA)	
	Domestic Liabilities (DL)
	Foreign Liabilities (FL)

Using the HKMA's definition, we have the following equation:

$$NDA + NFA = Cash + AB + EFBN_{HKMA} + EFBN_{banks} \quad (5.37)$$

The NDA variable derived with the HKMA's definition of the monetary base is thus written as follows:

$$NDA_s = Cash + AB + EFBN_{HKMA} + EFBN_{banks} - NFA \quad (5.38)$$

To distinguish the two NDA variables, we the standard measure (NDA_{ns}) to denote the one calculated with the conventional definition of the base and displayed in eq. 5.35. We use the HKMA measure (NDA_s) to indicate the one defined by the HKMA and presented in eq. 5.38.

The data and variables for the estimation of the offset and sterilization coefficients are shown in Tables 5.9 and 5.10.

Table 5.9 Data and Variables for the Offset and Sterilization Coefficients Estimation

Variable	Label	Note
FA_t	Foreign assets	
FL_t	Foreign liabilities	
GDP_t	Real Gross Domestic Product	
MB_t	Monetary Base	
$DEBT_t$	Bank-held Exchange Fund Bills and Notes	Only for Hong Kong
CPI_t	Consumer Price Index	
e_t	Spot exchange rate against the dollar	
r_t^*	3-month Treasury Bill rate	
r_t	3-month domestic interest rate	
r_t	Singapore Overnight Rate Average	Only for Singapore

Table 5.10 Variables and Labels for the Offset and Sterilization Coefficients Estimation

Variable	Label	Formula
NFA_t		
$\Delta\mathrm{NFA_t}$	Year-over-year change in the net foreign assets in percentage of real GDP	$\frac{NFA_t - NFA_{t-12}}{GDP_t}$
$\mathrm{NDA_{s,t}}$	Standard net domestic assets	$MB_t - NFA_t$
$\Delta\mathrm{NDA_{s,t}}$	Year-over-year change in the HKMA measure of the net domestic assets in percentage of real GDP	$\frac{NDA_{s,t} - NDA_{s,t-12}}{GDP_t}$
$\mathrm{NDA_{ns,t}}$	The standard measure of the net domestic assets in percentage of real GDP	$MB_t - NFA_t - DEBT_t$
$\Delta\mathrm{NDA_{ns,t}}$	Year-over-year change in the non-standard net domestic assets in percentage of real GDP	$\frac{NDA_{ns,t} - NDA_{ns,t-12}}{GDP_t}$
$TREND_t$	HP-filtered trend of real GDP	
$y_{c,t-1}$	Cyclical component of real GDP	$GDP_t - TREND_t$
$Y_{c,t-1}$	Cyclical component of real GDP in percentage of the GDP trend	$\frac{y_{c,t-1}}{TREND_t}$

Δp_{t-1}	Year-over-year percentage change in the consumer price index	$\frac{CPI_t - CPI_{t-12}}{CPI_{t-12}}$
e_{t-1}	First lag of the spot exchange rate of local currency against the dollar	
$E_t s_{t+1}$	Perfect expectation on the percentage change in the spot exchange rate of local currency against the dollar	$\ln(e_{t+1})$
$\Delta(E_t s_{t+1} + r_t^*)$	Change in the expectation on the spot exchange rate and the foreign interest rate from the last period	$(E_t s_{t+1} + r_t^*) - (E_{t-1} s_t + r_{t-1}^*)$
d_1	Dummy variable indicating if domestic money market is in surplus or deficit[74]	$=0$ if $\Delta NDA_t > 0$; $=2$ if $\Delta NDA_t < 0$
$\sigma_{r,t-1}$	Volatilities in the domestic interest rate	$std(r_t)$
$(1 - d_1)\sigma_{r,t-1}$	Absolute value of the volatilities in the domestic interest rate for the last period	

The stationarity of variables is examined with Augmented Dickey Fuller (ADF) test. The results are presented in Tables 5.11 and 5.12. Based on the test statistics, the null hypothesis of a unit root is rejected. The data series is stationary.

Table 5.11 The Augmented Dickey Fuller Test Results for Hong Kong

Variable	ADF test statistic (with drift)
ΔNFA_t	-2.26**
ΔNDA_t	-3.26***
$Y_{c,t-1}$	-4.352***
Δp_{t-1}	-2.842***
e_{t-1}	-3.306***
$\Delta(E_t s_{t+1} + r_t^*)$	-11.059***
$(1 - d_1)\sigma_{r,t-1}$	-11.322***

* P <0.1, ** P<0.05, *** P<0.01

[74] The dummy variable is constructed to make sure that the interest rate volatilities variable $(1 - d_1)\sigma_{r,t-1}$ always have a positive value.

Table 5.12 The Augmented Dickey Fuller Test Results for Singapore

Variable	ADF test statistic (with drift)
$\Delta \mathrm{NFA_t}$	-1.628*
$\Delta \mathrm{NDA_t}$	-1.852**
$Y_{c,t-1}$	-3.848***
$\Delta \mathrm{p_{t-1}}$	-2.602***
e_{t-1}	-1.330*
$\Delta(E_t s_{t+1} + r_t^*)$	-12.502***
$(1-d_1)\sigma_{3m,t-1}$	-8.626***
$(1-d_1)\sigma_{sora,t-1}$	-5.179***

* P <0.1, ** P<0.05, *** P<0.01

Chapter 6 Estimated Interest Rate Pass-Through

The estimates of interest rate pass-through with equation 5.1 are presented in this chapter. We find that the asset substitutability between the United States and Hong Kong is not perfect. The interest rate pass-through from the US to Hong Kong is less than one for one in most cases. It is estimated to be 0.769 on average. And there is a large variation in the pass-through over time and across maturities, suggesting imperfect capital mobility between Hong Kong and the US.

The interest rate pass-through from the US to Singapore is also estimated and presented following the estimates for Hong Kong. By comparing the estimated pass-through between Hong Kong and Singapore, we find that the pass-through from the US to Singapore is lower than that to Hong Kong in every subsample with which both are estimated to be statistically significant, substantiating that a managed floating exchange rate regime is more effective to insulate the monetary autonomy of a small open economy than a hard peg under free capital flows. Nevertheless, the small open economy is not completely protected from foreign monetary shocks with managed floating as the interest rate pass-through from the US to Singapore is statistically significant and positive in most cases.

Our estimates of interest rate pass-through show that there are limits to arbitrage. One likely reason is that investors may be risk averse in the financial markets of Hong Kong and Singapore, which makes capital mobility imperfect in normal times; 2) In a financial crisis that originates from the base country, a credit crunch can make the degree of capital mobility decrease dramatically and reduce the strength of the international monetary transmission; 3) In the aftermath of the crisis, the capital mobility can be lower than its pre-crisis level as investors become more risk averse and with unconventional monetary policy, which allows domestic interest rates to deviate from the base rates to a greater extent.[75]

Investors are risk averse in the financial markets of Hong Kong and Singapore. The estimated interest rate pass-through from the US to Hong Kong increases from 0.0656 to 0.621 at daily frequency as the interest rate maturity increases from 1 month to 10 years. Similarly, the pass-through to Singapore is estimated to be not statistically significant with 3- or 6-month interest rates at daily frequency. The daily interest rate pass-through that is estimated to be statistically significant increases from 0.08 to 0.305 as the maturity of interest rates rises from 1 year to 10 years in the case of Singapore. The results indicate that investors are more likely to take arbitrage of long-term assets, which is less risky, than short-term assets within one day.

In addition to the daily estimates, the 1-month interest rate pass-through to Hong Kong that is estimated to be significant is much lower than the estimates of interest rates with longer maturities than one month in all samples at monthly frequency. It means that investors are less likely to take the arbitrage of a one-month asset than that with a longer maturity even though investors have one month to take the arbitrage.

The credit crunch in the 2008 global financial crisis negatively affected the short-term asset substitutability between the US and the small open economies. The 1- and 3-month interest rate pass-through to Hong Kong is estimated to be not significant for the GFC period at daily

[75] Another factor may be increases in capital requirements which reduce the quantity of funds available for arbitrage.

frequency. Similarly, the 3-month and 1-year interest rate pass-through to Singapore is not statistically significant at daily frequency for the crisis period. When foreign assets are not available in the financial markets in crisis, investors cannot take the arbitrage and domestic interest rates can, therefore, deviate from the long-run relationship with the base rates in a very short period.

Investors can be more risk averse in the aftermath of a financial crisis. The highest interest rate pass-through to Hong Kong for the pre-Asian Financial Crisis (AFC) period is estimated to be 0.885 with the 5-year interest rates at daily frequency. In the subperiods after the AFC, the estimated 10-year interest rate daily pass-through is found to be the highest. At monthly frequency, the 1-year interest rate pass-through to Hong Kong is estimated to be the highest in the subperiods prior to the Global Financial Crisis (GFC) period and the highest pass-through for the ZLB period is found with the 7-year interest rates[76]. The maturity of interest rates with the highest asset substitutability increases to 10 years for the post-ZLB period. The change in the assets with the highest substitutability is also related to unconventional monetary policy which involves long-term Treasury bond yields. As a result, the estimated interest rate pass-through to Hong Kong decreases from the pre-GFC period to the post-ZLB period.

The estimated interest rate pass-through from the US to Hong Kong is less than one for one and has a heterogenous pattern across different subperiods and maturities. The estimates show the risk aversion of investors in the Asian financial markets in normal time and the aftermath of a financial crisis, the credit crunch in the crisis, and unconventional monetary policy that all make

[76] The estimates with government bond yields are excluded for a shorter sample coverage.

the capital mobility imperfect and allows the small open economy to have some scopes for monetary autonomy partially in the short run.

The interest rate pass-through to Singapore is estimated to be lower than for Hong Kong when both are statistically significant in the whole period and each subperiod, with the interest rates of each maturity, and at both monthly and daily frequencies.

The extra scope for monetary autonomy in Singapore than Hong Kong increases when the MAS does not make foreign exchange interventions (FXIs) intensively. The gap increases from the GFC period to the ZLB period, indicating that more transmission fell on exchange rates in Singapore after the financial crisis. The market expected the local currency to appreciate, and investors did not seek for the yields of foreign assets in the aftermath.

The gap in monetary autonomy is narrowed between Hong Kong and Singapore when the MAS takes intensive FXIs. The estimated interest rate pass-through to Singapore increases from the pre-GFC period to the post-ZLB period. In contrast, the estimated interest rate pass-through to Hong Kong declines before and after the GFC and ZLB periods. It indicates that less transmission falls on exchange rates and investors are more likely to take arbitrage for the rise in the US rates in Singapore in the post-ZLB period.

The estimated interest rate pass-through is shown as follows in detail.

Section 6.1 The Estimated US-Hong Kong Interest Rate Pass-Through

Tables 6.1 and 6.2 show that the international pass-through from the U.S. to HK estimated using the 1-month interest rates is significant for the pre-GFC and post-ZLB periods but not significant for the GFC and ZLB periods. The daily pass-through is estimated to be significant at a 99.9% confidence level with the magnitude of .2 prior to the GFC but not significant from the GFC period. At a monthly frequency, the estimated pass-through is significant in the pre-GFC and post-ZLB periods. From the time period before the GFC to that after the ZLB, the magnitude of the pass-through is estimated to decrease from .377 to .277.

The monthly variation of the HK 1-month rate explained by the US counterpart decreases from 6.4% in the pre-GFC period to 1.4% in the post-ZLB period as suggested by the adjusted R-squares of the regression models based on the two subsamples. The daily variation explained by the US 1-month rate is 2.2% for the pre-GFC period. Using the 1-month interest rates, the U.S. interest rate is estimated to explain 2.2% variation of the HK counterpart in the pre-GFC period at a daily frequency.

Tables 6.3 and 6.4 show that the substitutability of the U.S. 3-month Treasury security for the HK 3-month EFN is estimated to be statistically significant in the subsamples except the AFC and GFC periods. The estimation for the periods before the GFC has a higher confidence level of 99.9% than for the ZLB and post-ZLB periods. At a monthly frequency, the pass-through keeps declining from the pre-AFC period to the ZLB period. The magnitude of the estimated monthly pass-through is .875 in the pre-AFC phase, .586 for the pre-GFC era, and .35 for the ZLB period. It increases to .51 in the post-ZLB period. At a daily frequency, the pass-through is .487 before the AFC, .252 after the AFC and before the GFC, .0715 in the ZLB era, and .218 in the post-ZLB period.

The proportion of variation in the HK 3-month interest rate pass-through explained by the US 3-month interest rate has similar changes over time with the magnitude of the estimated pass-through. It decreased from the pre-AFC period to the ZLB era and then increased in the most recent period. The proportion for the post-ZLB phase remains lower than that for the pre-AFC period. At a monthly frequency, the U.S. interest rate explained 26.1% variation in the HK rate prior to the AFC. The proportion declined to 13% for the pre-GFC period, 2.7% for the ZLB period, and 13.2% in the post-ZLB period. At a daily frequency, 5% of daily variation in the HK rate is explained by the US rate in the pre-AFC phase. The proportion is 3.9% for the pre-GFC phase, .5% for the ZLB era, and 1.5% in the post-ZLB period.

Tables 6.5 and 6.6 show that the estimated US-HK pass-through regarding 6-month interest rate is significant at a monthly frequency in the pre-AFC, pre-GFC, and post-ZLB periods, and at a daily frequency based on the subsamples except the AFC and post-ZLB periods. The estimated pass-through decreases over time. The estimated monthly pass-through is .994 for the pre-AFC period, .816 for the pre-GFC period, and .601 for the post-ZLB phase. The estimated daily pass-through is .685 for the pre-AFC phase, .454 for the pre-GFC period, .126 for the GFC period, and .113 for the ZLB era.

The estimation of the interest rate pass-through with the 6-month interest rates shows a decline in the variation of the HK rate explained by the US rate. The monthly variation explained by the US rate was 41.3% prior to the AFC, 27.2% after the AFC and before the GFC, and 19.8% for the post-ZLB period. The proportion of daily variation in the HK rate explained by its U.S. counterpart was 12.2% in the pre-AFC era, 10.2% in the pre-GFC period, 1.4% in the GFC phase, and 1.5% in the ZLB era.

Table 6.7 and 6.8 show that the 1-year interest rate pass-through from the US to HK is estimated to be significant at a monthly frequency in the sample period except the AFC and ZLB phases and at a daily frequency based on the subsamples except the AFC period. The estimated monthly pass-through remains higher than .9 before the ZLB period. It is in particular one for one for the GFC period. In the post-ZLB phase, the pass-through decreased to .596. The estimated daily pass-through begins to decline before the GFC period. It is .743 for the pre-AFC phase, .581 for the pre-GFC period, .233 for the GFC phase, .171 for the ZLB era, and .22 for the post-ZLB period.

The proportion of monthly variation in the HK rate explained by its US counterpart is higher than 40% in the pre-AFC and pre-GFC periods, 34.2% in the GFC period, and 23.5% in the post-ZLB period. The proportion of daily variation is greater than 20% in the pre-AFC and pre-GFC periods and drops to 4% or less in the GFC, ZLB, and post-ZLB periods.

Tables 6.9-6.12 show that the estimated pass-through of the 2-year interest rate is statistically significant in all the periods except the AFC era from both monthly and daily data. All the significant estimates have the confidence level of 99.9%. The estimated pass-through remains higher than .95 for the pre-AFC, pre-GFC, and GFC periods, declines to .463 in the ZLB period, and rebounds to .539 in the post-ZLB period from the monthly data. The estimated daily pass-through begins to decrease from the pre-GFC period. It is .806 for the pre-AFC period, .681 for the pre-GFC period, .563 for the GFC, and around .4 for the ZLB and post-ZLB period.

The proportion of monthly variation in the HK rate explained by the US rate is greater than 52% prior to the ZLB period and less than 26% in the ZLB and post-ZLB periods. The explained proportion of daily variation remains between 31.3% and 37% throughout the pre-AFC period to ZLB period and declines to 14% in the post-ZLB.

Tables 6.13-6.16 show that the estimated 3-year interest rate pass-through is statistically significant at the significance level of .1% from the pre-AFC period to the post-ZLB period except the AFC period at both daily and monthly frequencies. The estimated pass-through from the monthly data increases slightly over time prior to the ZLB phase. It is .884 for the pre-AFC period, .928 for the pre-GFC period, and 1.023 for the GFC period. The estimated pass-through decreases to .756 in the ZLB period. The pass-through is also estimated using the HK government bond yield for the ZLB and post-ZLB periods. It is .783 for the ZLB period and .591 for the post-ZLB period.

The estimated daily pass-through decreases throughout the six sub-periods. It is .848 for the pre-AFC period, .684 for the pre-GFC period, .578 for the GFC period, .512 for the ZLB period. The estimate with the government bond yield is .558 for the ZLB period and .421 for the post-ZLB period.

The proportion of variation in the HK rate explained by the US rate remains stable between 57% and 68.8% at the monthly frequency. The proportion for the government bond yield is lower than that for the EFN rate. It is 43.7% in the ZLB period and 31.7% in the post-ZLB period. The proportion at the daily frequency ranges between 35% and 47.5% for the EFN rate. It is 29.7% for the ZLB period and 14.2% for the post-ZLB period with the government bond yields.

Tables 6.17-6.20 show the estimated daily and monthly 5-year interest rate pass-through is statistically significant at the 99.9% confidence level based on the six sub-samples except the AFC period. The estimated monthly pass-through ranges between .752 and .889 using the EFN rate until Feb. 2015 and is around .7 using the government bond yield for the ZLB and post-ZLB periods. The estimated daily pass-through decreases before and after the GFC. It is .885 for the pre-AFC period, .718 for the pre-GFC period, and around .55 for the GFC and ZLB periods. The daily pass-through estimated using the government bond yield is slightly below .5 for the last two periods.

The adjusted R-square of the monthly estimate is higher than 60% and less than 65% for the periods with the significant estimates except the GFC period. It is 49% in the crisis period. The R-square of the monthly estimate using the government bond yield is 52.4% for the ZLB period and 44% for the post-ZLB period. The R-square of the daily estimate is around 50% in the periods with significant estimates except the GFC period with the R-square of 43%. The R-square of the daily estimate with the government bond yield is 30.5% for the ZLB period and 20.5% for the post-ZLB period.

Tables 6.21 and 6.22 show that the estimated 7-year interest rate pass-through is statistically significant at the 99.9% confidence level for the periods by Feb. 27, 2015 except the AFC period.

The estimated monthly pass-through varies over time. It is greater than .9 for the pre-AFC and GFC periods, .861 for the pre-GFC period, and .773 for the ZLB period. The estimated daily pass-through decreases over time. It is .847 for the pre-AFC period, .734 for the pre-GFC period, .597 for the GFC period, and .539 for the ZLB period.

The U.S. rate explains more than 50% of variation in the HK rate except in the GFC period. The proportion of daily variation explained by the US rate is 43.6% in the GFC phase and around 52% for the rest of subsamples with significant pass-through. The proportion of monthly variation explained by the US rate is 48.3% in the GFC period and around 64% in the other subsamples except the AFC period.

Tables 6.23-6.26 show that the estimated 10-year interest rate pass-through is statistically significant for the six periods except the AFC period. The confidence level of daily estimates is 99.9% while the confidence level of monthly estimates is 99.9% for the pre-GFC, ZLB, and post-ZLB periods, 99% for the GFC period, and 95% for the pre-AFC period.

The estimated monthly pass-through increases from the pre-AFC phase to the pre-GFC period and declines slightly in the periods after the GFC. It is .617 for the pre-AFC period, .845 for the pre-GFC period, .805 for the GFC period, and .768 for the ZLB period. The estimated pass-through using the government bond yield is .692 for the ZLB period and .789 for the post-ZLB period.

The estimated daily pass-through decreases over time. It is .845 for the pre-AFC period, .777 for the pre-GFC period, .67 for the GFC, and .565 for the ZLB period. The estimate with the government bond yield is around .5 for the ZLB and post-ZLB periods.

The adjusted R-square of the monthly estimate is around 60% for the pre-GFC, ZLB, and post-ZLB periods, and 37.6% on average for the pre-AFC and GFC period. The R-square of the estimate with the government bond yield is 54% for the ZLB period and 58.1% for the post-ZLB period.

The adjusted R-square of the daily estimate ranges between 52.1% and 53.9% from the pre-AFC period to the ZLB period except the GFC period with the R-square of 41.8%. The R-square of the estimate with the government bond yield is 39.8% for the ZLB period and 21.5% for the post-ZLB period.

Tables 6.41-6.53 show the US-HK interest rate pass-through estimated with the ARDL model.

On average, the speed of adjustment is less than 3 days for the interest rates of maturities shorter than one year, including 1-, 3-, and 6-month rates, and longer than three days for the interest rates of maturities equal to or longer than one year, including 1-, 2-, 3-, 5-, 7-, and 10-year rates. The average of the half-life increases as the maturity increases for the short-run interest rates whose adjustment takes less than three days. For the interest rates whose adjustment takes more than three days, the 2-year rate takes the least time of around 3 days. Following the 2-year rate, the 3- and 5-year rates take less than four days but longer than 3 days to make the adjustment. Both 1- and 10-year rates take around 4 days for the adjustment on average. The 7-year rate spends more than 5 but less than 6 days as the interest rate with the slowest adjustment speed. Besides, the HK interest rates are adjusted to their US counterparts in most of periods but not every period. The significant proportion of the adjustment coefficients is less than 100% for every interest rate in the samples.

The estimated interest rate relationship from the whole sample increases from .709 to 1.697 as the maturity increases from 30 days to 10 years. In addition to the estimates from the EFBN data, the relation is also estimated with the long-run government bond yields. The estimated government bond yield pass-through remains between .72 and .79 (footnote: the sample coverage of the government bond yields is shorter than that of the EFBNs.). The adjustment time increases from 2.22—5.57 days to 6.31—9.25 days as the maturity increases from being equal to one year or less to being longer than one year. In the interest rates of maturities less than two years, the adjustment time increases as the maturity increases from one month to one year. In the interest rates of maturities longer than one year, the adjustment time remains less than seven days for the 2-year rate, more than eight but less than nine days for 3- to 7-year rates, and more than nine days for the 10-year rate. The government bond yields take more than one and less than four days to complete the adjustment.

In the pre-AFC period, the long-run equilibrium in the interest rate relationship between the US and HK remains around 1 for the 3-, 6-month, 1-, and 2-year rates. The level relationship of the 3-year rate is .887 while the 10-year rate relationship is 1.184. The 7-year interest rates do not have a significant relation in this sample. The short-term dynamics converge to the long-run equilibrium in the interest rates except the 5- and 7-year rates. The 6-month, 1-, and 2-year rate takes less than one day to make the adjustment; and the 3-month and 3-year rates take more than one but less than two days to be adjusted to the US counterpart.

The relationship between the US and HK interest rates is not statistically significant for the AFC period. The adjustment coefficients, however, are significant for the interest rates whose maturity is 3 years or shorter. The interest rates with significant adjustment coefficients take no longer than 2 days to complete the adjustment.

The HK interest rates maintain significant long-run equilibrium relationship with their US counterparts for the pre-GFC period. The level relationship increases from .846 to 1.1 as the maturity increases from one month to two years. The 2- and 3-year rate relationships remain around 1.1. The relations of 5-, 7-, and 10-year interest rates are greater than 1.1 and increase with the maturity increasing. The adjustment of the local interest rates to the corresponding US rates are effective for this period except the 7- and 10-year rates. The adjustment time ranges between three and seven days. The 1- and 3-month rates take more than three and less than five days to make the adjustment. The time spent in the rest of interest rates is more than five and less than seven days.

The level interest rate relationship between HK and the US is statistically significant for the GFC phase except the 1-month rate. The 3- and 6-month rate relations are .71 and .779, respectively; The relations of 1-, 2-, 3-, and 5-year rates are around 1; And the 7- and 10-year rate relations are greater than 1.2. The 1-, 3-, and 6-month rates take less than one day but some time to make the adjustment while the rest of interest rates of longer maturities are immediately adjusted to the US counterparts during the GFC period.

The US-HK interest rate level relationship is effective in the interest rates for the ZLB period except the 3-, 6-month, and 1-year rates. The significant long-run relationship is .552 in the 1-month rate and increases from .518 to .917 as the maturity increases from 2 years to 10 years. The relationship estimated with the government bond yields ranges between .468 and .888 and rises with the maturity increasing from 2 years to 10 years. The adjustment of interest rates of maturities less than two years increases from .75 day to 3.12 days as the maturity increases from 1 month to 1 year. The adjustment of interest rates of maturities equal or greater than 2 years range between 1.6 and 2.5 days from the EFN data. The adjustment of the government bond yields takes more than three days in terms of the 10-year rate and less than two days regarding the rest of interest rates.

The long-run equilibrium relationship between HK and the US interest rates remains effective for the post-ZLB period. The estimated level relations with the EFBN yields from the highest to the lowest is .815 in the 6-month rates, .807 in the 3-month rates, .803 in the 1-year rates, .749 in the 2-year rates, and .737 in the 1-month rates. The estimated relations from the government bond yields decrease from .74 to .7 as the maturity increases from 3 years to 10 years. The 1-year rate takes the longest 3 days to make the adjustment to the US rate. The 2-year rate follows the 1-year rate and takes around 2.86 days to complete the adjustment. The 2-, 5-, and 10-year government bond yields also take more than two and less than three days to be adjusted to the long-run equilibrium relationship with the US rate. The short-run interest rates of maturities less than one year take 2 days or less to make the adjustment.

Section 6.2 The Estimated US-Singapore Interest Rate Pass-Through

The interest rate pass-through from the United States to Singapore is estimated to be lower than the US-HK interest rate pass-through. The SGP estimates range between .43 and .645 from the monthly data while the HK monthly estimates range between .692 and .845. The estimated daily pass-through is within the range between .119 and .367 in the case of Singapore while the daily estimate is between .481 and .777.

The SGP estimates do not have values greater than one but have negative values. There are seven negative estimates in the SGP results. In contrast to 7 out of 8 negative estimates from the AFC sample in the case of HK, 5 out of 7 negative estimates are from the ZLB sample and the remainder is from the AFC sample in the case of Singapore. In addition, the SGP estimates have a statistically significant negative pass-through while the HK estimates do not have one. The US-SGP 3-month rate pass-through estimated from the daily data is statistically significant at 95% confidence level for the AFC period.

Tables 6.27 and 6.28 show that the 3-month interest rate pass-through from the US to SGP is effective in the AFC and pre-GFC samples. The estimate is statistically significant at 95%

confidence level from the daily data for the AFC period and at 99% confidence level from the monthly data and 99.9% confidence level from the daily data for the pre-GFC period. The significant estimates range between -3 and .4. They are -2.77 for the AFC period, .121 from the daily data and .379 from the monthly data for the pre-GFC period. The proportion of variation in the SGP rate explained by the US corresponding rate is less than 11% and the proportion estimated from the monthly data is greater than that from the daily data. The proportion is .6% for the AFC period, 1.7% at the daily frequency for the pre-GFC period and 10.9% at the monthly frequency for the pre-GFC period.

The statistically significant estimates of the 3-moth interest rates in the case of SGP are lower than their corresponding estimates in the case of Hong Kong for the pre-GFC period regarding magnitude and adj. R-square. The HK estimates are .252 from the daily data and .586 from the monthly data. The adjusted R-squares of the HK estimates are 3.9% at the daily frequency and 13% at the monthly frequency.

Tables 6.29 and 6.30 show that the 6-month interest rates have an effective pass-through from the US to SGP in the post-ZLB period at the significance level of 1% at the monthly frequency. The estimate is .589. It is slightly lower than the HK estimate of .601. The proportion of variation explained by the US rate is more in the case of SGP than that in the case of HK. The adjusted R-square of the SGP estimate is 44% while the percentage for the HK estimate is 19.8%.

Tables 6.31 and 6.32 show that the US-SGP pass-through of the 1-year interest rates is effective for the pre-GFC and post-ZLB periods. The significant estimate is .375 from the monthly data. It is statistically significant at the significance level of 1%. The estimate from the daily data is .0997 for the pre-GFC period and .153 for the post-ZLB period. The significance level is .1% for the pre-GFC estimate and 1% for the post-ZLB estimate.

The estimates are all lower than their HK counterparts. The HK estimate is .976 from the monthly data for the pre-GFC period, and .581 for the pre-GFC period and .22 for the post-ZLB period at the daily frequency.

Tables 6.33 and 6.34 show that the 2-year interest rate pass-through from the US to SGP could be effective in every period. The daily pass-through is statistically significant at 95% confidence level for the AFC period; Both daily and monthly pass-throughs are significant at 99.9% confidence level for the pre-GFC period; The pass-through for the GFC period is significant at the confidence level of 95% from the monthly data and 99.9% from the daily data; The daily pass-through is significant at 99.9% confidence level for the ZLB period; The pass-through for the post-ZLB period is significant at 99% confidence level from the monthly data and 99.9% confidence level from the daily data.

The significant estimates of the US-SGP pass-through of the 2-year interest rates are overall lower than the corresponding HK estimates. The SGP estimates range between .273 and .371 from the monthly data while the monthly pass-through from the US to HK is estimated to be within a range from .463 to .962. The significant daily estimates range between .133 and .239 in the case of SGP while they range between .429 and .681 in the case of HK. However, the SGP rates are not necessarily less related to the US rates than the HK rates. In the AFC period, the US-HK pass-through is not statistically significant while the US-SGP pass-through is significant. Besides, the HK estimates decreases from the GFC period to the post-ZLB period while the SGP estimates increase over time.

Tables 6.35 and 6.36 show that the 5-year interest rate pass-through from the US to SGP is effective in every period but the significance level of the estimate varies across the different periods. It is .1% for the pre-GFC and post-ZLB periods, 1% for the ZLB period, and 5% for the GFC period from the monthly data; The daily estimate has the significance level of 1% for the AFC period and .1% for the rest of periods. The monthly estimate peaks at .608 in the GFC period and remains .358 and .301 for the pre-GFC and ZLB periods, respectively. From the ZLB period to the post-ZLB period, the estimate increases to .426. The daily pass-through estimates range between .122 and .299. It is the lowest in the AFC period and the highest in the post-ZLB period. The estimate for the pre-GFC period is as high as that for the post-ZLB period. It decreases from .294 to .188 from the pre-GFC period to the GFC period and increases to .222 for the ZLB period.

The SGP estimates are overall lower than the HK counterparts. The minimum values of the HK estimates are greater than the maximum values of the SGP estimates. The HK estimates are greater than .675 from the monthly data and .466 from the daily data while the SGP estimates are less than .608 from the monthly data and .3 from the daily data.

Tables 6.37 and 6.38 show that the estimated 7-year interest rate pass-through from the US to SGP is statistically significant for the pre-GFC period at 99.9% confidence level and the GFC period at 95% confidence level at the monthly frequency. The daily pass-through is effective in the AFC period with the significance level of 5% and the rest of periods with the significance level of .1%. The monthly estimates are .439 for the pre-GFC period and .602 for the GFC period. The daily estimate remains the lowest at .0948 for the AFC period, peaks at .313 for the pre-GFC period, and decreases to .186 for the GFC period, and .157 for the ZLB period. The variation of the SGP rate explained by the US rate remains around 31% at the monthly frequency in the two periods with significant estimates while it drops from 17.8% in the pre-GFC period to 7.9% for the GFC period and 5.4% for the ZLB period.

The US-SGP pass-throughs of the 7-year interest rates are lower than the corresponding US-HK pass-throughs. The HK estimates are higher than .861 for the pre-GFC and GFC periods from the monthly data while the SGP estimates are lower than .602. The HK estimates are greater than .53 from the daily data while the SGP estimates are lower than .32. But the US-SGP pass-through is effective in the AFC period at the daily frequency in contrast that the US-HK pass-through is not statistically significant in this period.

Tables 6.39 and 6.40 show that the US-SGP pass-through of the 10-year interest rates is effective from the AFC period to the post-ZLB period. The estimate is statistically significant at 99.9% confidence level in the periods except the AFC period with the estimates whose significance levels are higher than 5% from the monthly data and less than 1% from the daily data and the GFC period with the significance level of 5%. The monthly pass-through increases after the GFC happened. The estimate is .43 for the pre-GFC period. It increases to .645 for the GFC period and stays at on average .54 for the ZLB and post-ZLB periods. The daily pass-throughs for the crisis periods are lower than those in normal time. The estimates are .119 for the AFC period and .217 for the GFC period while the estimates range between .3 and .37 for the pre-GFC, ZLB and post-ZLB periods.

Tables 6.54-6.60 show that the US-SGP interest rate pass-through estimated with the ARDL model.

Table 6.54 shows that the 3-month interest rate pass-through from the US to Singapore is estimated to be significant for the full sample and subperiods except the AFC and post-ZLB periods. The highest level relationship is estimated to be 0.484 for the GFC period. The local interest rate is adjusted to the US rate in the full sample and subperiods except the AFC period. It takes around 4 days to complete the adjustment on average in the full sample.

Table 6.55 shows that the 6-month SGP interest rate is statistically significantly affected by the US counterpart in the post-ZLB period. The estimated level relationship between SGP and the US is higher than that between HK and the US. The estimate is .921 from the SGP sample while it is .815 from the HK sample. The SGP interest rate, however, does not have significant adjustment to the long-run relationship with the US rate for both the ZLB and post-ZLB phases.

Table 6.56 shows that the 1-year interest rate of SGP has long-run equilibrium relationship with the corresponding US rate for the pre-GFC, GFC, and post-ZLB periods. The estimated relations are between .45 and .49 for the pre-GFC and GFC phases and .718 for the post-ZLB period. The local interest rate is adjusted to the long-run equilibrium effectively for the three periods. The time spent on adjustment in the case of SGP is shorter than that in the case of HK for the pre-GFC and post-ZLB periods. The adjustment of the SGP rate takes around three days in the pre-GFC sample while the HK rate takes around six days. The adjustment time is less than three days in the SGP rate but around three days in the HK rate for the post-ZLB period. Although the adjustment coefficients are smaller than -1 in both cases for the GFC period, suggesting both the SGP and HK rates are adjusted instantly in this period, the coefficient of HK is greater than that of SGP in magnitude, implying a quicker response to changes in the US counterpart.

Table 6.57 shows that the US-SGP 2-year interest rate relationship is statistically significant for the periods except the AFC and ZLB eras. The significant level relationship is .511 for the pre-GFC period, .465 for the GFC period, and .673 for the post-ZLB period. Recall that the level relationship between HK and the US rates is 1.1 for the pre-GFC period, .979 for the GFC period, and .749 for the post-ZLB period. Compared to the considerable difference in the relationship between SGP and HK for the pre-GFC and GFC periods, the estimated equilibrium relations of SGP and HK with the US rate are closer in the post-ZLB period. The SGP rate is adjusted more quickly than the HK rate for the pre-GFC, GFC, and post-ZLB periods. The adjustment of the SGP rate costs around 3.43 days for the pre-GFC period while the HK rate takes more than five days to make the adjustment. For the GFC period, the adjustment coefficient in the case of SGP is larger than that in the case of HK, suggesting a quicker adjustment occurred to the SGP rate than the HK rate. The adjustment coefficient of SGP is -1.83

and the coefficient of HK is -1.67. The time spent on adjustment is 2.29 days in the SGP rate and 2.86 days in the HK rate for the post-ZLB period.

Table 6.58 shows that the US-SGP relationship in the 5-year interest rate is effective for the pre-GFC, GFC, and post-ZLB periods. The estimated relations are between .553 and .598 for the pre-GFC and GFC periods, respectively, and .788 for the post-ZLB period. The relations are lower than the corresponding US-HK estimates. The short-term dynamics of the SGP rate converge to the long-run equilibrium for the AFC, pre-GFC, and post-ZLB periods. The SGP rate take less time than the HK rate to be adjusted to the US rate for the AFC and pre-GFC periods but more time for the post-ZLB period. The time spent on the adjustment of the SGP rate is .18 day for the AFC period, 2.61 days for the pre-GFC period, and 4.27 days for the post-ZLB period. In contrast, the HK rate is not adjusted to the US rate for the AFC period, and takes 6.71 days and 2.31 days to make the adjustment for the pre-GFC and post-ZLB periods, respectively.

Table 6.59 shows that the 7-year interest rate relationship between SGP and the US is estimated to be statistically significant for the pre-GFC and GFC periods. The estimated relations remain around .6 for the two periods. Although the SGP rate does not necessarily own long-run equilibrium relationship with the US rate for every period, it is adjusted to the US rate for every period from the AFC to the ZLB phases. It takes less than one day and 2.86 days to make the adjustment for the AFC and pre-GFC periods. In contrast, the HK rate is not adjusted to the US rate for the two periods. For the GFC period, the HK rate completes the adjustment more quickly than the SGP rate. The coefficient adjustment is -2.626 in the case of SGP and -.573 in the case of HK for the GFC period, implying that the SGP rate takes .81 day to be adjusted to the US rate while the HK rate makes the adjustment immediately. The adjustment takes .69 day in the SGP rate for the ZLB period while the HK rate adjustment takes around 2 days for this period.

Table 6.60 shows that the 10-year interest rate of SGP is effectively affected by the US rate for the pre-GFC and post-ZLB periods. The estimated relations are .727 and .736 for the two periods, respectively. The estimate for the pre-GFC period is lower than the US-HK estimate of 1.51 while the US-SGP estimate for the post-ZLB period is higher than the US-HK estimate of .7. In contrast to the HK rate that is not adjusted to the US rate for the AFC and pre-GFC periods, the SGP rate is actively adjusted to the US rate for the two periods. In addition to the two periods, the SGP rate is adjusted to the US rate for the GFC and post-ZLB period. There is no significant adjustment found for the ZLB period. The time spent on the adjustment from the longest to the shortest is 2.96 days for the pre-GFC phase, 2.63 days for the post-ZLB era, .67 day for the GFC period, and .45 day for the AFC period. Compared to the SGP rate, the HK rate costs less time, instantly and 2.19 days, to make the adjustment for the GFC period and the post-ZLB period, respectively.

The results of estimated interest rate pass-through substantiate that the capital mobility is not perfect in Hong Kong. The interest rate pass-through from the US to Hong Kong is less than one for one under the hard peg. It means some scope for monetary autonomy in Hong Kong in the short run. The estimates also show that Singapore has more scope for monetary autonomy than Hong Kong as the estimated interest rate pass-through from the US to Singapore is lower than for Hong Kong.

We also find that the interest rate pass-through decreased after the Asian and global financial crises but increased in the most recent period. Investors' risk aversion helps explain the imperfect capital mobility and the change in the international monetary transmission over time.

Appendix

OLS Estimates

Table 6.1 Estimated US-HK 1-Month Interest Rate Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)	(4)	(5)
Period	Overall	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.163	0.377*	-0.258	0.0744	0.277**
	(0.178)	(0.171)	(0.309)	(0.137)	(0.103)
Constant	-0.0123	-0.00723	-0.301	-0.000794	0.000784
	(0.0221)	(0.0420)	(0.181)	(0.00890)	(0.0414)
N	235	72	16	84	63
Adj. R^2	0.009	0.064	-0.039	-0.010	0.014

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.2 Estimated US-HK 1-Month Interest Rate Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)	(4)	(5)
Period	Overall	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.0656*	0.200***	0.0299	0.0243	0.0563
	(0.0307)	(0.0565)	(0.0389)	(0.0239)	(0.0980)
Constant	-0.000629	-0.000119	-0.00926	-0.0000192	-0.000000321
	(0.000982)	(0.00160)	(0.00869)	(0.000356)	(0.00218)
N	5107	1564	360	1826	1357
Adj. R^2	0.003	0.022	-0.002	0.000	-0.000

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.3 Estimated US-HK 3-Month Interest Rate Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Period	Overall	Pre-AFC	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.757***	0.875***	2.447	0.586***	0.629	0.350*	0.510***
	(0.212)	(0.166)	(2.661)	(0.160)	(0.461)	(0.153)	(0.108)
Constant	-0.00614	-0.00622	-0.0309	-0.0116	-0.0328	-0.00135	0.00225
	(0.0284)	(0.0363)	(0.302)	(0.0343)	(0.269)	(0.00770)	(0.0282)
N	356	72	30	91	16	84	63
Adj. R^2	0.075	0.261	0.030	0.130	0.063	0.027	0.132

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.4 Estimated US-HK 3-Month Interest Rate Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Period	Overall	Pre-AFC	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.284**	0.487***	0.976	0.252***	0.0555	0.0715**	0.218**
	(0.101)	(0.0587)	(0.876)	(0.0536)	(0.0445)	(0.0254)	(0.0835)
Constant	-0.000764	-0.00103	-0.00122	-0.000609	-0.00916	-0.0000470	0.0000411
	(0.00311)	(0.00234)	(0.0356)	(0.00113)	(0.00576)	(0.000263)	(0.00113)
N	7754	1580	654	1977	360	1826	1357
Adj. R^2	0.002	0.050	0.002	0.039	0.002	0.005	0.015

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.5 Estimated US-HK 6-Month Interest Rate Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Period	Overall	Pre-AFC	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.784***	0.994***	0.844	0.816***	0.633	0.115	0.601***
	(0.170)	(0.142)	(1.977)	(0.118)	(0.372)	(0.0877)	(0.131)
Constant	-0.00513	-0.00241	-0.0236	-0.0106	-0.0493	-0.00104	0.00416
	(0.0252)	(0.0308)	(0.289)	(0.0296)	(0.210)	(0.00745)	(0.0242)
N	356	72	30	91	16	84	63
Adj. R^2	0.094	0.413	-0.023	0.272	0.076	-0.003	0.198

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.6 Estimated US-HK 6-Month Interest Rate Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Period	Overall	Pre-AFC	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.385***	0.685***	0.485	0.454***	0.126*	0.113***	0.161
	(0.0708)	(0.0667)	(0.559)	(0.0519)	(0.0598)	(0.0322)	(0.0829)
Constant	-0.000674	-0.000846	-0.000877	-0.000643	-0.00827	-0.0000983	0.0000568
	(0.00226)	(0.00205)	(0.0260)	(0.00109)	(0.00516)	(0.000260)	(0.000991)
N	7754	1580	654	1977	360	1826	1357
Adj. R^2	0.006	0.122	-0.000	0.102	0.014	0.015	0.009

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.7 Estimated US-HK 1-Year Interest Rate Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Period	Overall	Pre-AFC	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.790***	0.928***	-0.504	0.976***	1.091**	0.0975	0.596***
	(0.150)	(0.104)	(1.853)	(0.0898)	(0.333)	(0.0733)	(0.158)
Constant	-0.00501	-0.00454	0.00454	-0.00887	0.0406	-0.00169	0.00391
	(0.0233)	(0.0296)	(0.264)	(0.0264)	(0.165)	(0.00693)	(0.0210)
N	356	72	30	91	16	84	63
Adj. R^2	0.121	0.495	-0.029	0.427	0.342	0.005	0.235

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.8 Estimated US-HK 1-Year Interest Rate Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Period	Overall	Pre-AFC	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.505***	0.743***	0.368	0.581***	0.233**	0.171***	0.220**
	(0.0606)	(0.0510)	(0.553)	(0.0423)	(0.0849)	(0.0332)	(0.0807)
Constant	-0.000563	-0.000758	-0.000205	-0.000654	-0.00697	-0.000166	0.0000606
	(0.00173)	(0.00185)	(0.0198)	(0.00111)	(0.00503)	(0.000283)	(0.000848)
N	7754	1580	654	1977	360	1826	1357
Adj. R^2	0.018	0.221	-0.000	0.201	0.039	0.042	0.026

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.9 Estimated US-HK 2-Year Interest Rate Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Period	Overall	Pre-AFC	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.766***	0.989***	-0.521	0.955***	0.962***	0.463***	0.539***
	(0.102)	(0.0878)	(1.020)	(0.0793)	(0.192)	(0.0915)	(0.145)
Constant	-0.00404	-0.00228	0.0114	-0.00828	0.0130	-0.00316	0.00108
	(0.0212)	(0.0274)	(0.217)	(0.0263)	(0.102)	(0.0100)	(0.0191)
N	351	67	30	91	16	84	63
Adj. R^2	0.180	0.649	-0.022	0.527	0.520	0.257	0.249

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.10 Estimated US-HK 2-Year Interest Rate Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Period	Overall	Pre-AFC	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.589***	0.806***	-0.115	0.681***	0.563***	0.429***	0.442***
	(0.0243)	(0.0442)	(0.176)	(0.0305)	(0.0578)	(0.0413)	(0.0410)
Constant	-0.000301	0.0000773	0.000426	-0.000642	-0.00290	-0.000233	0.0000138
	(0.000978)	(0.00174)	(0.00951)	(0.00117)	(0.00395)	(0.000481)	(0.000970)
N	7638	1464	654	1977	360	1826	1357
Adj. R^2	0.116	0.362	-0.001	0.370	0.353	0.313	0.140

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.11 Estimated US-HK 2-Year Government Bond Yield Pass-Through in Different Subperiods at Monthly Frequency

	(1)
Period	ZLB
	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.679*** (0.109)
Constant	0.000695 (0.0116)
N	65
Adj. R^2	0.423

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.12 Estimated US-HK 2-Year Government Bond Yield Pass-Through in Different Subperiods at Daily Frequency

	(1)
Period	ZLB
	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.309*** (0.0298)
Constant	-0.0000119 (0.000592)
N	1439
Adj. R^2	0.124

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.13 Estimated US-HK 3-Year Interest Rate Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)	(4)	(5)	(6)
Period	Overall	Pre-AFC	AFC	Pre-GFC	GFC	ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.782***	0.884***	-0.309	0.928***	1.023***	0.756***
	(0.0851)	(0.0957)	(0.697)	(0.0734)	(0.156)	(0.0778)
Constant	-0.00359	0.00652	0.00975	-0.00905	0.0138	-0.000231
	(0.0241)	(0.0284)	(0.178)	(0.0230)	(0.0884)	(0.0129)
N	255	44	30	91	16	74
Adj. R^2	0.236	0.688	-0.028	0.607	0.608	0.570

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.14 Estimated US-HK 3-Year Interest Rate Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)	(4)	(5)	(6)
Period	Overall	Pre-AFC	AFC	Pre-GFC	GFC	ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.601***	0.848***	-0.0713	0.684***	0.578***	0.512***
	(0.0234)	(0.0593)	(0.133)	(0.0278)	(0.0536)	(0.0262)
Constant	-0.000269	0.000516	0.000431	-0.000659	-0.00289	-0.000205
	(0.00106)	(0.00184)	(0.00708)	(0.00129)	(0.00366)	(0.000598)
N	5568	959	654	1977	360	1618
Adj. R^2	0.170	0.475	-0.001	0.349	0.411	0.441

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.15 Estimated US-HK 3-Year Government Bond Yield Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)
Period	Overall	ZLB	Post-ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.637*** (0.0954)	0.783*** (0.139)	0.591*** (0.118)
Constant	-0.00169 (0.0128)	-0.00735 (0.0162)	0.00000406 (0.0195)
N	111	48	63
Adj. R^2	0.354	0.437	0.317

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.16 Estimated US-HK 3-Year Government Bond Yield Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)
Period	Overall	ZLB	Post-ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.471*** (0.0291)	0.558*** (0.0314)	0.421*** (0.0409)
Constant	-0.0000852 (0.000666)	-0.000203 (0.000806)	-0.0000850 (0.00100)
N	2432	1075	1357
Adj. R^2	0.190	0.297	0.142

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.17 Estimated US-HK 5-Year Interest Rate Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)	(4)	(5)	(6)
Period	Overall	Pre-AFC	AFC	Pre-GFC	GFC	ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.727***	0.884***	-0.0948	0.847***	0.889***	0.752***
	(0.0739)	(0.0934)	(0.568)	(0.0691)	(0.194)	(0.0643)
Constant	-0.0101	-0.0107	0.0122	-0.0136	-0.0267	-0.000720
	(0.0219)	(0.0311)	(0.152)	(0.0204)	(0.0804)	(0.0148)
N	244	33	30	91	16	74
Adj. R^2	0.261	0.644	-0.035	0.623	0.490	0.649

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.18 Estimated US-HK 5-Year Interest Rate Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)	(4)	(5)	(6)
Period	Overall	Pre-AFC	AFC	Pre-GFC	GFC	ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.611***	0.885***	0.0848	0.718***	0.551***	0.553***
	(0.0198)	(0.0581)	(0.113)	(0.0241)	(0.0428)	(0.0205)
Constant	-0.000535	-0.000305	0.000572	-0.000779	-0.00324	-0.0000631
	(0.000892)	(0.00205)	(0.00553)	(0.000981)	(0.00331)	(0.000748)
N	5328	719	654	1977	360	1618
Adj. R^2	0.254	0.505	-0.000	0.504	0.430	0.510

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.19 Estimated US-HK 5-Year Government Bond Yield Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)
Period	Overall	ZLB	Post-ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.701*** (0.0669)	0.719*** (0.0922)	0.675*** (0.0966)
Constant	-0.000882 (0.0127)	-0.00338 (0.0176)	0.00171 (0.0186)
N	135	72	63
Adj. R^2	0.491	0.524	0.440

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.20 Estimated US-HK 5-Year Government Bond Yield Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)
Period	Overall	ZLB	Post-ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.477*** (0.0191)	0.482*** (0.0210)	0.466*** (0.0376)
Constant	-0.000197 (0.000662)	-0.000276 (0.000888)	-0.000108 (0.000995)
N	2954	1597	1357
Adj. R^2	0.261	0.305	0.205

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.21 Estimated US-HK 7-Year Interest Rate Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)	(4)	(5)	(6)
Period	Overall	Pre-AFC	AFC	Pre-GFC	GFC	ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.746***	0.924***	-0.00123	0.861***	0.916***	0.773***
	(0.0688)	(0.138)	(0.548)	(0.0655)	(0.186)	(0.0667)
Constant	-0.0111	-0.0373	0.0157	-0.0141	-0.0488	0.00383
	(0.0222)	(0.0423)	(0.146)	(0.0191)	(0.0812)	(0.0171)
N	230	19	30	91	16	74
Adj. R^2	0.271	0.630	-0.036	0.635	0.483	0.644

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.22 Estimated US-HK 7-Year Interest Rate Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)	(4)	(5)	(6)
Period	Overall	Pre-AFC	AFC	Pre-GFC	GFC	ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.598***	0.847***	0.142	0.734***	0.597***	0.539***
	(0.0188)	(0.0737)	(0.0967)	(0.0231)	(0.0461)	(0.0220)
Constant	-0.000634	-0.00132	0.000708	-0.000811	-0.00368	-0.0000449
	(0.000885)	(0.00236)	(0.00526)	(0.000939)	(0.00324)	(0.000778)
N	5023	414	654	1977	360	1618
Adj. R^2	0.260	0.522	0.002	0.524	0.436	0.522

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.23 Estimated US-HK 10-Year Interest Rate Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)	(4)	(5)	(6)
Period	Overall	Pre-AFC	AFC	Pre-GFC	GFC	ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.738***	0.617*	0.171	0.845***	0.805**	0.768***
	(0.0674)	(0.229)	(0.534)	(0.0683)	(0.220)	(0.0703)
Constant	-0.0120	-0.0495	0.0203	-0.0189	-0.0914	0.00894
	(0.0219)	(0.0651)	(0.137)	(0.0182)	(0.0900)	(0.0188)
N	219	8	30	91	16	74
Adj. R^2	0.267	0.380	-0.032	0.622	0.371	0.609

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.24 Estimated US-HK 10-Year Interest Rate Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)	(4)	(5)	(6)
Period	Overall	Pre-AFC	AFC	Pre-GFC	GFC	ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.621***	0.845***	0.186	0.777***	0.670***	0.565***
	(0.0190)	(0.0706)	(0.0958)	(0.0233)	(0.0555)	(0.0205)
Constant	-0.000680	-0.00216	0.000937	-0.000965	-0.00430	0.000177
	(0.000899)	(0.00300)	(0.00518)	(0.000907)	(0.00335)	(0.000798)
N	4783	174	654	1977	360	1618
Adj. R^2	0.256	0.521	0.004	0.539	0.418	0.524

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.25 Estimated US-HK 10-Year Government Bond Yield Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)
Period	Overall	ZLB	Post-ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.733*** (0.0605)	0.692*** (0.0856)	0.789*** (0.0862)
Constant	-0.000156 (0.0119)	-0.00516 (0.0171)	0.00515 (0.0168)
N	133	70	63
Adj. R^2	0.560	0.540	0.581

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.26 Estimated US-HK 10-Year Government Bond Yield Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)
Period	Overall	ZLB	Post-ZLB
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.497*** (0.0187)	0.506*** (0.0202)	0.481*** (0.0371)
Constant	-0.000221 (0.000664)	-0.000443 (0.000837)	0.0000348 (0.00105)
N	2904	1547	1357
Adj. R^2	0.310	0.398	0.215

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.27 Estimated US-SGP 3-Month Interest Rate Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)	(4)	(5)
Period	Overall	AFC	Pre-GFC	GFC	ZLB
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.280* (0.118)	0.315 (0.614)	0.379** (0.142)	0.135 (0.194)	-0.375 (0.330)
Constant	0.000184 (0.0211)	-0.0563 (0.138)	0.0233 (0.0241)	-0.0714 (0.0869)	-0.00566 (0.00726)
N	187	23	91	16	57
Adj. R^2	0.042	-0.039	0.109	-0.040	0.054

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.28 Estimated US-SGP 3-Month Interest Rate Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)	(4)	(5)
Period	Overall	AFC	Pre-GFC	GFC	ZLB
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.00741		0.121***	0.0172	
	(0.0220)	-0.277* (0.122)	(0.0364)	(0.0201)	-0.0525 (0.0443)
Constant	-0.000188	-0.00132	0.00102	-0.00474	-0.000283
	(0.00105)	(0.00738)	(0.000830)	(0.00252)	(0.000337)
N	4098	520	1977	360	1241
Adj. R^2	-0.000	0.006	0.017	-0.000	0.002

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.29 Estimated US-SGP 6-Month Interest Rate Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)
Period	Overall	ZLB	Post-ZLB
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.609** (0.183)	-0.143 (0.128)	0.589** (0.198)
Constant	-0.00307 (0.0143)	0.00357 (0.00382)	-0.0199 (0.0329)
N	43	22	20
Adj. R^2	0.484	-0.015	0.440

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.30 Estimated US-SGP 6-Month Interest Rate Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)
Period	Overall	ZLB	Post-ZLB
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.163 (0.144)	-0.0148 (0.0244)	0.176 (0.161)
Constant	-0.00116** (0.000414)	0.0000751 (0.000237)	-0.00284** (0.000862)
N	969	513	436
Adj. R^2	0.033	-0.001	0.035

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.31 Estimated US-SGP 1-Year Interest Rate Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)	(4)	(5)	(6)
Period	Overall	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.333***	0.483	0.375**	0.230	-0.0286	0.414
	(0.0917)	(0.683)	(0.116)	(0.118)	(0.120)	(0.215)
Constant	-0.00196	-0.0764	0.0172	-0.0471	0.00463	-0.00956
	(0.0131)	(0.133)	(0.0223)	(0.0693)	(0.00903)	(0.0161)
N	278	23	91	16	84	63
Adj. R^2	0.076	-0.010	0.120	0.032	-0.011	0.193

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.32 Estimated US-SGP 1-Year Interest Rate Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)	(4)	(5)	(6)
Period	Overall	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.0800***	0.136	0.0997***	0.0200	0.0220	0.153**
	(0.0214)	(0.118)	(0.0299)	(0.0221)	(0.0251)	(0.0512)
Constant	-0.000278	-0.00251	0.000630	-0.00431*	0.000135	-0.000411
	(0.000559)	(0.00528)	(0.000808)	(0.00200)	(0.000264)	(0.000518)
N	6060	520	1977	360	1826	1357
Adj. R^2	0.005	0.001	0.013	-0.000	0.000	0.034

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.33 Estimated US-SGP 2-Year Interest Rate Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)	(4)	(5)	(6)
Period	Overall	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.293***	0.243	0.332***	0.273*	0.0181	0.371**
	(0.0698)	(0.615)	(0.0620)	(0.103)	(0.0757)	(0.120)
Constant	-0.00368	-0.0519	0.00986	-0.0379	0.00418	-0.00799
	(0.00996)	(0.107)	(0.0173)	(0.0455)	(0.0104)	(0.0138)
N	278	23	91	16	84	63
Adj. R^2	0.128	-0.022	0.230	0.216	-0.012	0.235

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.34 Estimated US-SGP 2-Year Interest Rate Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)	(4)	(5)	(6)
Period	Overall	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.170***	0.137*	0.193***	0.133***	0.133***	0.239***
	(0.0143)	(0.0625)	(0.0209)	(0.0342)	(0.0196)	(0.0311)
Constant	-0.000266	-0.00204	0.000328	-0.00286	0.0000599	-0.000322
	(0.000458)	(0.00309)	(0.000744)	(0.00290)	(0.000557)	(0.000660)
N	6060	520	1977	360	1826	1357
Adj. R^2	0.055	0.009	0.105	0.053	0.031	0.093

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.35 Estimated US-SGP 5-Year Interest Rate Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)	(4)	(5)	(6)
Period	Overall	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.346***	-0.0520	0.358***	0.608*	0.301**	0.426***
	(0.0581)	(0.330)	(0.0747)	(0.223)	(0.0957)	(0.0660)
Constant	-0.00528	-0.0113	-0.00407	0.0283	0.00600	-0.0139
	(0.0117)	(0.0786)	(0.0195)	(0.0899)	(0.0180)	(0.0144)
N	278	23	91	16	84	63
Adj. R^2	0.174	-0.046	0.251	0.325	0.134	0.345

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.36 Estimated US-SGP 5-Year Interest Rate Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)	(4)	(5)	(6)
Period	Overall	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.242***	0.122**	0.294***	0.188***	0.222***	0.299***
	(0.0129)	(0.0443)	(0.0234)	(0.0374)	(0.0180)	(0.0324)
Constant	-0.000296	-0.000524	-0.000259	-0.00216	0.000292	-0.000701
	(0.000527)	(0.00259)	(0.000899)	(0.00324)	(0.000872)	(0.000854)
N	6060	520	1977	360	1826	1357
Adj. R^2	0.105	0.012	0.169	0.085	0.096	0.125

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.37 Estimated US-SGP 7-Year Interest Rate Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)	(4)	(5)
Period	Overall	AFC	Pre-GFC	GFC	ZLB
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.391***		0.439***		
	(0.0706)	0.105 (0.307)	(0.0810)	0.602* (0.226)	0.298 (0.146)
Constant	-0.00906	-0.00997	-0.00478	0.0255	-0.00951
	(0.0185)	(0.0728)	(0.0199)	(0.0850)	(0.0471)
N	156	23	91	16	26
Adj. R^2	0.201	-0.040	0.311	0.310	0.107

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.38 Estimated US-SGP 7-Year Interest Rate Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)	(4)	(5)
Period	Overall	AFC	Pre-GFC	GFC	ZLB
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.228***	0.0948*	0.313***	0.186***	0.157***
	(0.0154)	(0.0378)	(0.0238)	(0.0347)	(0.0261)
Constant	-0.000604	-0.000860	-0.000357	-0.00209	0.0000430
	(0.000777)	(0.00214)	(0.000901)	(0.00304)	(0.00213)
N	3411	520	1977	360	554
Adj. R^2	0.100	0.011	0.178	0.079	0.054

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.39 Estimated US-SGP 10-Year Interest Rate Pass-Through in Different Subperiods at Monthly Frequency

	(1)	(2)	(3)	(4)	(5)	(6)
Period	Overall	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.483***	0.231	0.430***	0.645*	0.530***	0.552***
	(0.0502)	(0.272)	(0.0849)	(0.249)	(0.0859)	(0.0750)
Constant	-0.00633	-0.0541	-0.00947	0.0315	0.00716	-0.0120
	(0.0116)	(0.0732)	(0.0209)	(0.102)	(0.0170)	(0.0154)
N	273	18	91	16	84	63
Adj. R^2	0.297	-0.019	0.255	0.280	0.425	0.446

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.40 Estimated US-SGP 10-Year Interest Rate Pass-Through in Different Subperiods at Daily Frequency

	(1)	(2)	(3)	(4)	(5)	(6)
Period	Overall	AFC	Pre-GFC	GFC	ZLB	Post-ZLB
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.305***	0.119**	0.356***	0.217***	0.303***	0.367***
	(0.0138)	(0.0392)	(0.0262)	(0.0428)	(0.0204)	(0.0374)
Constant	-0.000432	-0.00231	-0.000516	-0.00137	0.000370	-0.000728
	(0.000543)	(0.00226)	(0.000948)	(0.00345)	(0.000941)	(0.000914)
N	5934	394	1977	360	1826	1357
Adj. R^2	0.144	0.021	0.184	0.067	0.163	0.174

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

ARDL Estimates

Table 6.41 Estimated US-HK 1-Month Interest Rate Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)	(4)	(5)
	D.EFB_30day	D.EFB_30day	D.EFB_30day	D.EFB_30day	D.EFB_30day
ARDL (p, q)	(2, 4)	(4, 0)	(1, 1)	(1, 0)	(4, 0)
Sample	2001m11 thru 2021m2	2001m11 thru 2007m7	2007m8 thru 2008m11	2008m12 thru 2015m11	2015m12 thru 2021m2
ADJ					
L.EFB_30day	-0.268*** (0.0535)	-0.198** (0.0666)	-0.666* (0.248)	-0.602*** (0.100)	-0.386*** (0.0867)
LR					
TCM_1m	0.709*** (0.0539)	0.846*** (0.134)	0.468 (0.245)	0.552* (0.232)	0.737*** (0.115)
SR					
LD.EFB_30day	-0.138* (0.0659)	-0.204 (0.113)			-0.170 (0.116)
L2D.EFB_30day		0.0430 (0.109)			-0.164 (0.116)
L3D.EFB_30day		0.252* (0.107)			0.174 (0.113)
D.TCM_1m	-0.0831 (0.0930)		-0.443 (0.336)		
LD.TCM_1m	0.199* (0.0880)				
L2D.TCM_1m	0.119 (0.0837)				

L3D.TCM_1m	0.234** (0.0858)				
_cons	-0.00404 (0.0274)	-0.0381 (0.0784)	-0.110 (0.383)	0.0178 (0.0121)	-0.0297 (0.0559)
N	232	69	16	84	63
adj. R-sq	0.208	0.197	0.270	0.292	0.330

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.42 Estimated US-HK 3-Month Interest Rate Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	D.EFB_91day	D.EFB_91day	D.EFB_91day	D.EFB_91day	D.EFB_91day	D.EFB_91day	D.EFB_91day
ARDL (p, q)	(2, 2)	(2, 1)	(1, 0)	(1, 2)	(1, 0)	(1, 0)	(1, 0)
Sample	1991m10 thru 2021m2	1991m10 thru 1997m6	1997m7 thru 1999m12	2000m1 thru 2007m7	2007m8 thru 2008m11	2008m12 thru 2015m11	2015m12 thru 2021m2
ADJ							
L.EFB_91day	-0.156*** (0.0329)	-0.482*** (0.0998)	-0.479** (0.157)	-0.148** (0.0549)	-0.700** (0.232)	-0.334*** (0.0809)	-0.317*** (0.0658)
LR							
TCM_3m	1.059*** (0.0833)	1.022*** (0.0616)	2.966 (1.936)	0.989*** (0.122)	0.710** (0.216)	0.659 (0.359)	0.807*** (0.0998)
SR							
LD.EFB_91day	-0.232*** (0.0519)	0.276** (0.0971)					
D.TCM_3m	0.502*** (0.136)	0.378* (0.164)		0.222 (0.178)			
LD.TCM_3m	0.308* (0.140)			0.262 (0.173)			
_cons	-0.0402 (0.0424)	-0.0845 (0.136)	-3.865 (4.195)	-0.0860 (0.0711)	-0.244 (0.364)	0.0179 (0.0137)	-0.0233 (0.0422)
N	353	69	30	91	16	84	63
adj. R-sq	0.207	0.430	0.247	0.219	0.325	0.160	0.271

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.43 Estimated US-HK 6-Month Interest Rate Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	D.EFB_182day	D.EFB_182day	D.EFB_182day	D.EFB_182day	D.EFB_182day	D.EFB_182day	D.EFB_182day
ARDL (p, q)	(2, 2)	(4, 4)	(1, 1)	(1, 1)	(1, 0)	(3, 0)	(1, 0)
Sample	1991m10 thru 2021m2	1991m10 thru 1997m6	1997m7 thru 1999m12	2000m1 thru 2007m7)	2007m8 thru 2008m11	2008m12 thru 2015m11	2015m12 thru 2021m2
ADJ							
L.EFB_182day	-0.118*** (0.0284)	-0.517*** (0.122)	-0.510** (0.167)	-0.129* (0.0495)	-0.752** (0.240)	-0.208* (0.0896)	-0.291*** (0.0586)
LR							
TCM_6m	1.076*** (0.0988)	1.024*** (0.0479)	2.935 (1.499)	1.006*** (0.124)	0.779** (0.188)	0.282 (0.360)	0.815*** (0.0967)
SR							
LD.EFB_182day	-0.215*** (0.0518)	0.305* (0.119)				-0.0368 (0.105)	
L2D.EFB_182day		0.168 (0.118)				-0.244* (0.0932)	
L3D.EFB_182day		0.165 (0.108)					
D.TCM_6m	0.532*** (0.130)	0.228 (0.187)	-2.410 (1.592)	0.567*** (0.165)			
LD.TCM_6m	0.380** (0.135)	0.0865 (0.181)					
L2D.TCM_6m		-0.260 (0.164)					
L3D.TCM_6m		-0.444** (0.165)					
_cons	-0.0369 (0.0394)	-0.108 (0.115)	-4.007 (3.538)	-0.0856 (0.0627)	-0.380 (0.374)	0.0186 (0.0169)	-0.0271 (0.0391)
N	353	69	30	91	16	84	63
adj. R-sq	0.198	0.610	0.230	0.311	0.348	0.174	0.290

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.44 Estimated US-HK 1-Year Interest Rate Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	D.EFB_364day	D.EFB_364day	D.EFB_364day	D.EFB_364day	D.EFB_364day	D.EFB_364day	D.EFB_364day
ARDL (p, q)	(4, 4)	(4, 4)	(1, 1)	(1, 1)	(4, 2)	(3, 0)	(1, 1)
Sample	1991m10 thru 2021m2	1991m10 thru 1997m6	1997m7 thru 1999m12	2000m1 thru 2007m7)	2007m8 thru 2008m11	2008m12 thru 2015m11	2015m12 thru 2021m2
ADJ							
L.EFB_364day	-0.117*** (0.0269)	-0.564*** (0.124)	-0.454** (0.141)	-0.106* (0.0483)	-2.049** (0.508)	-0.199* (0.0787)	-0.202** (0.0707)
LR							
TCM_1yr	1.123*** (0.0919)	0.949*** (0.0412)	2.504 (1.358)	1.071*** (0.148)	1.021*** (0.0513)	0.234 (0.243)	0.803*** (0.127)
SR							
LD.EFB_364day	-0.166** (0.0545)	0.346** (0.123)			1.186* (0.411)	0.0163 (0.0938)	
L2D.EFB_364day	0.0952 (0.0551)	0.225 (0.122)			0.431 (0.247)	-0.225* (0.0929)	
L3D.EFB_364day	0.0931 (0.0525)	0.167 (0.108)			0.304 (0.206)		
D.TCM_1yr	0.538*** (0.118)	0.126 (0.170)	-2.898* (1.197)	0.777*** (0.147)	-0.506 (0.501)		0.263 (0.167)
LD.TCM_1yr	0.324* (0.126)	-0.0325 (0.162)			-1.248* (0.465)		
L2D.TCM_1yr	0.148 (0.128)	-0.226 (0.149)					
L3D.TCM_1yr	-0.328** (0.125)	-0.469** (0.151)					
_cons	-0.0462 (0.0380)	0.143 (0.126)	-2.499 (2.873)	-0.0816 (0.0610)	-1.389* (0.432)	0.0234 (0.0178)	-0.0180 (0.0361)
N	353	69	30	91	16	84	63
adj. R-sq	0.221	0.687	0.278	0.447	0.690	0.153	0.321

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.45 Estimated US-HK 2-Year Interest Rate Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	D.EFN_2yr	D.EFN_2yr	D.EFN_2yr	D.EFN_2yr	D.EFN_2yr	D.EFN_2yr	D.EFN_2yr
ARDL (p, q)	(4, 4)	(2, 1)	(1, 1)	(1, 1)	(4, 2)	(4, 1)	(1, 2)
Sample	1992m3 thru 2021m2	1992m3 thru 1997m6	1997m7 thru 1999m12	2000m1 thru 2007m7)	2007m8 thru 2008m11	2008m12 thru 2015m11	2015m12 thru 2021m2
ADJ							
L.EFN_2yr	-0.104*** (0.0250)	-0.530*** (0.0938)	-0.359* (0.137)	-0.123* (0.0490)	-1.670*** (0.296)	-0.341*** (0.0928)	-0.215* (0.0859)
LR							
TCM_2yr	1.149*** (0.0919)	0.953*** (0.0431)	1.597 (1.298)	1.100*** (0.143)	0.979*** (0.0363)	0.518*** (0.103)	0.749*** (0.106)
SR							
LD.EFN_2yr	-0.159** (0.0547)	0.264*** (0.0641)			0.904** (0.236)	-0.159 (0.0939)	
L2D.EFN_2yr	0.0864 (0.0551)				0.352* (0.121)	-0.0520 (0.0768)	
L3D.EFN_2yr	0.105* (0.0531)				0.202 (0.108)	0.150* (0.0656)	
D.TCM_2yr	0.615*** (0.0908)	0.312* (0.135)	-1.691 (0.826)	0.765*** (0.119)	-0.491 (0.304)	0.222* (0.0909)	0.224 (0.143)
LD.TCM_2yr	0.255** (0.0983)				-1.125** (0.271)		0.187 (0.120)
L2D.TCM_2yr	0.110 (0.0993)						
L3D.TCM_2yr	-0.243* (0.0971)						
_cons	-0.0477 (0.0360)	0.186 (0.131)	-0.338 (2.437)	-0.0926 (0.0696)	-0.608* (0.214)	0.0395 (0.0239)	0.00282 (0.0361)
N	348	64	30	91	16	84	63
adj. R-sq	0.267	0.778	0.212	0.551	0.852	0.431	0.381

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.46 Estimated US-HK 2-Year Government Bond Yield Pass-Through in Different Subperiods with the ARDL Model

	(1)
	D.gb_2yr
ARDL (p, q)	(4, 1)
Sample	2010m1 thru 2015m2
ADJ	
L.gb_2yr	-0.468*** (0.130)
LR	
TCM_2yr	0.468*** (0.111)
SR	
LD.gb_2yr	0.0141 (0.127)
L2D.gb_2yr	-0.0288 (0.117)
L3D.gb_2yr	0.280* (0.110)
D.TCM_2yr	0.395** (0.119)
_cons	0.0873* (0.0356)
N	62
adj. R-sq	0.580

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.47 Estimated US-HK 3-Year Interest Rate Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)	(4)	(5)	(6)
	D.EFN_3yr	D.EFN_3yr	D.EFN_3yr	D.EFN_3yr	D.EFN_3yr	D.EFN_3yr
ARDL (p, q)	(2, 3)	(1, 2)	(1, 1)	(1, 1)	(4, 2)	(3, 3)
Sample	1994m2 thru 2015m1	1994m2 thru 1997m6	1997m7 thru 1999m12	2000m1 thru 2007m7	2007m8 thru 2008m11	2008m12 thru 2015m1
ADJ						
L.EFN_3yr	-0.0790** (0.0265)	-0.340** (0.124)	-0.285* (0.131)	-0.1000* (0.0440)	-1.581*** (0.237)	-0.273* (0.121)
LR						
TCM_3yr	1.205*** (0.141)	0.887*** (0.120)	1.607 (1.445)	1.097*** (0.178)	0.952*** (0.0318)	0.743*** (0.102)
SR						
LD.EFN_3yr	-0.128* (0.0629)				0.732** (0.191)	-0.353* (0.134)
L2D.EFN_3yr					0.382** (0.0954)	-0.278* (0.109)
L3D.EFN_3yr					0.264* (0.0871)	

D.TCM_3yr	0.654*** (0.0930)	0.358* (0.149)	-1.136 (0.683)	0.792*** (0.0969)	-0.396 (0.251)	0.535*** (0.114)
LD.TCM_3yr	0.197 (0.102)	0.310** (0.0873)			-0.958** (0.221)	0.329** (0.117)
L2D.TCM_3yr	0.140 (0.0894)					0.219* (0.104)
_cons	-0.0418 (0.0466)	0.350 (0.240)	-0.292 (2.153)	-0.0574 (0.0711)	-0.241 (0.159)	0.0135 (0.0266)
N	252	41	30	91	16	74
adj. R-sq	0.284	0.821	0.161	0.622	0.914	0.689

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.48 Estimated US-HK 3-Year Government Bond Yield Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)
	D.gb_3yr	D.gb_3yr	D.gb_3yr
ARDL (p, q)	(1, 2)	(1, 1)	(1, 2)
Sample	2012m3 thru 2021m2	2012m3 thru 2015m11	2015m12 thru 2021m2
ADJ			
L.gb_3yr	-0.269*** (0.0707)	-0.307* (0.114)	-0.250** (0.0917)
LR			
TCM_3yr	0.729*** (0.0607)	0.516** (0.180)	0.740*** (0.0869)
SR			
D.TCM_3yr	0.370*** (0.102)	0.622*** (0.148)	0.271* (0.133)
LD.TCM_3yr	0.115 (0.0788)		0.223* (0.107)
_cons	0.0170 (0.0232)	0.0645 (0.0453)	0.0113 (0.0366)
N	108	45	63
adj. R-sq	0.463	0.546	0.462

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.49 Estimated US-HK 5-Year Interest Rate Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)	(4)	(5)	(6)
	D.EFN_5yr	D.EFN_5yr	D.EFN_5yr	D.EFN_5yr	D.EFN_5yr	D.EFN_5yr
ARDL (p, q)	(1, 2)	(1, 1)	(1, 0)	(1, 1)	(4, 2)	(3, 2)
Sample	1995m1 thru 2015m1	1995m1 thru 1997m6	1997m7 thru 1999m12	2000m1 thru 2007m7	2007m8 thru 2008m11	2008m12 thru 2015m1
ADJ						

L.EFN_5yr	-0.0814** (0.0248)	-0.272 (0.145)	-0.188 (0.122)	-0.0981* (0.0392)	-1.602*** (0.253)	-0.323** (0.114)
LR						
TCM_5yr	1.321*** (0.144)	1.184*** (0.299)	1.780 (2.021)	1.193*** (0.204)	1.044*** (0.0447)	0.858*** (0.0700)
SR						
D.TCM_5yr	0.613*** (0.0822)	0.548* (0.212)		0.723*** (0.0837)	-0.653* (0.281)	0.468*** (0.107)
LD.TCM_5yr	0.141 (0.0785)				-0.949** (0.240)	0.263* (0.101)
LD.EFN_5yr					0.684** (0.196)	-0.207 (0.115)
L2D.EFN_5yr					0.473** (0.102)	-0.0864 (0.0601)
L3D.EFN_5yr					0.242 (0.107)	
_cons	-0.0845 (0.0530)	-0.133 (0.478)	-0.364 (1.907)	-0.0893 (0.0895)	-0.813* (0.296)	-0.0362 (0.0391)
N	241	30	30	91	16	74
adj. R-sq	0.297	0.667	0.108	0.641	0.883	0.744

Standard errors in parentheses = “* p<0.05 ** p<0.01 *** p<0.001”

Table 6.50 Estimated US-HK 5-Year Government Bond Yield Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)
	D.gb_5yr	D.gb_5yr	D.gb_5yr
ARDL (p, q)	(1, 2)	(3, 1)	(1, 2)
Sample	2010m3 thru 2021m2	2010m3 thru 2015m11	2015m12 thru 2021m2
ADJ			
L.gb_5yr	-0.336*** (0.0681)	-0.622*** (0.120)	-0.259* (0.0987)
LR			
TCM_5yr	0.726*** (0.0527)	0.813*** (0.0532)	0.707*** (0.0819)
SR			
D.TCM_5yr	0.429*** (0.0834)	0.293* (0.125)	0.373** (0.128)
LD.TCM_5yr	0.151* (0.0598)		0.251** (0.0937)
LD.gb_5yr		0.119 (0.0777)	
L2D.gb_5yr		0.133 (0.0764)	
_cons	0.0266 (0.0295)	-0.00706 (0.0481)	0.0236 (0.0394)
N	132	69	63
adj. R-sq	0.605	0.667	0.573

Standard errors in parentheses = “* p<0.05 ** p<0.01 *** p<0.001”

Table 6.51 Estimated US-HK 7-Year Interest Rate Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)	(4)	(5)	(6)
	D.EFN_7yr	D.EFN_7yr	D.EFN_7yr	D.EFN_7yr	D.EFN_7yr	D.EFN_7yr
ARDL (p, q)	(1, 2)	(1, 3)	(1, 0)	(2, 2)	(4, 4)	(2, 2)
Sample	1996m3 thru 2015m1	1996m3 thru 1997m6	1997m7 thru 1999m12	2000m1 thru 2007m7	2007m8 thru 2008m11	2008m12 thru 2015m1
ADJ						
L.EFN_7yr	-0.0810** (0.0256)	-0.0525 (0.121)	-0.188 (0.125)	-0.0656 (0.0380)	-2.626** (0.526)	-0.293** (0.0941)
LR						
TCM_7yr	1.436*** (0.168)	-1.341 (6.068)	1.544 (1.949)	1.327*** (0.331)	1.242*** (0.0288)	0.899*** (0.0805)
SR						
D.TCM_7yr	0.621*** (0.0857)	0.709** (0.176)		0.794*** (0.0824)	-2.063* (0.636)	0.494*** (0.104)
LD.TCM_7yr	0.148 (0.0807)	0.268 (0.124)		0.322** (0.110)	-1.957** (0.442)	0.253* (0.104)
L2D.TCM_7yr		0.298* (0.121)			-0.765 (0.416)	
L3D.TCM_7yr					-0.393 (0.311)	
LD.EFN_7yr				-0.207* (0.101)	1.433** (0.354)	-0.155 (0.113)
L2D.EFN_7yr					0.997* (0.289)	
L3D.EFN_7yr					0.504 (0.222)	
_cons	-0.132 (0.0684)	0.789 (0.963)	-0.147 (1.983)	-0.102 (0.109)	-3.511** (0.774)	-0.0900 (0.0597)
N	227	16	30	91	16	74
adj. R-sq	0.305	0.778	0.098	0.676	0.907	0.728

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.52 Estimated US-HK 10-Year Interest Rate Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)	(4)	(5)
	D.EFN_10yr	D.EFN_10yr	D.EFN_10yr	D.EFN_10yr	D.EFN_10yr
ARDL (p, q)	(4, 1)	(1, 0)	(2, 2)	(3, 2)	(1, 2)
Sample	1997m2 thru 2015m1	1997m7 thru 1999m12	2000m1 thru 2007m7	2007m8 thru 2008m11	2008m12 thru 2015m1

ADJ					
L.EFN_10yr	-0.0722** (0.0236)	-0.193 (0.120)	-0.0545 (0.0328)	-1.384** (0.419)	-0.249*** (0.0693)
LR					
TCM_10yr	1.697*** (0.232)	1.684 (1.864)	1.510** (0.493)	1.556*** (0.139)	0.917*** (0.107)
SR					
LD.EFN_10yr	0.0746 (0.0577)		-0.201 (0.103)	0.743 (0.345)	
L2D.EFN_10yr	0.0506 (0.0582)			0.433* (0.171)	
L3D.EFN_10yr	-0.135* (0.0575)				
D.TCM_10yr	0.634*** (0.0877)		0.794*** (0.0820)	-0.907 (0.599)	0.508*** (0.0926)
LD.TCM_10yr			0.296** (0.112)	-1.465* (0.602)	0.179** (0.0599)
_cons	-0.205* (0.0894)	-0.256 (1.879)	-0.136 (0.152)	-4.040* (1.574)	-0.118 (0.0813)
N	216	30	91	16	74
adj. R-sq	0.309	0.109	0.656	0.649	0.694

Standard errors in parentheses = “* p<0.05 ** p<0.01 *** p<0.001”

Table 6.53 Estimated US-HK 10-Year Government Bond Yield Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)
	D.gb_10yr	D.gb_10yr	D.gb_10yr
ARDL (p, q)	(2, 1)	(4, 1)	(1, 2)
Sample	2010m5 thru 2021m2	2010m5 thru 2015m11	2015m12 thru 2021m2
ADJ			
L.gb_10yr	-0.205*** (0.0505)	-0.186* (0.0759)	-0.271* (0.104)
LR			
TCM_10yr	0.786*** (0.0844)	0.888*** (0.168)	0.700*** (0.0823)
SR			
LD.gb_10yr	0.173** (0.0558)	0.204* (0.0767)	
L2D.gb_10yr		0.0631 (0.0808)	
L3D.gb_10yr		-0.153 (0.0807)	
D.TCM_10yr	0.560*** (0.0684)	0.574*** (0.0931)	0.507*** (0.126)
LD.TCM_10yr			0.154 (0.0849)
_cons	-0.00399 (0.0395)	-0.0395 (0.0776)	0.0233 (0.0476)
N	130	67	63

adj. R-sq	0.633	0.639	0.640

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.54 Estimated US-SGP 3-Month Interest Rate Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)	(4)	(5)
	D.sgs_3m_yield	D.sgs_3m_yield	D.sgs_3m_yield	D.sgs_3m_yield	D.sgs_3m_yield
ARDL (p, q)	(2, 2)	(1, 0)	(1, 2)	(1, 0)	(4, 0)
Sample	1998m5 thru 2013m8	1998m5 thru 1999m12	2000m1 thru 2007m7	2007m8 thru 2008m11	2008m12 thru 2013m8
ADJ					
L.sgs_3m_yield	-0.185*** (0.0400)	-0.0658 (0.154)	-0.227*** (0.0417)	-0.477* (0.180)	-0.299*** (0.0814)
LR					
TCM_3m	0.399*** (0.0498)	12.22 (32.13)	0.441*** (0.0492)	0.484** (0.149)	0.103 (0.419)
SR					
LD.sgs_3m_yield	0.230** (0.0699)				0.0775 (0.110)
L2D.sgs_3m_yield					0.0444 (0.0649)
L3D.sgs_3m_yield					0.166*** (0.0463)
D.TCM_3m	0.150 (0.0863)		0.126 (0.102)		
LD.TCM_3m	0.169 (0.0876)		0.418*** (0.102)		
_cons	0.0581 (0.0317)	-3.801 (2.432)	0.0782 (0.0436)	0.0901 (0.198)	0.0877** (0.0256)
N	184	20	91	16	57
adj. R-sq	0.214	0.101	0.404	0.259	0.331

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.55 Estimated US-SGP 6-Month Interest Rate Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)
	D.sgs_6m_yield	D.sgs_6m_yield	D.sgs_6m_yield
ARDL (p, q)	(3, 4)	(1, 0)	(2, 4)
Sample	2012m11 thru 2021m3	2012m11 thru 2014m5	2019m10 thru 2021m2
ADJ			

L.sgs_6m_yield	-0.139 (0.196)	-0.320 (0.177)	-0.584 (0.313)
LR			
TCM_6m	1.199* (0.497)	-0.610 (0.331)	0.921*** (0.0461)
SR			
LD.sgs_6m_yield	-0.848*** (0.189)		-0.617* (0.214)
L2D.sgs_6m_yield	-0.227 (0.179)		
D.TCM_6m	0.294 (0.195)		-0.157 (0.293)
LD.TCM_6m	0.740*** (0.172)		0.489 (0.256)
L2D.TCM_6m	0.521** (0.170)		0.274* (0.115)
L3D.TCM_6m	0.323** (0.104)		0.224* (0.0699)
_cons	0.0477 (0.0403)	0.108 (0.0555)	0.153* (0.0672)
N	37	19	17
adj. R-sq	0.896	0.101	0.921

Standard errors in parentheses = “* p<0.05 ** p<0.01 *** p<0.001”

Table 6.56 Estimated US-SGP 1-Year Interest Rate Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)	(4)	(5)	(6)
	D.sgs_1yr_yield	D.sgs_1yr_yield	D.sgs_1yr_yield	D.sgs_1yr_yield	D.sgs_1yr_yield	D.sgs_1yr_yield
ARDL (p, q)	(1, 3)	(1, 0)	(1, 2)	(2, 4)	(4, 2)	(2, 3)
Sample	1998m5 thru 2021m3	1998m5 thru 1999m12	2000m1 thru 2007m7	2007m8 thru 2008m11	2008m12 thru 2015m11	2015m12 thru 2021m2
ADJ						
L.sgs_1yr_yield	-0.129*** (0.0303)	-0.109 (0.177)	-0.197*** (0.0475)	-1.418** (0.302)	-0.0349 (0.0474)	-0.231** (0.0776)
LR						
TCM_1yr	0.424*** (0.0522)	4.030 (8.288)	0.489*** (0.0618)	0.457*** (0.0356)	0.453 (2.111)	0.718*** (0.0728)
SR						
D.TCM_1yr	0.154* (0.0702)		0.185 (0.0986)	-0.606* (0.211)	0.134 (0.136)	0.00836 (0.106)
LD.TCM_1yr	0.208** (0.0686)		0.282** (0.0968)	-0.558* (0.192)	0.212* (0.104)	0.341** (0.100)
L2D.TCM_1yr	0.0949 (0.0673)			-0.300 (0.163)		0.282** (0.0978)
L3D.TCM_1yr				-0.326 (0.147)		

LD.sgs_1yr_ yield				0.751* (0.238)	0.0350 (0.113)	-0.302** (0.112)
L2D.sgs_1yr _yield					-0.0225 (0.104)	
L3D.sgs_1yr _yield					0.250** (0.0939)	
_cons	0.0540* (0.0230)	-2.021 (1.773)	0.0343 (0.0474)	0.156 (0.154)	0.0194 (0.0201)	0.0652 (0.0424)
N	275	20	91	16	84	63
adj. R-sq	0.193	0.106	0.325	0.605	0.098	0.547

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.57 Estimated US-SGP 2-Year Interest Rate Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)	(4)	(5)	(6)
	D.sgs_2yr _yield	D.sgs_2yr _yield	D.sgs_2yr _yield	D.sgs_2yr _yield	D.sgs_2yr _yield	D.sgs_2yr _yield
ARDL (p, q)	(2, 2)	(1, 0)	(1, 2)	(3, 4)	(1, 0)	(1, 3)
Sample	1998m5 thru 2021m3	1998m5 thru 1999m12	2000m1 thru 2007m7	2007m8 thru 2008m11	2008m12 thru 2015m11	2015m12 thru 2021m2
ADJ						
L.sgs_2yr_yi eld	-0.121*** (0.0282)	-0.0130 (0.186)	-0.183*** (0.0502)	-1.830*** (0.303)	-0.0285 (0.0475)	-0.261** (0.0808)
LR						
TCM_2yr	0.464*** (0.0442)	23.34 (345.4)	0.511*** (0.0608)	0.465*** (0.0132)	-0.0766 (1.827)	0.673*** (0.0548)
SR						
LD.sgs_2yr_ yield	0.117* (0.0585)			1.108** (0.215)		
L2D.sgs_2yr _yield				0.437 (0.206)		
D.TCM_2yr	0.199*** (0.0466)		0.225*** (0.0622)	-0.790** (0.166)		0.0805 (0.0910)
LD.TCM_2y r	0.117* (0.0490)		0.113 (0.0586)	-0.620** (0.140)		0.179* (0.0767)
L2D.TCM_2 yr				-0.424* (0.126)		0.133 (0.0704)
L3D.TCM_2 yr				-0.382** (0.0887)		
_cons	0.0429* (0.0190)	-1.600 (1.561)	0.0344 (0.0465)	0.217* (0.0823)	0.0193 (0.0251)	0.0864* (0.0376)

N	275	20	91	16	84	63
adj. R-sq	0.236	0.078	0.366	0.859	-0.017	0.503

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.58 Estimated US-SGP 5-Year Interest Rate Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)	(4)	(5)	(6)
	D.sgs_5yr_yield	D.sgs_5yr_yield	D.sgs_5yr_yield	D.sgs_5yr_yield	D.sgs_5yr_yield	D.sgs_5yr_yield
ARDL (p, q)	(4, 2)	(1, 3)	(2, 1)	(3, 3)	(1, 1)	(3, 3)
Sample	1998m5 thru 2021m3	1998m5 thru 1999m12	2000m1 thru 2007m7	2007m8 thru 2008m11	2008m12 thru 2015m11	2015m12 thru 2021m2
ADJ						
L.sgs_5yr_yield	-0.140*** (0.0312)	-0.977** (0.308)	-0.233*** (0.0609)	-0.609 (0.338)	-0.0571 (0.0496)	-0.150* (0.0663)
LR						
TCM_5yr	0.576*** (0.0495)	0.103 (0.158)	0.553*** (0.0744)	0.598** (0.162)	-0.0608 (0.788)	0.788*** (0.134)
SR						
LD.sgs_5yr_yield	0.0843 (0.0600)		0.240** (0.0852)	-0.208 (0.249)		-0.107 (0.121)
L2D.sgs_5yr_yield	-0.0755 (0.0534)			-0.600* (0.204)		-0.314** (0.110)
L3D.sgs_5yr_yield	0.121* (0.0535)					
D.TCM_5yr	0.255*** (0.0462)	-0.861* (0.332)	0.233*** (0.0672)	0.210 (0.230)	0.305*** (0.0831)	0.240** (0.0807)
LD.TCM_5yr	0.0799 (0.0489)	-0.321 (0.322)		0.370 (0.173)		0.164 (0.0848)
L2D.TCM_5yr		-0.563 (0.304)		0.611** (0.149)		0.237** (0.0831)
_cons	0.0531* (0.0255)	3.294 (1.554)	0.0967 (0.0817)	0.264 (0.376)	0.0734 (0.0555)	0.0213 (0.0474)
N	275	20	91	16	84	63
adj. R-sq	0.259	0.302	0.370	0.841	0.138	0.535

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.59 Estimated US-SGP 7-Year Interest Rate Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)	(4)	(5)
	D.sgs_7yr_yield	D.sgs_7yr_yield	D.sgs_7yr_yield	D.sgs_7yr_yield	D.sgs_7yr_yield
ARDL (p, q)	(2, 1)	(2, 0)	(2, 1)	(4, 3)	(2, 0)
Sample	1998m5 thru 2011m1	1998m5 thru 1999m12	2000m1 thru 2007m7	2007m8 thru 2008m11	2008m12 thru 2015m11
ADJ					
L.sgs_7yr_yield	-0.196*** (0.0437)	-0.613* (0.245)	-0.215*** (0.0608)	-0.573* (0.169)	-0.632*** (0.166)
LR					
TCM_7yr	0.738*** (0.0802)	-0.0110 (0.196)	0.627*** (0.0996)	0.585** (0.148)	0.302 (0.159)
SR					
LD.sgs_7yr_yield	0.161* (0.0688)	0.367 (0.238)	0.186* (0.0830)	-0.158 (0.179)	0.242 (0.178)
L2D.sgs_7yr_yield				-0.471* (0.147)	
L3D.sgs_7yr_yield				0.171 (0.124)	
D.TCM_7yr	0.258*** (0.0661)		0.308*** (0.0742)	0.355* (0.130)	
LD.TCM_7yr				0.434* (0.152)	
L2D.TCM_7yr				0.827*** (0.140)	
_cons	-0.0382 (0.0685)	2.665 (1.491)	0.0551 (0.102)	0.387 (0.342)	0.555 (0.330)
N	153	20	91	16	26
adj. R-sq	0.299	0.210	0.398	0.902	0.338

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 6.60 Estimated US-SGP 10-Year Interest Rate Pass-Through in Different Subperiods with the ARDL Model

	(1)	(2)	(3)	(4)	(5)	(6)
	D.sgs_10yr_yield	D.sgs_10yr_yield	D.sgs_10yr_yield	D.sgs_10yr_yield	D.sgs_10yr_yield	D.sgs_10yr_yield
ARDL (p, q)	(4, 4)	(1, 0)	(3, 1)	(4, 3)	(3, 3)	(1, 1)
Sample	1998m5 thru 2021m3	1998m5 thru 1999m12	2000m1 thru 2007m7	2007m8 thru 2008m11	2008m12 thru 2015m11	2015m12 thru 2021m2
ADJ						
L.sgs_10yr_yield	-0.183*** (0.0293)	-0.785*** (0.179)	-0.209*** (0.0549)	-0.644** (0.139)	-0.0522 (0.0589)	-0.232** (0.0716)
LR						
TCM_10yr	0.562*** (0.0414)	0.205 (0.120)	0.727*** (0.134)	0.299 (0.178)	0.0853 (0.702)	0.736*** (0.0888)
SR						
LD.sgs_10yr_yield	0.0393 (0.0585)		0.234** (0.0859)	0.0168 (0.176)	-0.264* (0.114)	
L2D.sgs_10yr_yield	-0.0692 (0.0571)		0.147 (0.0885)	-0.359* (0.146)	-0.293* (0.111)	
L3D.sgs_10yr_yield	0.173** (0.0559)			0.308 (0.139)		
D.TCM_10yr	0.412*** (0.0446)		0.288*** (0.0797)	0.651** (0.142)	0.577*** (0.0761)	0.357*** (0.0929)
LD.TCM_10yr	0.132* (0.0509)			0.707* (0.208)	0.243** (0.0881)	
L2D.TCM_10yr	0.114* (0.0502)			1.014** (0.225)	0.277** (0.0854)	
L3D.TCM_10yr	-0.0734 (0.0509)					
_cons	0.140*** (0.0328)	2.630* (0.963)	-0.00988 (0.133)	1.232 (0.542)	0.116 (0.0844)	0.0939 (0.0598)
N	270	15	91	16	84	63
adj. R-sq	0.441	0.609	0.390	0.856	0.503	0.518

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Chapter 7 Estimated Offset and Sterilization Coefficients

The estimated offset and sterilization coefficients of Hong Kong and Singapore are presented in this chapter. We find partial sterilization in Hong Kong and full sterilization in Singapore during the period in our samples. The results substantiate the imperfect capital mobility, which makes the small open economies have some scopes for monetary autonomy.

We also find the sterilization coefficient is estimated to be greater in value with the standard measure of the net domestic assets (NDA) than with the HKMA measure. It indicates that the HKMA is able to sterilize capital flows considerably by keeping the backing ratio of foreign exchange reserves to the monetary base over 100% and including outstanding debt securities in the monetary base.

The estimated offset coefficients are close to -1, indicating perfect capital mobility. But the estimates of the offset and sterilization coefficients contradict each other. As discussed in Chapters 2 and 3, the sterilization coefficients are a better measure of sterilization than the offset coefficients as a measure of capital mobility.

The results are explained as follows in detail.

Section 7.1 The Estimated Offset and Sterilization Coefficients for Hong Kong

Table 7.1 displays the estimated offset and sterilization coefficients of Hong Kong with simultaneous equations (5.24) and (5.25) using the 2SLS approach.

Hong Kong has succeeded in undertaking some degree of sterilization. The estimated sterilization coefficient of Hong Kong is -0.246, which is statistically different from zero, with the HKMA measure of the NDA. It indicates that, on average, 24.6% of capital flows are sterilized by the HKMA.

Hong Kong has been able to partially sterilize capital flows through having outstanding debt securities (EFBNs) in its monetary base than the estimate with the HKMA measure of the NDA. The sterilization coefficient with the standard measure is estimated to be -0.78. It is statistically less than one and greater than zero, suggesting that capital flows cannot be sterilized fully but to a greater extent than the official claims in Hong Kong which state that they do not sterilize. Their claims may be because with the measure of the base that they advocate there appears to be little sterilization.

Hong Kong has high capital mobility. The offset coefficient of Hong Kong is estimated to be -0.881 with the HKMA measure of the NDA and -0.858 with the standard measure. The former estimate indicates nearly perfect capital mobility. The latter estimate is only a little lower. The results and the estimated sterilization coefficients contradict each other. Since the pass-through estimates imply less than perfect capital mobility, there is a strong case for believing that the sterilization estimates are more accurate than the offset coefficients.

The cyclical component of real GDP significantly affects the central bank balance sheet components of Hong Kong. If the real GDP exceeds the trend by 1%, the NFA shrinks by 1.814%, and the NDA decreases by 1.134%, holding the other things constant. The results are expected as an inflationary gap requires a contractionary monetary policy to close and leads to currency appreciation and a deterioration in the account balance, making both NDA and NFA shrink. The effects are estimated to be smaller with the standard measure of NDA than with the HKMA measure, suggesting the positive impact of sterilization on monetary insulation.

The inflation rate from the last period affects the NDA negatively in Hong Kong, as shown in the first and third columns of Table 7.1. The coefficients suggest that, as estimated with the HKMA measure of the NDA, a 1% increase in the inflation rate in the last period can make domestic assets shrink by 5.928% on average. The standard measure estimates the effect is smaller than the HKMA measure. As shown in the third column, the coefficient on the variable Δp_{t-1} is -3.108. It means that the NDA, which does not have the outstanding EFBNs, shrinks by 3.108% in response to a 1% rise in the inflation rate in the last period. The results imply that the HKMA does not pursue inflation targeting with independent monetary policy, although it has some scopes to control inflation by tightening the domestic assets effectively by a moderate extent.

The inflation rate does not affect the NFA in Hong Kong, as suggested by the results in the second and fourth columns of Table 7.1. It is attributed to the credible currency board arrangement adopted by the HKMA to the US dollars. Capital flows are not impacted significantly by a rise in the domestic inflation rate with the belief that the inflation will be controlled well under the credible fixed exchange rate regime.

The spot exchange rate at the end of the last period affects both NDA and NFA in Hong Kong. Columns (1) and (3) of Table 7.1 show that if the spot exchange rate against the dollar depreciates by HK$1, the net domestic assets will decrease by 6.544% as estimated with the HKMA measure of the NDA and by 6.248% as estimated with the standard measure of the NDA. It means that the HKMA will raise domestic interest rates by reducing the NDA to stop capital outflows that may occur with the currency depreciation, which emphasizes that exchange rate stability takes priority over independent monetary policy as the single policy objective of the HKMA.

The influence of currency depreciation on the NFA is larger than on the NDA. Columns (2) and (4) of Table 7.1 show that if the Hong Kong dollar against the US dollar depreciates by HK$1, the net foreign assets will decrease by 10.6% as estimated with the HKMA measure of the NDA and 7.398% as estimated with the standard measure. The change in the NFA is attributed to the sale of foreign exchange reserves and the purchase of Hong Kong dollars by the HKMA in the foreign exchange market to defend the local currency from depreciating.

With the assumption of perfect foresight, the market expectation on the spot exchange rate for the next period is measured with the percentage change in the spot exchange rate from the current period to the next period plus the foreign interest rate for the current period. The change in the market expectation does not affect the NDA and NFA in Hong Kong, as shown in the first two columns of Table 7.1. But columns (3) and (4) of Table 7.1 show that the market expectation affects the NDA and NFA significantly as estimated with the standard measure of the NDA. The coefficient on the variable $\Delta(E_t s_{t+1} + r_t^*)$ in column (3) of Table 7.1 suggests that if the market expects HK dollars to depreciate by HK$1 to the US dollar, the NDA will decrease by 0.219% on average. The coefficient in column (4) suggests that the market expectation for a 1% depreciation on HK dollars can make the NFA decline by 0.185% on average. The results imply that the market expectation of currency depreciation for the next period affects the domestic money supply in the same direction and to a lesser extent than the current period's currency depreciation. The results are expected in the case of Hong Kong, which aims at stabilizing exchange rates and has limited monetary independence.

The 3-month interest rate volatilities from the last period affect the HKMA measure of the NDA but do not significantly affect the standard NDA, as shown in the first and third columns of Table 7.1. The results imply that the outstanding EFBNs in the monetary base absorb the short-term domestic interest rate volatilities in Hong Kong.

The standard measure of the NDA is better than the HKMA measure of the NDA because the simultaneous equations can explain more variations in the NDA and NFA with the standard measure than the HKMA measure. More than 70% of variations in the NDA and NFA are explained in the models presented in columns (3) and (4) of Table 7.1, but the estimates with the HKMA measure just explain 52.7% of variation in the NDA and 32.2% of variation in the NFA.

The estimated offset and sterilization coefficients of Hong Kong show that Hong Kong can undertake sterilization with imperfect capital mobility. Meanwhile, the scope for monetary autonomy is limited and subject to its fixed exchange rate regime.

Section 7.2 The Estimated Offset and Sterilization Coefficients for Singapore

Singapore has complete sterilization under high capital mobility. As shown in Table 7.2, the estimated sterilization coefficients are over -0.9, suggesting over 90% of capital flows are sterilized in Singapore. The estimated offset coefficient is -1.004. The estimates are consistent with what previous literature has found.

The coefficients on the cyclical component of real GDP are statistically significant, as shown in Table 7.2. The coefficients are negative, suggesting the MAS practice contractionary monetary policy to eliminate an inflationary gap in GDP. Specifically, 1% of real GDP above its long-run trend is estimated to lead to a decrease in the NDA by 0.562% with the 3-month interest rates or 1.113% with the SORA, as shown in columns (1) and (2) of Table 7.2. Column (3) of Table 7.2 indicates that there will be a 0.839% decrease in the NFA in response to a 1% above the long-run trend of real GDP.

The inflation rate is estimated to affect the NDA and NFA positively. The estimates are not expected because the MAS is supposed to counter the rise in the inflation rate through monetary tightening. The puzzling result may be related to the long-lasting low inflation in Singapore. Domestic interest rates are kept low without concerning a rising inflation rate.

The spot exchange rate from the last period affects the domestic money supply of Singapore significantly, as shown in columns (1) and (3) of Table 7.2. The coefficients on the variable e_{t-1} suggest that if the Singapore dollar depreciates by 1 Singapore dollar, on average, the net domestic assets will decrease by 0.277%, and the net foreign assets will decrease by 0.22%, holding the other things constant. The estimates show that Singapore exchanges monetary insulation for exchange rate stability. When the local currency depreciates, the domestic money supply of Singapore decreases for capital outflows and foreign exchange interventions with the sale of the NFA.

The market expectation on the spot exchange rate for the next period does not affect the NFA and NDA except in the model with the SORA volatilities. Column (2) of Table 7.2 shows that an expected currency depreciation of S$1 can lead to a 0.0831% decrease in the NDA. The effect is statistically significant at the 1% significance level. Compared to the results for Hong Kong, Singapore is less sensitive to the market expectation with a more flexible exchange rate regime.

Domestic interest rate volatilities affect the NFA and NDA in Singapore. A 1% increase in the volatilities expands the NDA by 0.0834% - 0.14%, shown in columns (1) and (2) of Table 7.2, and the NFA by 0.398% on average. The influence of the NFA is more than that on the NDA, suggesting limited monetary independence in Singapore due to its exchange rate-centered monetary policy framework.

The estimated offset and sterilization coefficients of Singapore show that the MAS is able to sterilize capital flows entirely under high capital mobility with managed floating exchange rates, substantiating the effectiveness of exchange rate flexibility on monetary insulation. In spite, the significant effects of currency depreciation on the NFA and NDA suggest that Singapore is not free from the influence of foreign monetary shocks as long as the exchange rates are managed.

This chapter explains Hong Kong's and Singapore's estimated offset and sterilization coefficients. As small open economies, Hong Kong and Singapore pursue exchange rate stability, and domestic monetary policy is affected by exchange rate variables. But they have some scope for monetary autonomy and can undertake sterilization with imperfect capital mobility. Moreover, Singapore is able to sterilize capital flows thoroughly with managed floating rates, but Hong Kong cannot make full sterilization under the currency board arrangement.

Appendix

Table 7.1 Hong Kong – Estimated Offset and Sterilization Coefficients with the 2SLS Approach

	(1)	(2)	(3)	(4)
	$\Delta NDA_{s,t}$	ΔNFA_t	$\Delta NDA_{ns,t}$	ΔNFA_t
ΔNFA_t	-0.246***		-0.780***	
	(0.0278)		(0.0484)	
$\Delta NDA_{s,t}$		-0.881***		
		(0.154)		
$\Delta NDA_{ns,t}$				-0.858***
				(0.0541)
$Y_{c,t-1}$	-1.134**	-1.814*	-1.003*	-1.217**
	(0.398)	(0.789)	(0.469)	(0.468)
Δp_{t-1}	-5.928***	-0.408	-3.108***	-0.660
	(0.709)	(1.296)	(0.774)	(0.791)
e_{t-1}	-6.544***	-10.60***	-6.248***	-7.398***
	(0.784)	(1.515)	(0.768)	(0.893)
$\Delta(E_t s_{t+1} + r_t^*)$	-0.0700	-0.0798	-0.219**	-0.185*
	(0.121)	(0.113)	(0.0829)	(0.0770)
$(1 - d_1)\sigma_{r,t-1}$	0.486**		0.273	
	(0.174)		(0.198)	
Constant	50.88***	82.94***	48.71***	57.86***
	(6.101)	(11.79)	(5.988)	(6.972)
N	256	256	256	256
adj. R-sq	0.527	0.322	0.705	0.708

Standard errors in parentheses * $p<0.05$ ** $p<0.01$ *** $p<0.001$

Table 7.2 Singapore – Estimated Offset and Sterilization Coefficients with the 2SLS Approach

	(1)	(2)	(3)
	$\Delta\mathrm{NDA_t}$	$\Delta\mathrm{NDA_t}$	$\Delta\mathrm{NFA_t}$
$\Delta\mathrm{NFA_t}$	-0.946***	-0.938***	
	(0.0164)	(0.0194)	
$\Delta\mathrm{NDA_t}$			-1.004***
			(0.0128)
$Y_{c,t-1}$	-0.562***	-1.113***	-0.839***
	(0.138)	(0.179)	(0.180)
$\Delta\mathrm{p_{t-1}}$	0.504	0.762*	1.411***
	(0.447)	(0.315)	(0.357)
e_{t-1}	-0.277***	-0.0797	-0.220***
	(0.0520)	(0.0814)	(0.0441)
$\Delta(E_t s_{t+1} + r_t^*)$	0.0131	-0.0831**	-0.0120
	(0.0293)	(0.0303)	(0.0324)
$(1 - d_1)\sigma_{3m,t-1}$	0.0834*		
	(0.0372)		
$(1 - d_1)\sigma_{sora,t-1}$		0.140**	
		(0.0425)	
Constant	0.485***	0.200	0.398***
	(0.0872)	(0.123)	(0.0717)
N	263	191	352
adj. R-sq	0.928	0.959	0.956

Standard errors in parentheses * p<0.05 ** p<0.01 *** p<0.001

Chapter 8 Robustness Checks

The robustness checks for the estimated interest rate pass-through and offset and sterilization coefficients are presented in this chapter.

Section 8.1 Robustness Checks for the Estimates of Interest Rate Pass-Through

We use samples with coverage extended to Feb. 28, 2023, Hong Kong base rate and 20-year Singapore government debt security yield, a least squares model with lags, and the non-linear ARDL (NARDL) model for the robustness checks.

Extended Sample Coverage and Lags

Tables 8.1 to 8.54 show the estimated interest rate pass-through with the extended samples. The results generally confirm our main findings.

The estimated policy rate pass-through is 1.01 between Jun. 1992 and Nov. 2008, suggesting that HK base rates were strictly adjusted to the US Federal Funds Rate before the zero lower bound era.

The policy rate transmission declined after the global financial crisis. The policy rate pass-through is estimated to be 0.577 with the Federal Funds Rate lower bound, effective since Dec. 2008. The decrease in the interest rate pass-through has been found from the estimates with government bond yields that are presented in Chapter 6.

The effective federal funds rate is also used to estimate the policy rate pass-through after Dec. 2008. The effective policy rate pass-through is estimated to be 0.596 during the ZLB period, increase to 0.864 for the period between Dec. 2015 and Jul. 2019 with the US monetary tightening, decrease to 0.238 for the period between Aug. 2019 and Mar. 2022 with monetary expansion in the US, and be 1.005 for the period between Feb. 2022 and Feb. 2023 with contractionary monetary policy in the US. The policy rate transmission appears to change significantly as the US monetary policy changes.

The 20-year interest rate pass-through from the US to Singapore is estimated to be 0.53 at monthly frequency and 0.321 at daily frequency, shown in columns (2) and (4) of Table 8.52. Consistent with the Singapore government bond yields with shorter maturities than 20 years, the interest rate pass-through is estimated to increase from 0.553 to 0.629 at a monthly frequency and from 0.308 to 0.385 aa t daily frequency from the ZLB period to the following period with the US monetary tightening.

The estimates show that there are lagged US interest rates with significant effects on the Hong Kong and Singapore interest rates. The current interest rate still has the most significant influence on local rates. No significant difference in the estimated interest rate pass-through is found between the models with and without lagged US interest rates.

NARDL Model

The NARDL model distinguishes the interest rate pass-through when the US interest rates rise from that when the US rates fall. If there is significant difference in the monetary transmission between the upturn and downturn, the local interest rate response to the US monetary policy is asymmetric. If there is asymmetric level relationship between the home and foreign interest rates, it is defined as long-run asymmetry. The long-run asymmetry is examined with a F-test. Tables 8.55 – 8.58 show the results of estimated interest rate pass-through from the NARDL model.

The estimates for Hong Kong are shown in Tables 8.55 and 8.56. The results show that the 1-, and 10-year interest rates have significant long-run asymmetry in the interest rate pass-through. The 1-year interest rate pass-through is calculated to be 0.563 in the upturn and 0.747 in the downturn of the US interest rate. And the estimated 10-year interest rate pass-through is 0.712, not significant in the upturn and 0.735 in the downturn. The estimates suggest that the US-HK interest rate pass-through is less than one-for-one.

The estimates for Singapore are shown in Tables 8.57 and 8.58. The results indicate that the US-SGP 1- and 7-year interest rate level relationship is asymmetric. The estimated 1-year interest rate pass-through is 0.24 but not statistically significant in the upturn of the US rate. It is 0.198 and statistically significant at the 5% significance level. The 7-year interest rate pass-through is estimated to be 0.532 and statistically significant at the 0.1% significance level in the upturn of the US rate. In the downturn of the US rate, the 10-year interest rate pass-through is estimated to be 0.225 and statistically significant at the 5% significance level.

Section 8.2 Robustness Checks of the Estimated Offset and Sterilization Coefficients

We estimate the offset and sterilization coefficients with a rolling window of 5 years and using the three-stage-least-squares (3SLS) model for the robustness check.

Recursive Estimates

Figures 8.1-8.7 show the rolling estimates of the offset and sterilization coefficients in Hong Kong and Singapore. The results confirm that sterilization has been undertaken by the MAS and HKMA heavily. Moreover, the estimates show that the extent of sterilization varies over time in the economies.

Figures 8.1-8.4 show the recursive estimates of the offset and sterilization coefficients in Hong Kong. From the rolling coefficients, we find that: 1) the estimates with the HKMA measure of the NDA are unreliable. As shown in Figure 7.2, the offset coefficients estimated with the HKMA measure of the NDA range between -3.5 and 0.5, which exceeds the regular range between -1 and 0, indicating that the NDA defined by the HKMA is a different variable from the standard NDA defined by the IMF. 2) the estimates suggest that the HKMA did not undertake sterilization in the GFC period or times with considerable capital outflows, such as in 2016 and 2017. Otherwise, there would be more capital outflows. But the HKMA would sterilize capital inflows when the exchange rate hit the lower (appreciation) bound of the Convertibility Undertakings between mid-2005 and early 2015. The rolling coefficients are shown in Figure 8.3.

Rolling estimates for Singapore are displayed in Figures 8.5 – 8.7. The results show that Singapore undertook complete sterilization until 2011, declining between 2012 and 2016. The sterilization coefficient is estimated to increase from slightly less than -1.2 in Jan. 2012 to greater than -0.4 in Jan. 2016, suggesting a considerable decrease in sterilization in Singapore. The ZLB policy with reduced capital flows across borders and more flexible exchange rates of Singapore dollars may help explain the reduction in sterilization for the post-crisis period. The sterilization coefficient is estimated to increase from 2016 and has stayed at full sterilization since mid-2019. The increase in sterilization may be attributed to the pressure on Singapore's interest rates to follow changes in the US rates in the post-ZLB periods. Sterilization could smooth changes in the domestic money supply affected by foreign monetary shocks.

3SLS Model

The estimates of the offset and sterilization coefficients with the 3SLS model are shown in Tables 8.59 and 8.60. They are largely consistent with our findings with the 2SLS model presented in Chapter 7.

Table 8.59 shows that the sterilization coefficient of Hong Kong is estimated to be -0.218 with the HKMA measure of the NDA and -0.755 with the standard measure. The estimates suggest that Hong Kong has undertaken a degree of sterilization successfully. The estimated offset coefficient is -1 with the HKMA measure of the NDA and -0.910 with the standard measure. The estimates of the offset and sterilization coefficients and coefficients on control variables are close to the estimates with the 2SLS approach.

Table 8.60 shows Singapore's estimated offset and sterilization coefficients with the 3SLS model. The sterilization coefficients are calculated to be -0.944 with the 3-month interest rate volatilities and -0.934 with the SORA volatilities, and the offset coefficient is estimated to be -1.019, suggesting complete sterilization under extremely high capital mobility. The results are consistent with the findings from the 2SLS model for Singapore.

We find robust evidence supporting the main findings presented in Chapters 6 and 7 by estimating the interest rate pass-through with extended samples and the non-linear ARDL model, calculating the rolling estimates of the offset and sterilization coefficients, and estimating the coefficients with the 3SLS model.

Appendix

Extended Sample Coverage and Lags

Table 8.1. Actual Policy Rate Pass-Through from the United States to Hong Kong from Jun. 1992 throughout Feb. 2023

	(1)	(2)	(3)	(4)
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	1.063*** (0.0962)	1.101*** (0.131)	0.689*** (0.190)	0.577*** (0.171)
$\Delta R_{US,t-1}$		-0.0251 (0.0239)		0.166 (0.106)
$\Delta R_{US,t-2}$		-0.0389 (0.0439)		0.234** (0.0850)
$\Delta R_{US,t-3}$		-0.0148 (0.0315)		0.0233 (0.0650)
Constant	-0.000393 (0.00629)	-0.00221 (0.00673)	0.00822 (0.0111)	0.000680 (0.00886)
N	197	194	170	167
Adj. R^2	0.852	0.855	0.585	0.693

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=the discount window base rate
R_{US}=DFEDTAR for (1) and (2)
R_{US}=DFEDTARL for (3) and (4)

Table 8.2. Effective Policy Rate Pass-Through from the United States to Hong Kong from Jun. 1992 throughout Feb. 2023

	(1)	(2)
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.529*** (0.0966)	0.468*** (0.0955)
$\Delta R_{US,t-1}$		0.263*** (0.0531)
$\Delta R_{US,t-2}$		0.190*** (0.0558)
$\Delta R_{US,t-3}$		0.0498 (0.0460)
Constant	0.000253 (0.00939)	-0.000303 (0.00840)
N	368	365
Adj. R^2	0.381	0.523

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=the discount window base rate
R_{US}=DFF

Table 8.3. Actual Policy Rate Pass-Through from the United States to Hong Kong in the Subperiods between Jun. 1992 and Jun. 1999

	(1)	(2)	(3)	(4)	(5)
	Before Feb. 1994	Before Jul. 1995	Before Mar. 1997	Before Sep. 1998	Before Jul. 1999
	Expansionary	Contractionary	Expansionary	Contractionary	Expansionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$

$\Delta R_{US,t}$	0	0.825***	0.284		
	(.)	(0.125)	(0.217)	0.786** (0.243)	0.740* (0.287)
$\Delta R_{US,t-1}$	0	0.109		-0.214	0.520
	(.)	(0.108)	0.0341 (0.0260)	(0.243)	(0.368)
$\Delta R_{US,t-2}$	0	0.134	0.284	-0.214	-0.260
	(.)	(0.109)	(0.217)	(0.243)	(0.260)
$\Delta R_{US,t-3}$	0	0.321*		-0.214	-4.97e-09
	(.)	(0.127)	0.0341 (0.0260)	(0.243)	(0.123)
Constant	0		0.0114		0
	(.)	-0.113 (0.0670)	(0.00796)	0.0536 (0.0607)	(4.66e-10)
N	16	17	20	18	10
Adj. R^2	.	0.879	0.364	-0.199	0.816

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=the discount window base rate
R_{US}=DFEDTAR

Table 8.4. Actual Policy Rate Pass-Through from the United States to Hong Kong in the Subperiods between Jul. 1999 and Nov. 2008

	(1)	(2)	(3)	(4)
	Before Jan. 2001	Before Jul. 2004	Before Sep. 2007	Before Dec. 2008
	Contractionary	Expansionary	Contractionary	Expansionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	1	1***	1***	1.349**
	(.)	(8.94e-17)	(5.12e-18)	(0.353)
$\Delta R_{US,t-1}$	0	-2.09e-16	-2.31e-18	-0.0485
	(.)	(1.04e-16)	(4.71e-18)	(0.0982)
$\Delta R_{US,t-2}$	0	1.45e-16	1.90e-17***	-0.257
	(.)	(7.81e-17)	(4.49e-18)	(0.209)
$\Delta R_{US,t-3}$	0	-7.28e-17	-1.68e-18	-0.0312
	(.)	(5.23e-17)	(5.15e-18)	(0.0496)
Constant	0	0	0	-0.0440
	(.)	(6.29e-18)	(2.26e-19)	(0.0657)
N	18	42	38	15
Adj. R^2	1.000	1.000	1.000	0.820

Standard errors in parentheses
= "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=the discount window base rate
R_{US}=DFEDTAR

Table 8.5. Actual Policy Rate Pass-Through from the United States to Hong Kong in the Subperiods between Dec. 2008 and Feb. 2023

	(1)	(2)	(3)	(4)
	Before Dec. 2015	Before Aug. 2019	Before Mar. 2022	After Feb. 2022
	Zero Lower Bound	Contractionary	Expansionary	Contractionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$

$\Delta R_{US,t}$	0	1***	0.243***	1***
	(.)	(9.50e-17)	(0.0344)	(1.31e-16)
$\Delta R_{US,t-1}$	0	9.73e-17***	0.312***	-6.06e-18
	(.)	(2.60e-17)	(0.0695)	(1.04e-16)
$\Delta R_{US,t-2}$	0	9.73e-17***	0.357***	-2.54e-17
	(.)	(2.60e-17)	(0.0535)	(1.22e-16)
$\Delta R_{US,t-3}$	0	-2.19e-16*	-0.00609	1.30e-17
	(.)	(1.04e-16)	(0.0996)	(1.02e-16)
Constant	0	-1.39e-17*	-0.00681	-1.11e-16
	(.)	(5.33e-18)	(0.0227)	(7.92e-17)
N	80	44	31	12
Adj. R^2	.	1.000	0.428	1.000

Standard errors in parentheses
= "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=the discount window base rate
R_{US}=DFEDTARL

Table 8.6. Effective Policy Rate Pass-Through from the United States to Hong Kong in the subperiods between Jun. 1992 and Jun. 1999

	(1)	(2)	(3)	(4)	(5)
	Before Feb. 1994	Before Jul. 1995	Before Mar. 1997	Before Sep. 1998	Before Jul. 1999
	Expansionary	Contractionary	Expansionary	Contractionary	Expansionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0		-0.0682	-0.197	
	(.)	0.620** (0.158)	(0.0451)	(0.249)	0.313* (0.103)
$\Delta R_{US,t-1}$	0	0.396*	-0.0594	-0.205	
	(.)	(0.139)	(0.0359)	(0.248)	0.0757 (0.264)
$\Delta R_{US,t-2}$	0			-0.316	
	(.)	-0.0815 (0.153)	0.0267 (0.0362)	(0.324)	-0.0595 (0.105)
$\Delta R_{US,t-3}$	0	0.218	0.00246	0.0534	
	(.)	(0.106)	(0.0217)	(0.151)	0.00543 (0.151)
Constant	0	-0.0782	-0.0163		-0.0528
	(.)	(0.0791)	(0.0117)	0.0637 (0.0529)	(0.0658)
N	16	17	20	18	10
Adj. R^2	.	0.614	0.392	-0.113	-0.389

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=the discount window base rate
R_{US}=DFF

Table 8.7. Effective Policy Rate Pass-Through from the United States to Hong Kong in the subperiods between Jul. 1999 and Nov. 2008

	(1)	(2)	(3)	(4)
	Before Jan. 2001	Before Jul. 2004	Before Sep. 2007	Before Dec. 2008
	Contractionary	Expansionary	Contractionary	Expansionary

	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.213 (0.106)	0.501*** (0.110)	0.214 (0.170)	1.185*** (0.230)
$\Delta R_{US,t-1}$	0.121 (0.117)	0.353** (0.126)	0.245 (0.191)	0.271 (0.134)
$\Delta R_{US,t-2}$	-0.0267 (0.0958)	0.120 (0.119)	0.259 (0.186)	-0.0203 (0.242)
$\Delta R_{US,t-3}$	-0.0773 (0.0815)	-0.000993 (0.108)	0.150 (0.212)	-0.284 (0.221)
Constant	0.0890* (0.0403)	-0.0181 (0.0139)	0.0164 (0.0156)	0.0260 (0.135)
N	18	42	38	15
Adj. R^2	0.219	0.643	0.214	0.751

Standard errors in parentheses
= "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=the discount window base rate
R_{US}=DFF

Table 8.8. Effective Policy Rate Pass-Through from the United States to Hong Kong in the subperiods between Dec. 2008 and Feb. 2023

	(1)	(2)	(3)	(4)
	Before Dec. 2015	Before Aug. 2019	Before Mar. 2022	After Feb. 2022
	Zero Lower Bound	Contractionary	Expansionary	Contractionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.596* (0.247)	0.864*** (0.113)	0.238*** (0.0373)	1.005*** (0.00605)
$\Delta R_{US,t-1}$	0.283* (0.124)	0.0385 (0.0978)	0.295*** (0.0774)	-0.00194 (0.00779)
$\Delta R_{US,t-2}$	0.552*** (0.0965)	-0.0240 (0.0675)	0.346*** (0.0548)	-0.00164 (0.00474)
$\Delta R_{US,t-3}$	0.109** (0.0336)	0.0492 (0.118)	-0.0223 (0.116)	0.000249 (0.00614)
Constant	0.00343 (0.00309)	0.00317 (0.0155)	-0.00868 (0.0220)	0.000210 (0.00295)
N	84	44	31	12
Adj. R^2	0.923	0.710	0.417	1.000

Standard errors in parentheses
= "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=the discount window base rate
R_{US}=DFF

Table 8.9. 3-Month Interest Rate Pass-Through from the United States to Hong Kong from Jun. 10, 1991 throughout Feb. 28, 2023

	(1)	(2)	(3)	(4)
	Monthly	Monthly	Daily	Daily
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.721*** (0.166)	0.635** (0.199)	0.276** (0.0956)	0.429 (0.304)
$\Delta R_{US,t-1}$		0.181 (0.207)		-0.250 (0.258)
$\Delta R_{US,t-2}$		0.0187 (0.196)		0.113 (0.0989)
$\Delta R_{US,t-3}$		0.0230 (0.160)		-0.0777 (0.100)
Constant	-0.00792 (0.0284)	-0.00262 (0.0288)	-0.000535 (0.00290)	-0.000456 (0.00850)

N	380	377	8276	3309
Adj. R^2	0.071	0.066	0.002	0.002

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFB3MO
R_{US}=DGS3MO

Table 8.10. 3-Month Interest Rate Monthly Pass-Through from the United States to Hong Kong in the Subperiods between Jun. 1991 and Jun. 1999

	(1)	(2)	(3)	(4)	(5)
	Before Feb. 1994	Before Jul. 1995	Before Mar. 1997	Before Sep. 1998	Before Jul. 1999
	Expansionary	Contractionary	Expansionary	Contractionary	Expansionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$		1.002*		-3.342	4.806
	0.840** (0.294)	(0.400)	-0.0706 (0.275)	(3.030)	(2.746)
$\Delta R_{US,t-1}$	0.290	0.0649	0.351	-3.051	1.957
	(0.351)	(0.374)	(0.290)	(2.533)	(2.308)
$\Delta R_{US,t-2}$	-0.676	0.293	0.535	-3.319	2.610
	(0.336)	(0.441)	(0.329)	(2.933)	(1.781)
$\Delta R_{US,t-3}$	-0.368	0.0261		-1.739	-2.016
	(0.333)	(0.490)	0.00356 (0.304)	(2.770)	(2.006)
Constant	-0.0505		-0.00376	0.314	-0.515
	(0.0578)	-0.0707 (0.144)	(0.0400)	(0.439)	(0.423)
N	28	17	20	18	10
Adj. R^2	0.406	0.160	-0.022	-0.192	0.379

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFB3MO
R_{US}=DGS3MO

Table 8.11. 3-Month Interest Rate Monthly Pass-Through from the United States to Hong Kong in the Subperiods between Jul. 1999 and Nov. 2008

	(1)	(2)	(3)	(4)
	Before Jan. 2001	Before Jul. 2004	Before Sep. 2007	Before Dec. 2008
	Contractionary	Expansionary	Contractionary	Expansionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.00513 (0.279)	0.831*** (0.0906)	-0.237 (0.184)	0.789 (0.434)
$\Delta R_{US,t-1}$	0.101 (0.426)	0.0813 (0.0960)	0.746 (0.400)	-0.358 (0.523)
$\Delta R_{US,t-2}$	1.347** (0.444)	-0.180 (0.141)	-0.327 (0.458)	0.365 (0.484)
$\Delta R_{US,t-3}$	0.913 (0.443)	0.0464 (0.0943)	0.536 (0.661)	0.554 (0.316)
Constant	-0.220* (0.0902)	-0.0477 (0.0317)	0.0171 (0.0522)	0.0353 (0.295)
N	18	42	38	15
Adj. R^2	0.229	0.611	-0.014	0.142

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFB3MO
R_{US}=DGS3MO

Table 8.12. 3-Month Interest Rate Monthly Pass-Through from the United States to Hong Kong in the Subperiods between Dec. 2008 and Feb. 2023

	(1)	(2)	(3)	(4)
	Before Dec. 2015	Before Aug. 2019	Before Mar. 2022	After Feb. 2022
	Zero Lower Bound	Contractionary	Expansionary	Contractionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.117 (0.134)	-0.0662 (0.309)	0.522*** (0.102)	0.873 (0.749)
$\Delta R_{US,t-1}$	0.0504 (0.0911)	0.394 (0.303)	0.212** (0.0734)	2.823* (0.950)
$\Delta R_{US,t-2}$	-0.0633 (0.102)	-0.370 (0.352)	-0.204*** (0.0220)	-1.921 (0.843)
$\Delta R_{US,t-3}$	-0.00289 (0.0705)	-0.745 (0.437)	0.312*** (0.0516)	-0.0323 (0.381)
Constant	-0.00127 (0.00827)	0.0898* (0.0436)	-0.00709 (0.0185)	-0.456 (0.228)
N	84	44	31	12
Adj. R^2	-0.037	0.007	0.647	0.622

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFB3MO
R_{US}=DGS3MO

Table 8.13. 3-Month Interest Rate Daily Pass-Through from the United States to Hong Kong in the Subperiods between Jun. 10, 1991 and Jun. 30, 1999

	(1)	(2)	(3)	(4)	(5)
	Before Feb. 4, 1994	Before Jul. 6, 1995	Before Mar. 26, 1997	Before Sep. 30, 1998	Before Jul. 1, 1999
	Expansionary	Contractionary	Expansionary	Contractionary	Expansionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.546***	0.588***	0.418***	4.268	-0.157
	(0.164)	(0.153)	(0.103)	(5.460)	(0.323)
$\Delta R_{US,t-1}$	0.244	-0.534	-0.0739	-5.609	-0.889
	(0.155)	(0.432)	(0.0977)	(4.991)	(0.456)
$\Delta R_{US,t-2}$		-0.257	-0.0131	1.472	
	0.0760 (0.164)	(0.315)	(0.0691)	(2.213)	0.0365 (0.256)
$\Delta R_{US,t-3}$	0.163	0.0889	-0.0986	-2.020	-0.359
	(0.101)	(0.155)	(0.0971)	(1.746)	(0.200)
Constant	-0.00278		0.00372	0.0118	-0.0352*
	(0.00622)	0.0257 (0.0155)	(0.00366)	(0.215)	(0.0159)
N	276	147	180	158	78
Adj. R^2	0.050	0.043	0.065	0.011	0.129

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFB3MO
R_{US}=DGS3MO

Table 8.14. 3-Month Interest Rate Daily Pass-Through from the United States to Hong Kong in the Subperiods between Jul. 1, 1999 and Dec. 15, 2008

	(1)	(2)	(3)	(4)
	Before Jan. 4, 2001	Before Jul. 1, 2004	Before Sep. 19, 2007	Before Dec. 16, 2008
	Contractionary	Expansionary	Contractionary	Expansionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.00275 (0.0647)	0.463** (0.146)	0.0522 (0.0548)	-0.0432 (0.128)
$\Delta R_{US,t-1}$	0.0630 (0.0567)	0.0851 (0.0640)	-0.0328 (0.0384)	0.305** (0.100)
$\Delta R_{US,t-2}$	-0.0283 (0.0578)	-0.0984 (0.116)	0.0259 (0.0408)	0.106 (0.0999)
$\Delta R_{US,t-3}$	0.0209 (0.0855)	0.117 (0.0818)	0.0151 (0.0520)	-0.0430 (0.0936)
Constant	-0.00791 (0.00592)	0.00188 (0.00186)	-0.00128 (0.00331)	-0.00150 (0.0108)
N	158	363	336	130
Adj. R^2	-0.020	0.241	-0.009	0.100

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFB3MO
R_{US}=DGS3MO

Table 8.15. 3-Month Interest Rate Daily Pass-Through from the United States to Hong Kong in the Subperiods between Dec. 16, 2008 and Feb. 28, 2023

	(1)	(2)	(3)	(4)
	Before Dec. 16, 2015	Before Aug. 2, 2019	Before Mar. 18, 2022	After Mar. 17, 2022
	Zero Lower Bound	Contractionary	Expansionary	Contractionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.137***	0.107	0.00226	0.227
	(0.0379)	(0.0610)	(0.125)	(0.125)
$\Delta R_{US,t-1}$	0.0556	-0.0149	0.157	0.0653
	(0.0670)	(0.0721)	(0.0902)	(0.113)
$\Delta R_{US,t-2}$	0.00813	-0.123	-0.00459	0.177*
	(0.0481)	(0.112)	(0.0639)	(0.0778)
$\Delta R_{US,t-3}$	-0.0194	-0.0694	0.0839	0.0378
	(0.0656)	(0.0957)	(0.0650)	(0.0771)
Constant	-0.00123***	-0.000906		-0.00705
	(0.000366)	(0.00155)	-0.000692 (0.00167)	(0.0101)
N	730	379	274	99
Adj. R^2	0.021	0.002	0.016	0.032

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFB3MO
R_{US}=DGS3MO

Table 8.16. 2-Year Interest Rate Pass-Through from the United States to Hong Kong from Nov. 19, 1991 throughout Feb. 28, 2023

	(1)	(2)	(3)	(4)
	Monthly	Monthly	Daily	Daily

	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.805*** (0.0926)	0.746*** (0.102)	0.598*** (0.0228)	0.532*** (0.0365)
$\Delta R_{US,t-1}$		0.194 (0.115)		0.0513 (0.0328)
$\Delta R_{US,t-2}$		0.181* (0.0851)		0.0174 (0.0337)
$\Delta R_{US,t-3}$		-0.152 (0.0809)		0.0461 (0.0399)
Constant	-0.00278 (0.0200)	-0.00373 (0.0198)	-0.000135 (0.000926)	0.00186 (0.00154)
N	375	372	8160	3262
Adj. R^2	0.212	0.230	0.127	0.087

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFN2Y
R_{US}=DGS2

Table 8.17. 2-Year Interest Rate Monthly Pass-Through from the United States to Hong Kong in the Subperiods between Nov. 1991 and Jun. 1999

	(1)	(2)	(3)	(4)	(5)
	Before Feb. 1994	Before Jul. 1995	Before Mar. 1997	Before Sep. 1998	Before Jul. 1999
	Expansionary	Contractionary	Expansionary	Contractionary	Expansionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	1.011*** (0.181)	0.790*** (0.164)	0.594*** (0.105)	-1.849 (1.178)	1.541* (0.565)
$\Delta R_{US,t-1}$	0.461* (0.177)	0.266 (0.160)	0.499* (0.170)	0.550 (2.029)	0.634 (0.402)
$\Delta R_{US,t-2}$	-0.187 (0.149)	0.180 (0.243)	-0.198 (0.127)	1.731 (1.284)	1.008 (0.933)
$\Delta R_{US,t-3}$	-0.345 (0.196)	-0.0959 (0.190)	-0.000684 (0.126)	-1.402 (1.301)	-0.207 (0.680)
Constant	-0.0378 (0.0530)	-0.00290 (0.0653)	-0.0229 (0.0266)	0.184 (0.315)	-0.485 (0.250)
N	23	17	20	18	10
Adj. R^2	0.727	0.756	0.702	0.087	0.373

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFN2Y
R_{US}=DGS2

Table 8.18. 2-Year Interest Rate Monthly Pass-Through from the United States to Hong Kong in the Subperiods between Jul. 1999 and Nov. 2008

	(1)	(2)	(3)	(4)
	Before Jan. 2001	Before Jul. 2004	Before Sep. 2007	Before Dec. 2008
	Contractionary	Expansionary	Contractionary	Expansionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.654* (0.222)	1.038*** (0.0729)	1.151*** (0.308)	1.014** (0.260)
$\Delta R_{US,t-1}$	0.371 (0.173)	-0.118 (0.0752)	-0.0799 (0.353)	-0.0697 (0.261)
$\Delta R_{US,t-2}$	-0.253 (0.139)	-0.0920 (0.0852)	0.245 (0.271)	0.194 (0.246)

$\Delta R_{US,t-3}$	0.0383 (0.232)	-0.0465 (0.104)	0.334 (0.237)	-0.00358 (0.203)
Constant	-0.0299 (0.0534)	-0.0426 (0.0246)	-0.0295 (0.0589)	0.0189 (0.0968)
N	18	42	38	15
Adj. R^2	0.475	0.799	0.310	0.458

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFN2Y
R_{US}=DGS2

Table 8.19. 2-Year Interest Rate Monthly Pass-Through from the United States to Hong Kong in the Subperiods between Dec. 2008 and Feb. 2023

	(1)	(2)	(3)	(4)
	Before Dec. 2015	Before Aug. 2019	Before Mar. 2022	After Feb. 2022
	Zero Lower Bound	Contractionary	Expansionary	Contractionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.481*** (0.0989)	0.416 (0.296)	0.509*** (0.116)	1.085*** (0.130)
$\Delta R_{US,t-1}$	0.0389 (0.0982)	0.235 (0.203)	0.342** (0.114)	0.320* (0.107)
$\Delta R_{US,t-2}$	0.116 (0.0878)	0.107 (0.158)	-0.195 (0.163)	0.175 (0.115)
$\Delta R_{US,t-3}$	0.0243 (0.0784)	-0.164 (0.202)	0.0149 (0.228)	-0.137 (0.131)
Constant	-0.000706 (0.0106)	0.0154 (0.0223)	-0.0202 (0.0181)	-0.124 (0.0925)
N	84	44	31	12
Adj. R^2	0.253	0.109	0.599	0.902

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFN2Y
R_{US}=DGS2

Table 8.20. 2-Year Interest Rate Daily Pass-Through from the United States to Hong Kong in the Subperiods between Nov. 19, 1991 and Jun. 30, 1999

	(1)	(2)	(3)	(4)	(5)
	Before Feb. 4, 1994	Before Jul. 6, 1995	Before Mar. 26, 1997	Before Sep. 30, 1998	Before Jul. 1, 1999
	Expansionary	Contractionary	Expansionary	Contractionary	Expansionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.640*** (0.0969)	0.786*** (0.0900)	0.767*** (0.0775)	-0.618 (0.532)	0.0422 (0.214)
$\Delta R_{US,t-1}$	-0.00608 (0.0707)	0.0259 (0.0826)	0.0842 (0.142)	-0.555 (0.608)	0.122 (0.199)
$\Delta R_{US,t-2}$	0.0635 (0.0682)	-0.181 (0.0926)	0.00144 (0.0705)	0.279 (0.698)	0.218 (0.212)
$\Delta R_{US,t-3}$	0.0175 (0.0591)	0.0161 (0.0591)	0.0578 (0.0462)	0.712 (1.032)	-0.0796 (0.155)
Constant	0.000421 (0.00381)	0.0133* (0.00590)	0.00199 (0.00319)	0.0240 (0.0267)	-0.00835 (0.00998)
N	229	147	180	158	78

Adj. R^2	0.270	0.359	0.465	-0.002	-0.017

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFN2Y
R_{US}=DGS2

Table 8.21. 2-Year Interest Rate Daily Pass-Through from the United States to Hong Kong in the Subperiods between Jul. 1, 1999 and Dec. 15, 2008

	(1)	(2)	(3)	(4)
	Before Jan. 4, 2001	Before Jul. 1, 2004	Before Sep. 19, 2007	Before Dec. 16, 2008
	Contractionary	Expansionary	Contractionary	Expansionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.407***		0.558***	0.472***
	(0.0742)	0.715*** (0.0744)	(0.0640)	(0.0905)
$\Delta R_{US,t-1}$	0.225**	0.0813	0.0535	0.117
	(0.0732)	(0.0502)	(0.0575)	(0.0804)
$\Delta R_{US,t-2}$	0.0178	-0.0454	0.0952	0.0329
	(0.0874)	(0.0464)	(0.0653)	(0.0766)
$\Delta R_{US,t-3}$	0.0364	0.0996	0.00109	-0.00214
	(0.0707)	(0.0606)	(0.0632)	(0.0863)
Constant			-0.00143	-0.00269
	-0.00176 (0.00334)	0.00374 (0.00305)	(0.00282)	(0.00721)
N	158	363	336	130
Adj. R^2	0.200	0.493	0.200	0.232

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFN2Y
R_{US}=DGS2

Table 8.22. 2-Year Interest Rate Daily Pass-Through from the United States to Hong Kong in the Subperiods between Dec. 16, 2008 and Feb. 28, 2023

	(1)	(2)	(3)	(4)
	Before Dec. 16, 2015	Before Aug. 2, 2019	Before Mar. 18, 2022	After Mar. 17, 2022
	Zero Lower Bound	Contractionary	Expansionary	Contractionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.432***	0.494***	0.438***	0.666***
	(0.0277)	(0.0634)	(0.0583)	(0.0707)
$\Delta R_{US,t-1}$	0.0381	0.0607	0.0215	0.148*
	(0.0254)	(0.0599)	(0.0912)	(0.0716)
$\Delta R_{US,t-2}$	-0.00480	0.0431	0.122	0.207**
	(0.0327)	(0.0543)	(0.0835)	(0.0776)
$\Delta R_{US,t-3}$	0.0112	0.0326	0.00506	-0.0422
	(0.0340)	(0.0507)	(0.0921)	(0.0796)
Constant	-0.00167* (0.000709)	-0.00109 (0.00166)	-0.000742 (0.00189)	0.000291 (0.00701)
N	730	379	274	99
Adj. R^2	0.329	0.165	0.224	0.450

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFN2Y
R_{US}=DGS2

Table 8.23. 10-Year Interest Rate Monthly Pass-Through from the United States to Hong Kong from Oct. 1996 throughout Feb. 2023

	(1)	(2)	(3)	(4)
	Until Feb. 2015	Until Feb. 2015	Since Jan. 2010	Since Jan. 2010
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.586*** (0.0619)	0.595*** (0.0617)	0.820*** (0.0541)	0.814*** (0.0533)
$\Delta R_{US,t-1}$		0.107 (0.0650)		0.101* (0.0511)
$\Delta R_{US,t-2}$		0.0341 (0.0524)		0.0758 (0.0459)
$\Delta R_{US,t-3}$		-0.0508 (0.0496)		-0.132** (0.0412)
Constant	-0.0141 (0.0157)	-0.0118 (0.0154)	0.00426 (0.0108)	0.00439 (0.0103)
N	316	313	157	157
Adj. R^2	0.221	0.225	0.658	0.684

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFN10YR for (1) and (2)
R_{HK}=gb_10yr for (3) and (4)
R_{US}=DGS10

Table 8.24. 10-Year Interest Rate Daily Pass-Through from the United States to Hong Kong from Oct. 29, 1996 throughout Feb. 28, 2023

	(1)	(2)	(3)	(4)
	Until Feb. 27, 2015	Until Feb. 27, 2015	Since Jan. 11, 2010	Since Jan. 11, 2010
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.475***	0.466***	0.538***	0.583***
	(0.0158)	(0.0256)	(0.0175)	(0.0237)
$\Delta R_{US,t-1}$		0.0106		0.0217
		(0.0188)		(0.0232)
$\Delta R_{US,t-2}$		0.0217		0.0464
		(0.0194)		(0.0293)
$\Delta R_{US,t-3}$		0.0221		0.00258
		(0.0245)		(0.0269)
Constant	-0.000701	-0.0000512	0.000205	-0.00253**
	(0.000652)	(0.00109)	(0.000641)	(0.000938)
N	6870	2746	3426	1370
Adj. R^2	0.196	0.179	0.347	0.422

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFN10YR for (1) and (2)
R_{HK}=gb_10yr for (3) and (4)
R_{US}=DGS10

Table 8.25. 10-Year Interest Rate Monthly Pass-Through from the United States to Hong Kong in the Subperiods between Mar. 1997 and Jun. 1999

	(1)	(2)
	Before Sep. 1998	Before Jul. 1999
	Contractionary	Expansionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	-0.253 (0.739)	1.068 (0.460)
$\Delta R_{US,t-1}$	0.219 (1.052)	0.760 (0.438)
$\Delta R_{US,t-2}$	0.827 (0.652)	0.610 (0.672)
$\Delta R_{US,t-3}$	-0.407 (0.641)	0.597 (0.274)
Constant	0.174 (0.170)	-0.283 (0.177)
N	18	10
Adj. R^2	-0.212	0.409

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFN10YR
R_{US}=DGS10

Table 8.26. 10-Year Interest Rate Monthly Pass-Through from the United States to Hong Kong in the Subperiods between Jul. 1999 and Nov. 2008

	(1)	(2)	(3)	(4)
	Before Jan. 2001	Before Jul. 2004	Before Sep. 2007	Before Dec. 2008
	Contractionary	Expansionary	Contractionary	Expansionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.605* (0.273)	0.990*** (0.0689)	0.970*** (0.195)	0.802* (0.329)
$\Delta R_{US,t-1}$	0.0942 (0.222)	-0.0393 (0.0708)	0.359* (0.166)	0.302 (0.477)
$\Delta R_{US,t-2}$	-0.0773 (0.162)	0.0299 (0.0542)	0.0895 (0.115)	0.769* (0.277)
$\Delta R_{US,t-3}$	-0.0775 (0.150)	-0.142* (0.0683)	0.0674 (0.119)	-0.0927 (0.305)
Constant	-0.0370 (0.0375)	-0.0411* (0.0177)	-0.00220 (0.0274)	-0.0210 (0.104)
N	18	42	38	15
Adj. R^2	0.273	0.848	0.568	0.380

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFN10Y
R_{US}=DGS10

Table 8.27. 10-Year Interest Rate Monthly Pass-Through from the United States to Hong Kong in the Subperiods between Dec. 2008 and Feb. 2023

	(1)	(2)	(3)	(4)	(5)
	Before Dec. 2015	Before Dec. 2015	Before Aug. 2019	Before Mar. 2022	After Feb. 2022
	Zero Lower Bound	Zero Lower Bound	Contractionary	Expansionary	Contractionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.731*** (0.0695)	0.730*** (0.0776)	0.625*** (0.134)	0.907*** (0.0859)	1.013*** (0.143)

$\Delta R_{US,t-1}$		0.148*	0.223		-0.0411
	0.132 (0.0708)	(0.0724)	(0.159)	0.0306 (0.0879)	(0.134)
$\Delta R_{US,t-2}$	-0.0192	0.0820	0.139	-0.162	0.0421
	(0.0517)	(0.0642)	(0.107)	(0.0822)	(0.134)
$\Delta R_{US,t-3}$		-0.139*	-0.103		-0.242
	-0.102 (0.0524)	(0.0554)	(0.111)	0.0863 (0.0884)	(0.150)
Constant	0.00523	-0.00208	0.00380	0.00806	0.0484
	(0.0164)	(0.0151)	(0.0200)	(0.0210)	(0.105)
N	84	70	44	31	12
Adj. R^2	0.647	0.648	0.440	0.752	0.874

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFN10Y for (1)
R_{HK}=gb_10yr for (2)— (5)
R_{US}=DGS10

Table 8.28. 10-Year Interest Rate Daily Pass-Through from the United States to Hong Kong in the Subperiods between Oct. 29, 1996 and Jun. 30, 1999

	(1)	(2)	(3)
	Before Mar. 26, 1997	Before Sep. 30, 1998	Before Jul. 1, 1999
	Expansionary	Contractionary	Expansionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.896*** (0.130)	-0.0842 (0.323)	0.0320 (0.161)
$\Delta R_{US,t-1}$	0.156 (0.169)	0.0319 (0.261)	0.272 (0.176)
$\Delta R_{US,t-2}$	0.0662 (0.143)	-0.0252 (0.257)	0.260 (0.160)
$\Delta R_{US,t-3}$	-0.0585 (0.147)	0.564 (0.433)	-0.149 (0.115)
Constant	-0.00246 (0.00827)	0.0116 (0.0138)	-0.00802 (0.00783)
N	40	158	78
Adj. R^2	0.551	-0.002	0.084

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFN10Y
R_{US}=DGS10

Table 8.29. 10-Year Interest Rate Daily Pass-Through from the United States to Hong Kong in the Subperiods between Jul. 1, 1999 and Dec. 15, 2008

	(1)	(2)	(3)	(4)
	Before Jan. 4, 2001	Before Jul. 1, 2004	Before Sep. 19, 2007	Before Dec. 16, 2008
	Contractionary	Expansionary	Contractionary	Expansionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.370***	0.884***	0.724***	0.619***
	(0.0787)	(0.0415)	(0.0468)	(0.0891)
$\Delta R_{US,t-1}$	0.0828	-0.0142	-0.0162	-0.0310
	(0.0651)	(0.0495)	(0.0388)	(0.0701)
$\Delta R_{US,t-2}$	0.00522	-0.0350	0.0449	0.0310
	(0.0567)	(0.0433)	(0.0487)	(0.0682)

$\Delta R_{US,t-3}$	0.0219 (0.0478)	0.00808 (0.0429)	-0.0362 (0.0474)	0.0527 (0.0778)
Constant	-0.00409 (0.00279)	0.000351 (0.00253)	-0.00136 (0.00179)	-0.00780 (0.00531)
N	158	363	336	130
Adj. R^2	0.222	0.630	0.479	0.418

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFN10Y
R_{US}=DGS10

Table 8.30. 10-Year Interest Rate Daily Pass-Through from the United States to Hong Kong in the Subperiods between Dec. 16, 2008 and Feb. 28, 2023

	(1)	(2)	(3)	(4)	(5)
	Before Dec. 16, 2015	Before Dec. 16, 2015	Before Aug. 2, 2019	Before Mar. 18, 2022	After Mar. 17, 2022
	Zero Lower Bound	Zero Lower Bound	Contractionary	Expansionary	Contractionary
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.510*** (0.0282)	0.542*** (0.0293)	0.630*** (0.0483)	0.541*** (0.0603)	0.737*** (0.0635)
$\Delta R_{US,t-1}$	0.0204 (0.0215)	0.0169 (0.0225)	0.117* (0.0511)	-0.0930 (0.0663)	0.0680 (0.0762)
$\Delta R_{US,t-2}$	0.0285 (0.0253)	0.0257 (0.0273)	0.00493 (0.0572)	0.0626 (0.0945)	0.124 (0.0651)
$\Delta R_{US,t-3}$	-0.0308 (0.0262)	-0.00130 (0.0283)	-0.0419 (0.0501)	0.0648 (0.0770)	-0.0972 (0.0745)
Constant	-0.00109 (0.00118)	-0.00296* (0.00117)	-0.00307 (0.00189)	-0.00226 (0.00194)	0.00737 (0.00600)
N	730	618	379	274	99
Adj. R^2	0.492	0.499	0.303	0.332	0.549

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=EFN10Y for (1)
R_{HK}=gb_10yr for (2)— (5)
R_{US}=DGS10

Table 8.31. 20-Year Interest Rate Pass-Through from the United States to Hong Kong from May 25, 2022 throughout Feb. 28, 2023

	(1)	(2)	(3)	(4)
	Monthly	Monthly	Daily	Daily
	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$	$\Delta R_{HK,t}$
$\Delta R_{US,t}$	0.949*** (0.170)	0.640* (0.0105)	0.698*** (0.0556)	0.774*** (0.0648)
$\Delta R_{US,t-1}$		-0.114 (0.00957)		0.0502 (0.0674)
$\Delta R_{US,t-2}$		-0.385* (0.00957)		0.00378 (0.0761)
$\Delta R_{US,t-3}$		-0.583* (0.0102)		-0.139 (0.0861)

Constant	-0.0177 (0.0687)	0.138* (0.00365)	0.000561 (0.00340)	0.00288 (0.00489)
N	9	6	199	78
Adj. R^2	0.682	1.000	0.507	0.624

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{HK}=GB20Y
R_{US}=DGS20

Table 8.32. 3-Month Interest Rate Monthly Pass-Through from the United States to Singapore from Jan. 1998 throughout Feb. 2023

	(1)	(2)	(3)	(4)
	Until Aug. 2013	Until Aug. 2013	Since Oct. 2005	Since Oct. 2005
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.220* (0.0919)	0.185 (0.0966)	0.221** (0.0684)	0.0572 (0.0548)
$\Delta R_{US,t-1}$		0.192 (0.0981)		0.182** (0.0620)
$\Delta R_{US,t-2}$		0.0420 (0.0774)		0.181*** (0.0480)
$\Delta R_{US,t-3}$		-0.0764 (0.0680)		0.148*** (0.0386)
Constant	-0.00447 (0.0135)	-0.00424 (0.0128)	0.00481 (0.00754)	0.00308 (0.00569)
N	301	298	208	208
Adj. R^2	0.037	0.072	0.159	0.537

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}=STB 3mo for (1) and (2)
R_{SGP}=SORA 3m for (3) and (4)
R_{US}=DGS3MO

Table 8.33. 3-Month Interest Rate Daily Pass-Through from the United States to Singapore from Jan. 2, 1998 throughout Feb. 28, 2023

	(1)	(2)	(3)	(4)
	Until Sep. 18, 2013	Until Sep. 18, 2013	Since Oct. 4, 2005	Since Oct. 4, 2005
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.00666 (0.0192)	0.00673 (0.0322)	0.0106* (0.00437)	0.00170 (0.00615)
$\Delta R_{US,t-1}$		-0.0000288 (0.0229)		0.00217 (0.00637)
$\Delta R_{US,t-2}$		0.0197 (0.0296)		0.00305 (0.00391)
$\Delta R_{US,t-3}$		-0.0205 (0.0354)		0.00644 (0.00466)
Constant	-0.000123 (0.000655)	0.00119 (0.000954)	0.000283* (0.000120)	0.0000290 (0.000114)
N	6568	2626	4546	1818
Adj. R^2	-0.000	-0.001	0.004	0.003

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}= STB 3mo for (1) and (2)
R_{SGP}=SORA 3m for (3) and (4)
R_{US}=DGS3MO

Table 8.34. 3-Year Interest Rate Pass-Through from the United States to Singapore in the Subperiods between Sep. 30, 1998 and Jun. 30, 1999

	(1)	(2)
	Monthly	Daily
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	1.653* (0.517)	-0.397 (0.229)
$\Delta R_{US,t-1}$	1.150 (0.576)	0.256 (0.275)
$\Delta R_{US,t-2}$	1.396 (0.854)	0.783** (0.261)
$\Delta R_{US,t-3}$	0.470 (0.705)	-0.0451 (0.189)
Constant	-0.110 (0.150)	-0.0104 (0.0134)
N	10	78
Adj. R^2	0.549	0.153

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}= STB 3mo
R_{US}=DGS3MO

Table 8.35. 3-Month Interest Rate Monthly Pass-Through from the United States to Singapore in the Subperiods between Jul. 1999 and Nov. 2015

	(1)	(2)	(3)	(4)	(5)
	Before Jan. 2001	Before Jul. 2004	Before Sep. 2007	Before Dec. 2008	Before Dec. 2015
	Contractionary	Expansionary	Contractionary	Expansionary	Zero Lower Bound
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.642	0.253*	0.107	0.247	
	(0.473)	(0.120)	(0.104)	(0.290)	-0.189 (0.164)
$\Delta R_{US,t-1}$	0.187	0.687***	0.184	0.299	
	(0.579)	(0.185)	(0.249)	(0.269)	-0.217 (0.145)
$\Delta R_{US,t-2}$	0.886	-0.466**	0.397	0.125	
	(0.540)	(0.134)	(0.251)	(0.256)	0.0806 (0.135)
$\Delta R_{US,t-3}$	0.715	-0.195	0.0778		
	(0.363)	(0.168)	(0.223)	-0.0522 (0.191)	0.0608 (0.0767)
Constant	-0.150	-0.0143	-0.0324	0.0579	-0.00231
	(0.178)	(0.0268)	(0.0685)	(0.221)	(0.00477)
N	18	42	38	15	84
Adj. R^2	0.007	0.563	0.057	-0.167	0.106

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}= STB 3mo
R_{US}=DGS3MO

Table 8.36 3-Month Interest Rate Monthly Pass-Through from the United States to Singapore in the Subperiods between Dec. 2008 and Feb. 2023

	(1)	(2)	(3)	(4)
	Before Dec. 2015	Before Aug. 2019	Before Mar. 2022	After Feb. 2022
	Zero Lower Bound	Contractionary	Expansionary	Contractionary
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.0509 (0.0976)	0.0288 (0.0817)	0.169*** (0.0143)	0.241* (0.0762)
$\Delta R_{US,t-1}$	0.0894* (0.0380)	0.0677 (0.130)	0.184*** (0.00652)	0.480*** (0.0622)
$\Delta R_{US,t-2}$	0.0777 (0.0407)	0.220 (0.138)	0.250*** (0.00868)	0.149 (0.0982)
$\Delta R_{US,t-3}$	0.218*** (0.0214)	0.185* (0.0886)	0.132*** (0.00846)	0.0898 (0.0916)
Constant	0.000496 (0.00250)	0.00488 (0.0112)	0.00381 (0.00592)	-0.110 (0.0484)
N	84	44	31	12
Adj. R^2	0.671	0.028	0.912	0.853

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP} =SORA 3m
R_{US}=DGS3MO

Table 8.37 3-Month Interest Rate Daily Pass-Through from the United States to Singapore in the Subperiods between Jul. 1, 1999 and Dec. 15, 2015

	(1)	(2)	(3)	(4)	(5)
	Before Jan. 4, 2001	Before Jul. 1, 2004	Before Sep. 19, 2007	Before Dec. 16, 2008	Before Dec. 16, 2015
	Contractionary	Expansionary	Contractionary	Expansionary	Zero Lower Bound
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.0105 (0.0747)	0.236** (0.0773)	0.0141 (0.0126)	-0.0219 (0.0325)	0.0163 (0.0234)
$\Delta R_{US,t-1}$	0.110* (0.0537)	-0.00736 (0.0547)	-0.0196 (0.0120)	-0.0270 (0.0236)	0.0202 (0.0365)
$\Delta R_{US,t-2}$	0.0792 (0.0835)	-0.0672 (0.0804)	0.00213 (0.0109)	-0.0334 (0.0210)	-0.0567 (0.0298)
$\Delta R_{US,t-3}$	-0.0706 (0.0811)	0.0971 (0.0638)	0.0130 (0.0130)	0.0167 (0.0188)	-0.00575 (0.0149)
Constant	0.000814 (0.00371)	0.00112 (0.00167)	0.000313 (0.00120)	-0.00538 (0.00334)	0.0000258 (0.000186)
N	158	363	336	130	730
Adj. R^2	0.005	0.098	-0.006	0.025	0.018

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}= STB 3mo
R_{US}=DGS3MO

Table 8.39 3-Month Interest Rate Daily Pass-Through from the United States to Singapore in the Subperiods between Dec. 16, 2008 and Feb. 28, 2023

	(1)	(2)	(3)	(4)

	Before Dec. 16, 2015	Before Aug. 2, 2019	Before Mar. 18, 2022	After Mar. 17, 2022
	Zero Lower Bound	Contractionary	Expansionary	Contractionary
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	-0.00610 (0.00770)	0.00133 (0.00777)	0.00489 (0.00982)	0.00412 (0.0197)
$\Delta R_{US,t-1}$	-0.0170 (0.00915)	0.0168 (0.00884)	0.00393 (0.0105)	0.00281 (0.0166)
$\Delta R_{US,t-2}$	-0.0221 (0.0125)	0.0167 (0.00951)	0.00781 (0.0114)	0.00386 (0.0133)
$\Delta R_{US,t-3}$	-0.0177 (0.0114)	-0.00343 (0.0114)	0.0141 (0.0152)	0.0249 (0.0154)
Constant	-0.000138 (0.0000756)	0.000676** (0.000258)	-0.00146*** (0.000227)	0.00694*** (0.00122)
N	730	379	274	99
Adj. R^2	0.022	0.003	0.008	-0.011

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}=SORA 3m
R_{US}=DGS3MO

Table 8.40 2-Year Interest Rate Pass-Through from the United States to Singapore from Jan. 1998 throughout Feb. 2023

	(1)	(2)	(3)	(4)
	Monthly	Monthly	Daily	Daily
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.350*** (0.0669)	0.307*** (0.0634)	0.188*** (0.0135)	0.209*** (0.0244)
$\Delta R_{US,t-1}$		0.125* (0.0570)		0.0230 (0.0176)
$\Delta R_{US,t-2}$		0.0719 (0.0467)		0.0569* (0.0253)
$\Delta R_{US,t-3}$		0.0461 (0.0523)		0.0104 (0.0187)
Constant	0.00279 (0.0102)	0.00450 (0.00997)	0.000107 (0.000436)	0.00163* (0.000714)
N	301	298	6568	2626
Adj. R^2	0.180	0.220	0.069	0.084

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP} =sgs_2yr
R_{US}=DGS2

Table 8.41 2-Year Interest Rate Pass-Through from the United States to Singapore in the Subperiod between Sep. 30, 1998 and Jun. 30, 1999

	(1)	(2)
	Monthly	Daily

	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	1.030** (0.212)	0.159 (0.149)
$\Delta R_{US,t-1}$	0.0249 (0.106)	0.187 (0.129)
$\Delta R_{US,t-2}$	0.204 (0.188)	0.277 (0.177)
$\Delta R_{US,t-3}$	0.127 (0.296)	-0.200 (0.166)
Constant	-0.288* (0.0814)	-0.00193 (0.00726)
N	10	78
Adj. R^2	0.666	0.126

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}=sgs_2yr
R_{US}=DGS2

Table 8.42 2-Year Interest Rate Monthly Pass-Through from the United States to Singapore in the Subperiods between Jul. 1999 and Nov. 2008

	(1)	(2)	(3)	(4)
	Before Jan. 2001	Before Jul. 2004	Before Sep. 2007	Before Dec. 2008
	Contractionary	Expansionary	Contractionary	Expansionary
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.360* (0.148)	0.349*** (0.0758)	0.236** (0.0689)	0.139 (0.125)
$\Delta R_{US,t-1}$	0.185 (0.154)	0.101 (0.0771)	0.275 (0.154)	0.172 (0.0815)
$\Delta R_{US,t-2}$	0.0375 (0.276)	-0.0738 (0.0789)	0.333** (0.0935)	0.195 (0.132)
$\Delta R_{US,t-3}$	-0.166 (0.356)	-0.0854 (0.101)	0.0854 (0.0927)	-0.0803 (0.149)
Constant	0.0486 (0.0454)	-0.0304 (0.0242)	-0.0236 (0.0239)	-0.000743 (0.0821)
N	18	42	38	15
Adj. R^2	-0.042	0.280	0.274	0.126

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}=sgs_2yr
R_{US}=DGS2

Table 8.43 2-Year Interest Rate Monthly Pass-Through from the United States to Singapore in the Subperiods between Dec. 2008 and Feb. 2023

	(1)	(2)	(3)	(4)
	Before Dec. 2015	Before Aug. 2019	Before Mar. 2022	After Feb. 2022
	Zero Lower Bound	Contractionary	Expansionary	Contractionary
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	-0.0234 (0.0917)	0.274* (0.125)	0.319** (0.103)	0.688** (0.166)
$\Delta R_{US,t-1}$	0.0681 (0.0767)	0.186 (0.107)	0.311** (0.0976)	-0.215 (0.129)
$\Delta R_{US,t-2}$	0.00474 (0.0764)	0.0835 (0.137)	0.135 (0.0909)	-0.115 (0.179)
$\Delta R_{US,t-3}$	0.145 (0.0733)	-0.109 (0.144)	-0.00155 (0.0996)	0.286 (0.169)
Constant	0.00773 (0.0107)	0.00210 (0.0176)	-0.000692 (0.0182)	0.0199 (0.0847)
N	84	44	31	12
Adj. R^2	0.016	0.123	0.612	0.638

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP} =sgs_2yr
R_{US}=DGS2

Table 8.44 2-Year Interest Rate Daily Pass-Through from the United States to Singapore in the Subperiods between Jul. 1, 1999 and Dec. 15, 2008

	(1)	(2)	(3)	(4)
	Before Jan. 4, 2001	Before Jul. 1, 2004	Before Sep. 19, 2007	Before Dec. 16, 2008
	Contractionary	Expansionary	Contractionary	Expansionary
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.168*		0.142***	0.164*
	(0.0691)	0.228*** (0.0520)	(0.0348)	(0.0826)
$\Delta R_{US,t-1}$	-0.116	0.0152	0.0244	0.0335
	(0.0755)	(0.0286)	(0.0276)	(0.0638)
$\Delta R_{US,t-2}$	-0.0265		-0.00503	0.0899
	(0.103)	0.000372 (0.0303)	(0.0390)	(0.0785)
$\Delta R_{US,t-3}$	-0.0599	0.0227	0.0327	0.0655
	(0.0519)	(0.0287)	(0.0355)	(0.0580)
Constant			0.00145	0.0102
	0.000754 (0.00375)	0.00230 (0.00198)	(0.00150)	(0.00575)
N	158	363	336	130
Adj. R^2	0.020	0.180	0.049	0.051

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}sgs_2yr
R_{US}=DGS2

Table 8.45 2-Year Interest Rate Daily Pass-Through from the United States to Singapore in the Subperiods between Dec. 16, 2008 and Feb. 28, 2023

	(1)	(2)	(3)	(4)
	Before Dec. 16, 2015	Before Aug. 2, 2019	Before Mar. 18, 2022	After Mar. 17, 2022
	Zero Lower Bound	Contractionary	Expansionary	Contractionary
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.134***	0.304***	0.292***	0.290***
	(0.0355)	(0.0510)	(0.0544)	(0.0564)
$\Delta R_{US,t-1}$	0.0133	0.0597	0.0453	0.0492
	(0.0322)	(0.0435)	(0.0609)	(0.0483)
$\Delta R_{US,t-2}$	0.0400	-0.00837	0.133	0.182***
	(0.0360)	(0.0518)	(0.0774)	(0.0494)
$\Delta R_{US,t-3}$	0.00690	-0.0187	0.128*	-0.0554
	(0.0387)	(0.0489)	(0.0596)	(0.0422)
Constant		0.00117	-0.00183	
	0.00144 (0.000881)	(0.00140)	(0.00136)	-0.000257 (0.00417)
N	730	379	274	99
Adj. R^2	0.026	0.111	0.236	0.267

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}=sgs_2yr
R_{US}=DGS2

Table 8.46 10-Year Interest Rate Pass-Through from the United States to Singapore from Jun. 1998 throughout Feb. 2023

	(1)	(2)	(3)	(4)
	Monthly	Monthly	Daily	Daily
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.498*** (0.0458)	0.515*** (0.0434)	0.312*** (0.0128)	0.330*** (0.0190)
$\Delta R_{US,t-1}$		0.136* (0.0542)		0.0155 (0.0167)
$\Delta R_{US,t-2}$		0.0940* (0.0454)		0.0346 (0.0194)
$\Delta R_{US,t-3}$		-0.0497 (0.0410)		0.00824 (0.0174)
Constant	-0.00401 (0.0109)	-0.00440 (0.0105)	-0.000235 (0.000514)	-0.000466 (0.000797)
N	296	293	6442	2575
Adj. R^2	0.321	0.362	0.155	0.186

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}sgs_10yr
R_{US}=DGS10

Table 8.47 10-Year Interest Rate Pass-Through from the United States to Singapore in the Subperiod between Sep. 30, 1998 and Jun. 30, 1999

	(1)	(2)
	Monthly	Daily
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.915 (0.791)	0.0170 (0.0841)
$\Delta R_{US,t-1}$	0.543 (0.471)	0.236* (0.107)
$\Delta R_{US,t-2}$	0.0995 (0.440)	0.0809 (0.110)
$\Delta R_{US,t-3}$	-0.00630 (0.719)	0.0342 (0.0935)
Constant	-0.240 (0.193)	0.00252 (0.00496)
N	9	78
Adj. R^2	0.037	0.084

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}=sgs_10yr
R_{US}=DGS10

Table 8.48 10-Year Interest Rate Monthly Pass-Through from the United States to Singapore in the Subperiods between Jul. 1999 and Nov. 2008

	(1)	(2)	(3)	(4)
	Before Jan. 2001	Before Jul. 2004	Before Sep. 2007	Before Dec. 2008
	Contractionary	Expansionary	Contractionary	Expansionary

	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.0567 (0.165)	0.589*** (0.122)	0.314** (0.111)	0.788 (0.385)
$\Delta R_{US,t-1}$	0.267 (0.198)	0.218 (0.133)	0.140 (0.151)	0.664 (0.560)
$\Delta R_{US,t-2}$	-0.0549 (0.176)	0.157 (0.0981)	0.202 (0.140)	0.152 (0.404)
$\Delta R_{US,t-3}$	-0.229 (0.180)	0.0743 (0.125)	-0.00130 (0.108)	-0.575 (0.316)
Constant	-0.0148 (0.0356)	0.00856 (0.0342)	-0.0215 (0.0251)	0.0515 (0.131)
N	18	42	38	15
Adj. R^2	0.085	0.380	0.099	0.263

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}=sgs_10yr
R_{US}=DGS10

Table 8.49 10-Year Interest Rate Monthly Pass-Through from the United States to Singapore in the Subperiods between Dec. 2008 and Feb. 2023

	(1)	(2)	(3)	(4)
	Before Dec. 2015	Before Aug. 2019	Before Mar. 2022	After Feb. 2022
	Zero Lower Bound	Contractionary	Expansionary	Contractionary
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.541*** (0.0787)	0.663*** (0.0928)	0.474*** (0.0957)	0.610** (0.117)
$\Delta R_{US,t-1}$	0.0505 (0.0737)	0.0770 (0.102)	0.250 (0.129)	-0.101 (0.157)
$\Delta R_{US,t-2}$	0.111 (0.0610)	0.0872 (0.154)	-0.0572 (0.113)	-0.157 (0.122)
$\Delta R_{US,t-3}$	-0.0667 (0.0565)	-0.174 (0.122)	0.0683 (0.0911)	-0.0840 (0.146)
Constant	0.00907 (0.0172)	-0.00967 (0.0180)	0.00346 (0.0221)	0.0822 (0.0417)
N	84	44	31	12
Adj. R^2	0.425	0.477	0.486	0.611

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}sgs_10yr
R_{US}=DGS10

Table 8.50 10-Year Interest Rate Daily Pass-Through from the United States to Singapore in the Subperiods between Jul. 1, 1999 and Dec. 15, 2008

	(1)	(2)	(3)	(4)
	Before Jan. 4, 2001	Before Jul. 1, 2004	Before Sep. 19, 2007	Before Dec. 16, 2008
	Contractionary	Expansionary	Contractionary	Expansionary
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.180**		0.304***	0.313***
	(0.0563)	0.387*** (0.0577)	(0.0451)	(0.0676)
$\Delta R_{US,t-1}$	0.00350	-0.0342	0.0594	-0.0177
	(0.0508)	(0.0413)	(0.0385)	(0.0823)
$\Delta R_{US,t-2}$	0.0887	-0.0171	-0.0104	0.102
	(0.0912)	(0.0463)	(0.0496)	(0.0776)
$\Delta R_{US,t-3}$	0.0372	0.0476	0.0252	0.00421
	(0.0766)	(0.0438)	(0.0414)	(0.0576)
Constant	-0.00250 (0.00328)	0.00251 (0.00265)	-0.00124	0.000722

			(0.00168)	(0.00568)
N	158	363	336	130
Adj. R^2	0.043	0.223	0.149	0.122

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}=sgs_10yr
R_{US}=DGS10

Table 8.51 10-Year Interest Rate Daily Pass-Through from the United States to Singapore in the Subperiods between Dec. 16, 2008 and Feb. 28, 2023

	(1)	(2)	(3)	(4)
	Before Dec. 16, 2015	Before Aug. 2, 2019	Before Mar. 18, 2022	After Mar. 17, 2022
	Zero Lower Bound	Contractionary	Expansionary	Contractionary
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.319***	0.421***	0.417***	0.384***
	(0.0322)	(0.0553)	(0.0533)	(0.0489)
$\Delta R_{US,t-1}$	0.0190	-0.0151	0.0664	0.0877*
	(0.0266)	(0.0493)	(0.0588)	(0.0429)
$\Delta R_{US,t-2}$	0.0198	-0.00238	0.0347	0.119*
	(0.0271)	(0.0489)	(0.0810)	(0.0477)
$\Delta R_{US,t-3}$	-0.0461	0.0278	0.0425	-0.0592
	(0.0292)	(0.0643)	(0.0672)	(0.0432)
Constant		-0.00157	-0.00301	0.00278
	-0.00123 (0.00144)	(0.00187)	(0.00171)	(0.00384)
N	730	379	274	99
Adj. R^2	0.210	0.156	0.279	0.448

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}=sgs_10yr
R_{US}=DGS10

Table 8.52 20-Year Interest Rate Pass-Through from the United States to Singapore from Feb. 2007 throughout Feb. 2023

	(1)	(2)	(3)	(4)
	Monthly	Monthly	Daily	Daily
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$			0.281***	0.321***
	0.518*** (0.0497)	0.530*** (0.0546)	(0.0138)	(0.0198)
$\Delta R_{US,t-1}$		0.0437		0.0282
		(0.0483)		(0.0195)
$\Delta R_{US,t-2}$		0.0165		0.0213
		(0.0480)		(0.0235)
$\Delta R_{US,t-3}$		-0.0503		-0.0285
		(0.0480)		(0.0195)
Constant		0.00184		
	0.000215 (0.0108)	(0.0109)	-0.0000217 (0.000566)	-0.00116 (0.000893)

N	192	189	4182	1671
Adj. R^2	0.421	0.425	0.152	0.199

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}sgs_20yr
R_{US}=DGS20

Table 8.53 20-Year Interest Rate Monthly Pass-Through from the United States to Singapore in the Subperiods between Sep. 2007 and Feb. 2023

	(1)	(2)	(3)	(4)	(5)
	Before Dec. 2008	Before Dec. 2015	Before Aug. 2019	Before Mar. 2022	After Feb. 2022
	Expansionary	Zero Lower Bound	Contractionary	Expansionary	Contractionary
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.860*	0.553***	0.629***	0.480***	0.389
	(0.331)	(0.0612)	(0.110)	(0.0994)	(0.168)
$\Delta R_{US,t-1}$	0.461	-0.00137	0.0436	0.192	
	(0.425)	(0.0462)	(0.129)	(0.142)	-0.0128 (0.244)
$\Delta R_{US,t-2}$	0.269		0.0530		-0.465
	(0.490)	0.0608 (0.0460)	(0.144)	-0.0946 (0.137)	(0.233)
$\Delta R_{US,t-3}$	-0.548	-0.0627	-0.147	0.145	-0.195
	(0.572)	(0.0545)	(0.103)	(0.109)	(0.326)
Constant	0.0369	0.00664	-0.00924	0.000801	0.141
	(0.107)	(0.0140)	(0.0183)	(0.0255)	(0.0960)
N	15	84	44	31	12
Adj. R^2	0.292	0.547	0.421	0.395	0.165

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}=sgs_20yr
R_{US}=DGS20

Table 8.54 20-Year Interest Rate Daily Pass-Through from the United States to Singapore in the Subperiods between Sep. 19, 2007 and Feb. 28, 2023

	(1)	(2)	(3)	(4)	(5)
	Before Dec. 16, 2008	Before Dec. 16, 2015	Before Aug. 2, 2019	Before Mar. 18, 2022	After Mar. 17, 2022
	Expansionary	Zero Lower Bound	Contractionary	Expansionary	Contractionary
	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$	$\Delta R_{SGP,t}$
$\Delta R_{US,t}$	0.306***	0.308***	0.385***	0.375***	0.293***
	(0.0618)	(0.0290)	(0.0479)	(0.0536)	(0.0454)
$\Delta R_{US,t-1}$		0.0363			
	0.0165 (0.0922)	(0.0253)	-0.0113 (0.0500)	0.0248 (0.0495)	0.0433 (0.0549)
$\Delta R_{US,t-2}$		0.00880	-0.00224		-0.00942
	0.112 (0.0911)	(0.0253)	(0.0502)	0.0244 (0.0720)	(0.0557)
$\Delta R_{US,t-3}$	0.00544	-0.0334			
	(0.0599)	(0.0234)	0.0383 (0.0655)	-0.0405 (0.0591)	-0.105 (0.0533)

Constant	-0.00243 (0.00494)	-0.000298 (0.00131)	-0.00201 (0.00183)	-0.00174 (0.00166)	0.000585 (0.00361)
	130	730	379	274	99
N	0.132	0.227	0.143	0.276	0.302
Adj. R^2	0.306*** (0.0618)	0.308*** (0.0290)	0.385*** (0.0479)	0.375*** (0.0536)	0.293*** (0.0454)

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

R_{SGP}=sgs_20yr
R_{US}=DGS20

Non-linear ARDL Estimates

Table 8.55 Estimated US-HK Interest Rate Pass-Through in Different Subperiods with the Non-Linear ARDL Model

	(1)	(2)	(3)	(4)	(5)
	EFB_30day	EFB_91day	EFB_182day	EFB_364day	EFN_2yr
_y L1.	-0.319*** (0.057)	-0.171*** (0.035)	-0.129*** (0.030)	-0.134*** (0.028)	- 0.114*** (0.026)
_x1p L1.	0.267*** (0.053)	0.171*** (0.041)	0.129*** (0.035)	0.143*** (0.034)	0.123*** (0.032)
_x1n L1.	0.268*** (0.052)	0.176*** (0.040)	0.134*** (0.034)	0.149*** (0.033)	0.127*** (0.031)
_dy L1.	-0.130 (0.066)	-0.214*** (0.052)	-0.205*** (0.052)	-0.152** (0.055)	-0.154** (0.055)
_dy L2.				0.105 (0.057)	0.096 (0.056)
_dy L3.				0.091 (0.053)	0.109* (0.053)
_dx1p __.	-0.129 (0.202)	0.287 (0.316)	0.431 (0.311)	0.563* (0.247)	0.758*** (0.172)
_dx1p L1.	-0.061 (0.212)	0.230 (0.325)	0.267 (0.316)	0.055 (0.260)	-0.001 (0.179)
_dx1p L2.	-0.224 (0.206)			0.200 (0.260)	-0.016 (0.177)
_dx1p L3.	-0.029 (0.206)			-0.698** (0.250)	-0.314 (0.175)
_dx1n __.	0.233 (0.133)	0.835*** (0.176)	0.767*** (0.171)	0.747*** (0.171)	0.700*** (0.150)
_dx1n L1.	0.147 (0.131)	0.334 (0.176)	0.447* (0.173)	0.441* (0.178)	0.451** (0.154)
_dx1n L2.	0.148 (0.122)			0.111 (0.179)	0.198 (0.157)

_dx1n L3.	0.279* (0.118)			-0.140*** (0.227)	-0.236 (0.154)
Constant	0.946*** (0.178)	1.064*** (0.230)	0.851*** (0.211)	1.052*** (0.227)	0.963*** (0.231)
N	232	355	355	353	348
Adj. R-sq	0.2171	0.2043	0.1980	0.2224	0.2656
Long-run effect [+]	0.836***	0.995***	0.997***	1.070***	1.079***
Long-run effect [-]	-0.841***	-1.026***	-1.034***	-1.115***	- 1.114***
Long-run asymmetry F-stat	0.09878	0.597	0.6089	1.406	0.8504
Short-run asymmetry F-stat	7.11**	1.478	1.211	3.908*	2.252
Cointegration test statistics					
t_BDM	-5.6255	-4.9616	-4.3165	-4.7106	-4.2888
F_PSS	10.5899	8.2264	6.2582	7.6197	6.3492
Model diagnostics					
Portmanteau test up to lag 40 (chi2)	44.8	77.62***	86.54***	82.1***	91.07***
Breusch/Pagan heteroskedasticity test (chi2)	13.35***	165.2***	184***	157.7***	172***
Ramsey RESET test (F)	7.931***	16.11***	11.29***	8.927**	4.534**
Jarque-Bera test on normality (chi2)	594.4***	12848***	9598***	7524***	7249***

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 8.56 Estimated US-HK Interest Rate Pass-Through in Different Subperiods with the Non-Linear ARDL Model (Cont'd)

	(6)	(7)	(8)	(9)
	EFN_3yr	EFN_5yr	EFN_7yr	EFN_10yr
_y L1.	-0.099** (0.029)	-0.101** (0.030)	-0.109** (0.033)	-0.106** (0.034)
_x1p L1.	0.080* (0.035)	0.080* (0.037)	0.090* (0.043)	0.077 (0.048)
_x1n L1.	0.091** (0.033)	0.092** (0.035)	0.104* (0.040)	0.096* (0.044)

_dy L1.	-0.123 (0.063)	-0.040 (0.0653)	0.012 (0.068)	0.066 (0.069)
_dy L2.				0.072 (0.060)
_dy L3.				-0.102 (0.061)
_dx1p __.	0.722*** (0.170)	0.660*** (0.154)	0.732*** (0.157)	0.712*** (0.167)
_dx1p L1.	0.027 (0.173)	0.064 (0.157)	0.090 (0.160)	0.069 (0.169)
_dx1p L2.	-0.041 (0.165)			
_dx1p L3.				
_dx1n __.	0.723*** (0.157)	0.736*** (0.139)	0.700*** (0.148)	0.735*** (0.147)
_dx1n L1.	0.346* (0.165)	0.296* (0.15)	0.231 (0.160)	0.132 (0.160)
_dx1n L2.	0.307 (0.159)			
_dx1n L3.				
Constant	0.966** (0.288)	1.023** (0.314)	1.120** (0.350)	1.173** (0.384)
N	254	243	229	216
Adj. R-sq	0.2848	0.2961	0.3058	0.3081
Long-run effect [+]	0.809**	0.788*	0.832*	0.719
Long-run effect [-]	-0.921***	-0.907**	-0.957**	-0.899*
Long-run asymmetry F-stat	2.608	2.927	2.89	4.886*
Short-run asymmetry F-stat	2.154	0.7563	0.089	0.056
Cointegration test statistics				
t_BDM	-3.3426	-3.3292	-3.3274	-3.1054
F_PSS	3.7959	3.8270	3.9006	3.4826
Model diagnostics				
Portmanteau test up to lag 40 (chi2)	77.61***	81.95***	68.67**	53.09

Breusch/Pagan heteroskedasticity test (chi2)	148.9***	114.4***	91.35***	33.12***
Ramsey RESET test (F)	1.258	1.542	1.922	0.719
Jarque-Bera test on normality (chi2)	3176***	2077***	1885***	1220***

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 8.57 Estimated US-SGP Interest Rate Pass-Through in Different Subperiods with the Non-Linear ARDL Model

	(1)	(2)	(3)	(4)
	sgs_3m_yield	sgs_6m_yield	sgs_1yr_yield	sgs_2yr_yield
_y L1.	-0.216*** (0.041)	-0.158 (0.133)	-0.167*** (0.036)	-0.137*** (0.030)
_x1p L1.	0.124*** (0.027)	0.237* (0.111)	0.100*** (0.022)	0.081*** (0.019)
_x1n L1.	0.111*** (0.021)	0.228* (0.110)	0.090*** (0.019)	0.077*** (0.017)
_dy L1.	0.193** (0.067)	-0.993*** (0.143)	0.017 (0.062)	0.114* (0.056)
_dy L2.		-0.779*** (0.156)		
_dx1p __.	0.101 (0.223)	-0.448 (0.449)	0.24 (0.155)	0.332*** (0.085)
_dx1p L1.	-0.283 (0.225)	0.178 (0.440)	-0.453** (0.158)	-0.144 (0.086)
_dx1p L2.		-1.607** (0.408)	0.191 (0.157)	
_dx1p L3.		0.411 (0.399)		
_dx1n __.	0.254* (0.106)	0.685*** (0.064)	0.198* (0.089)	0.183** (0.067)
_dx1n L1.	0.310** (0.108)	0.680*** (0.112)	0.428*** (0.092)	0.282*** (0.072)
_dx1n L2.		0.953*** (0.149)	0.023 (0.092)	
_dx1n L3.		0.539*** (0.087)		
Constant	0.550*** (0.095)	1.177 (0.592)	0.451*** (0.085)	0.394*** (0.08)
N	186	39	276	277
Adj. R-sq	0.2424	0.9440	0.2553	0.2762

Long-run effect [+]	0.575***	1.503*	0.597***	0.594***
Long-run effect [-]	-0.512***	-1.442*	-0.539***	-0.559***
Long-run asymmetry F-stat	3.543	1.403	6.648*	3.627
Short-run asymmetry F-stat	3.932*	14.25**	5.126*	2.607
Cointegration test statistics				
t_BDM	-5.2365	-1.1858	-4.6635	-4.5730
F_PSS	10.4921	20.8233	8.5863	7.4701
Model diagnostics				
Portmanteau test up to lag 40 (chi2)	40.71	0.7773	55.98*	41.51
Breusch/Pagan heteroskedasticity test (chi2)	0.4524	0.6579	17.01***	25.8***
Ramsey RESET test (F)	6.062***	0.1016	12.27***	4.532**
Jarque-Bera test on normality (chi2)	201.3***	0.6925	555.1***	1549***

Standard errors in parentheses = "* p<0.05 ** p<0.01 *** p<0.001"

Table 8.58 Estimated US-SGP Interest Rate Pass-Through in Different Subperiods with the Non-Linear ARDL Model (Cont'd)

	(5)	(6)	(7)
	sgs_5yr_yield	sgs_7yr_yield	sgs_10yr_yield
_y L1.	-0.139*** (0.031)	-0.237*** (0.052)	-0.169*** (0.030)
_x1p L1.	0.097*** (0.024)	0.123** (0.038)	0.104*** (0.026)
_x1n L1.	0.093*** (0.023)	0.136*** (0.037)	0.102*** (0.024)
_dy L1.	0.094 (0.060)	0.166* (0.080)	0.023 (0.060)
_dy L2.	-0.069 (0.053)		-0.070 (0.058)
_dy L3.	0.118* (0.053)		0.168** (0.056)
_dx1p __.	0.605*** (0.082)	0.532*** (0.113)	0.639*** (0.082)
_dx1p L1.	0.092 (0.088)	0.033 (0.115)	0.273** (0.090)

_dx1p L2.			0.072 (0.090)
_dx1p L3.			-0.043 (0.088)
_dx1n __.	0.109 (0.075)	0.225* (0.107)	0.406*** (0.074)
_dx1n L1.	0.063 (0.077)	0.105 (0.117)	0.036 (0.076)
_dx1n L2.			0.182* (0.076)
_dx1n L3.			-0.093 (0.077)
Constant	0.407*** (0.112)	0.940*** (0.221)	0.603*** (0.133)
N	275	155	270
Adj. R-sq	0.2904	0.3208	0.4462
Long-run effect [+]	0.697***	0.520***	0.612***
Long-run effect [-]	-0.666***	-0.572***	-0.600***
Long-run asymmetry F-stat	2.229	4.513*	0.2983
Short-run asymmetry F-stat	7.877**	0.7316	2.454
Cointegration test statistics			
t_BDM	-4.5268	-4.5388	-5.6575
F_PSS	7.3344	6.9903	12.2767
Model diagnostics			
Portmanteau test up to lag 40 (chi2)	37.44	32.13	46.36
Breusch/Pagan heteroskedasticity test (chi2)	3.101	0.08679	4.538*
Ramsey RESET test (F)	0.4382	0.2701	3.627*
Jarque-Bera test on normality (chi2)	118.4***	42.55***	19.36**

Standard errors in parentheses = "* $p<0.05$ ** $p<0.01$ *** $p<0.001$"

Recursive Estimates

Figure 8.1 Hong Kong - Rolling Sterilization Coefficients Estimated with the HKMA measure of the NDA

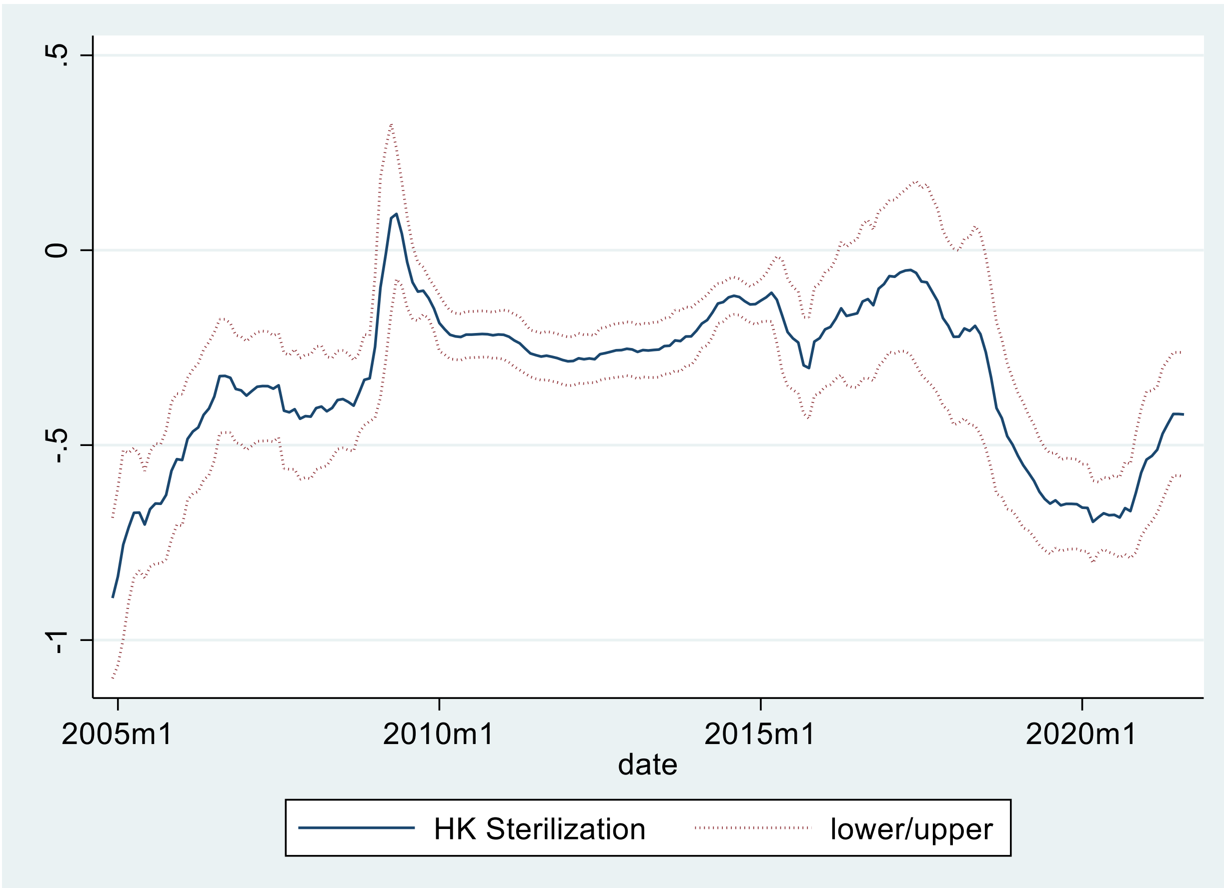


Figure 8.2 Hong Kong - Rolling Offset Coefficients Estimated with the HKMA measure of the NDA

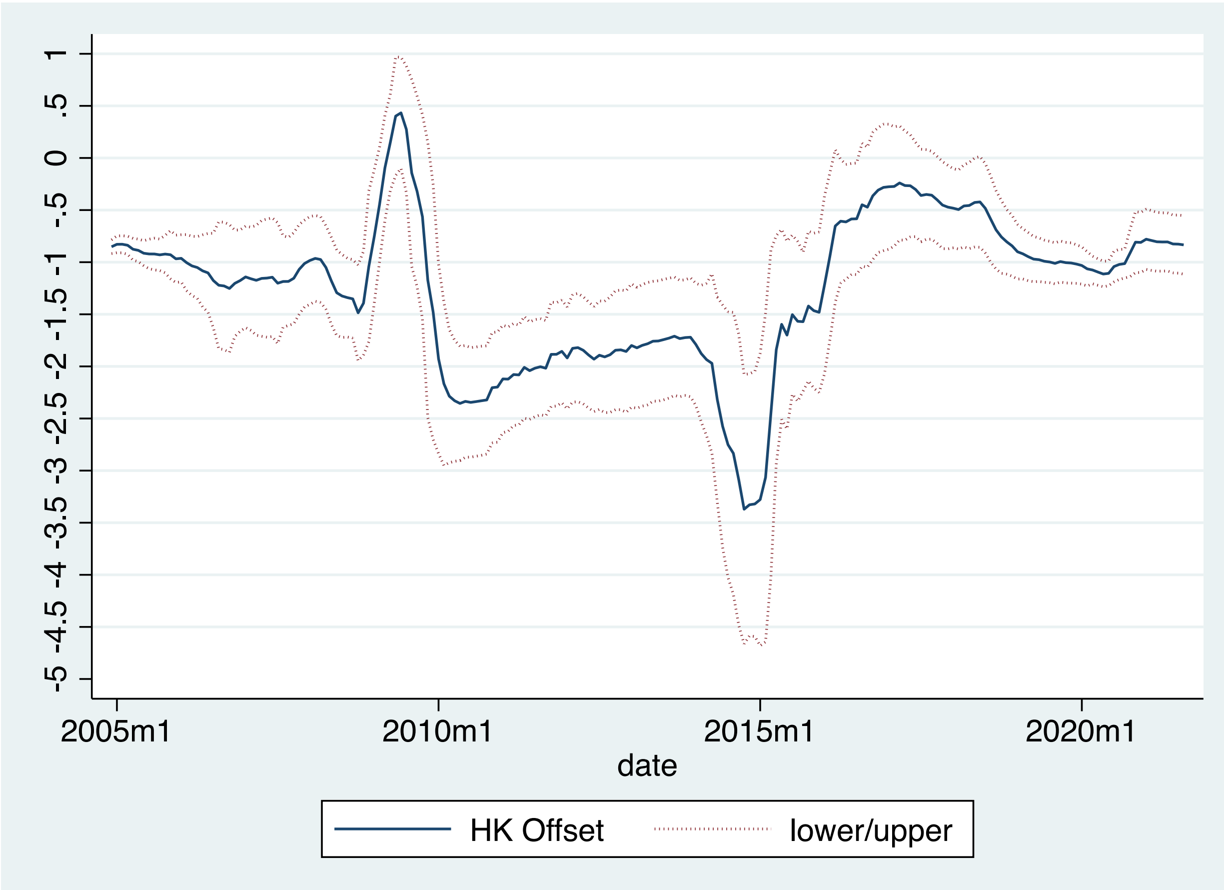


Figure 8.3 Hong Kong - Rolling Sterilization Coefficients Estimated with the Standard measure of the NDA

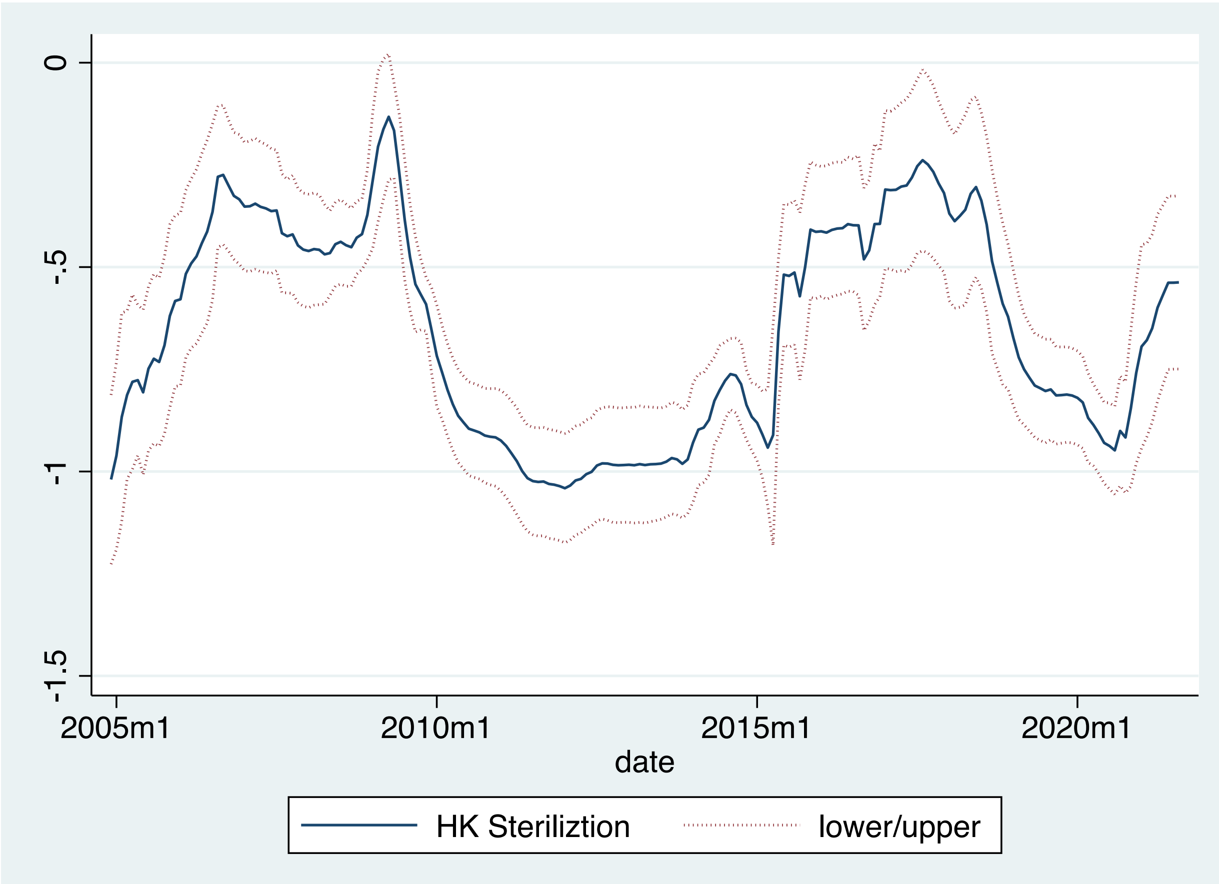


Figure 8.4 Hong Kong - Rolling Offset Coefficients Estimated with the Standard measure of the NDA

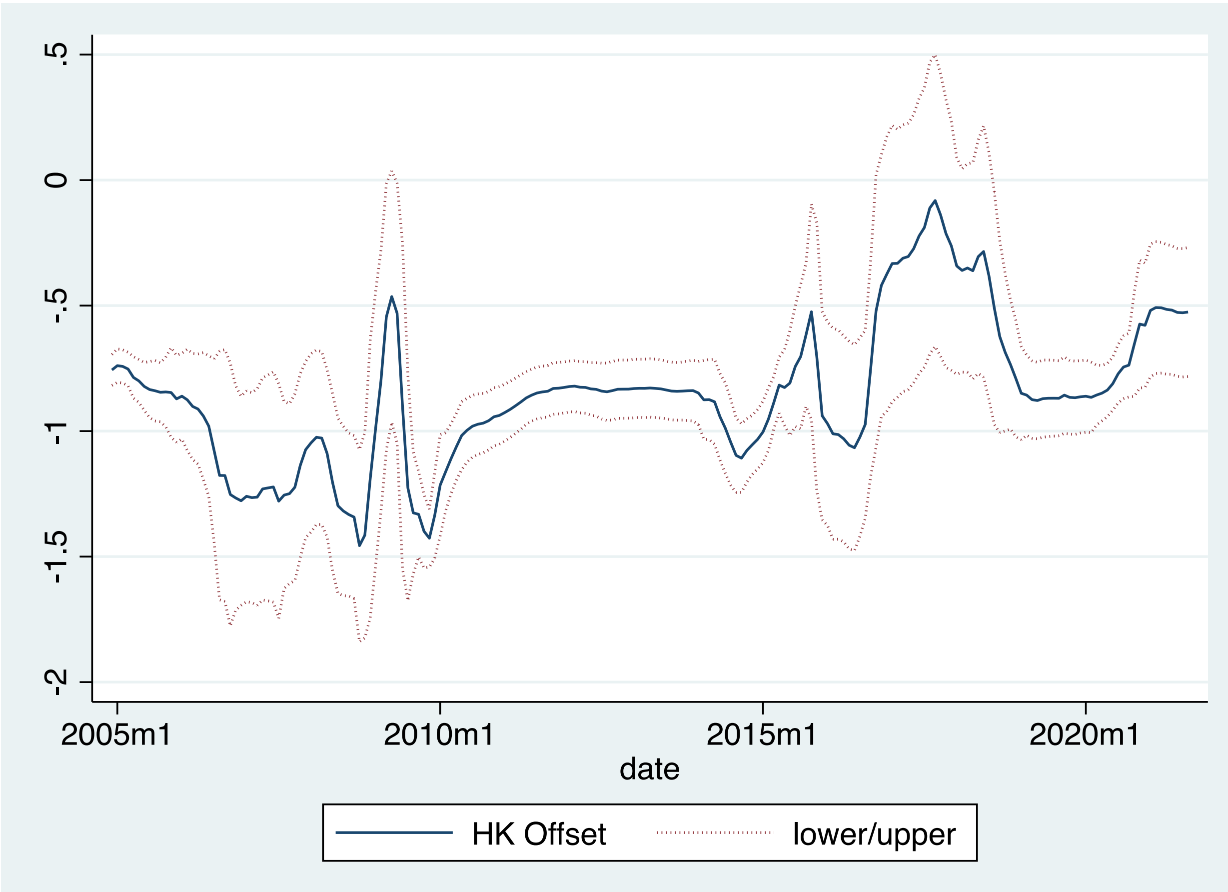


Figure 8.5 Singapore - Rolling Sterilization Coefficients Estimated with the 3-month Rates

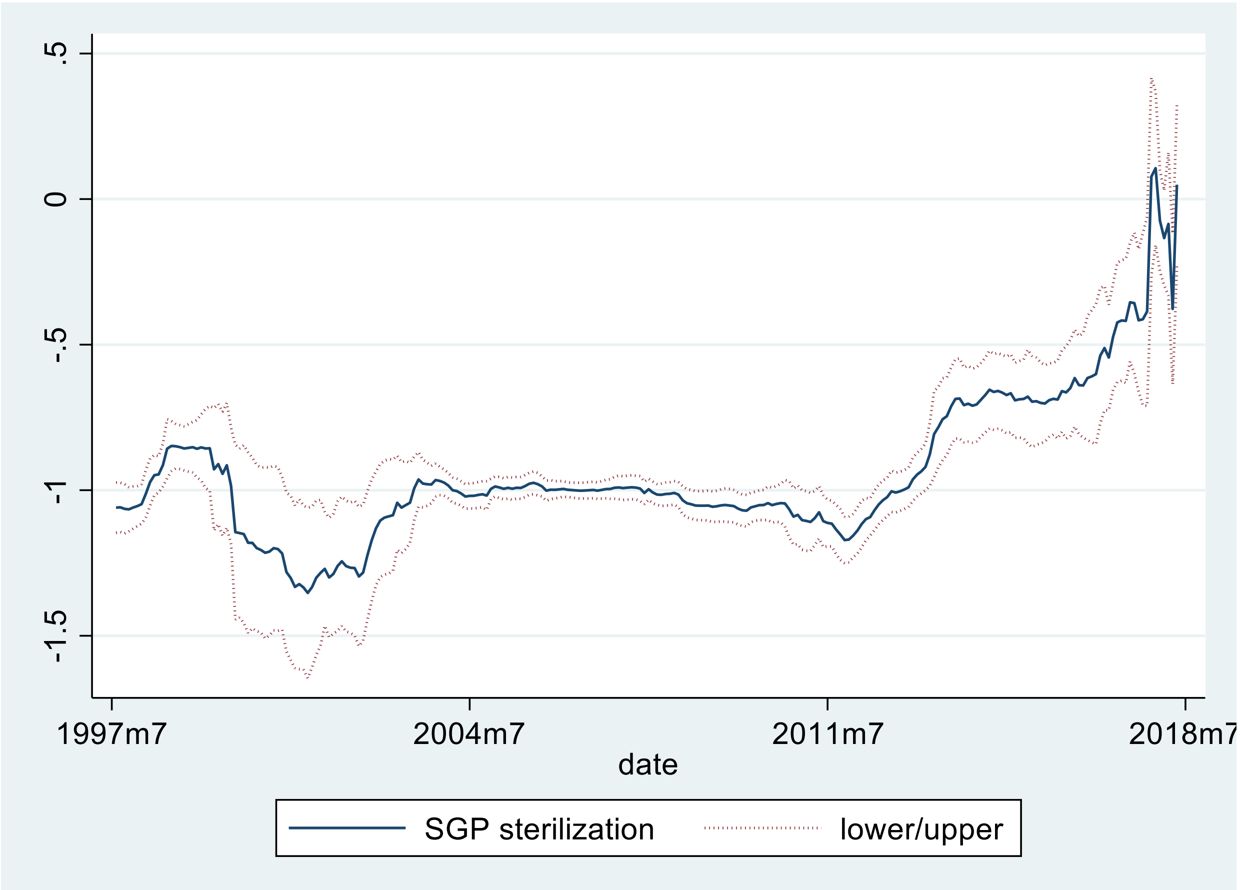


Figure 8.6 Singapore - Rolling Sterilization Coefficients Estimated with the SORA

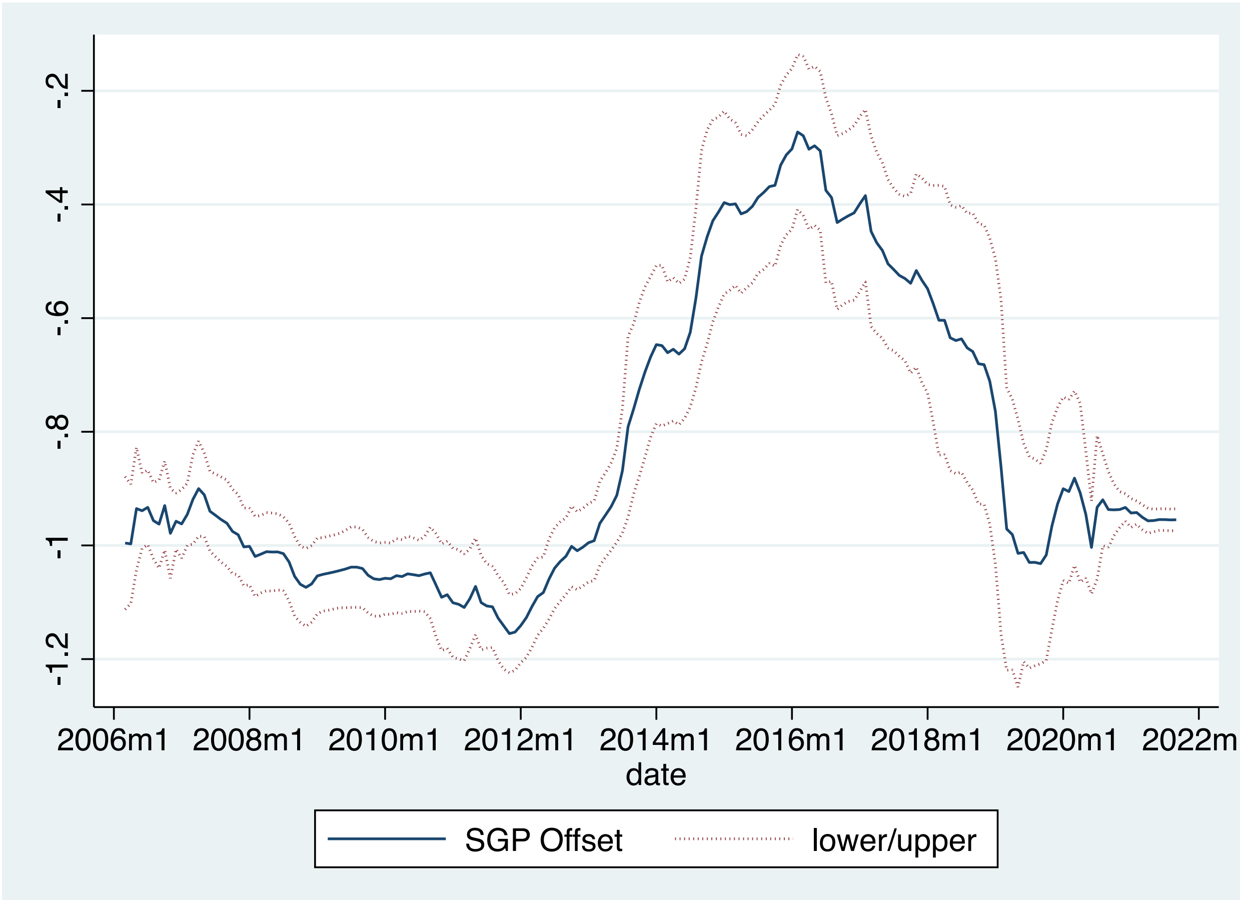
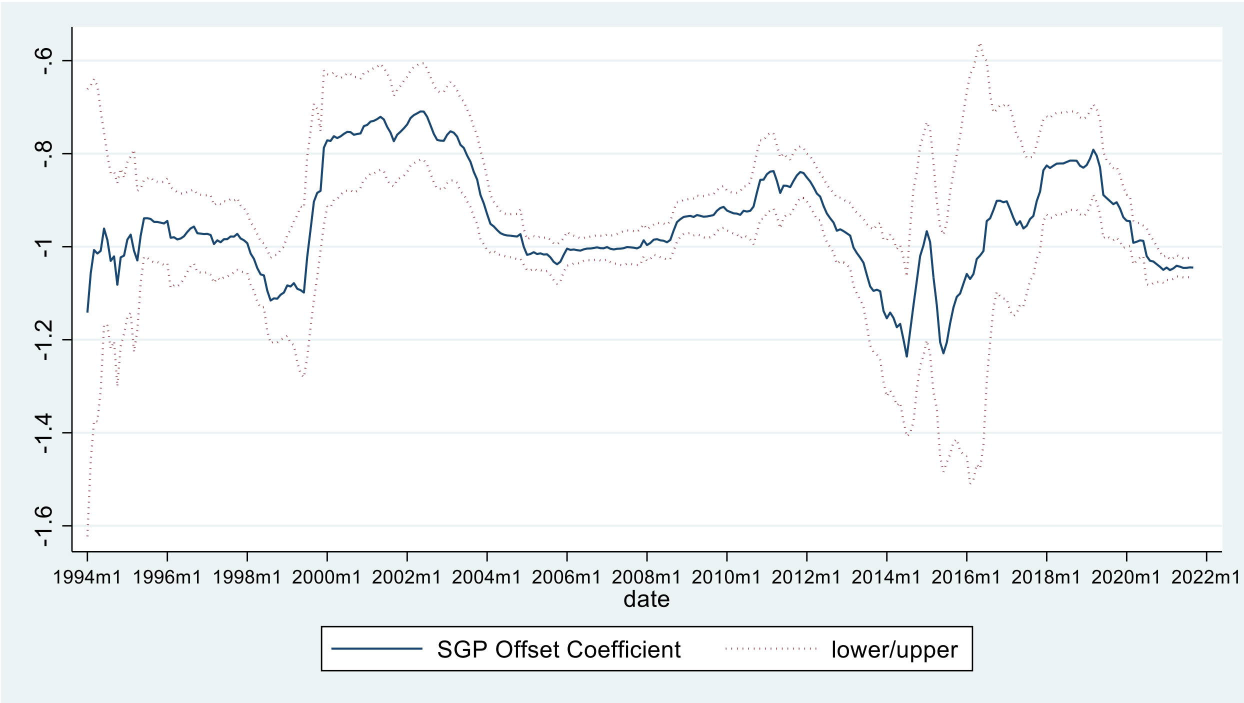


Figure 8.7 Singapore - Rolling Offset Coefficients



3SLS Model

Table 8.59 Hong Kong – Estimated Offset and Sterilization Coefficients with the 3SLS Approach

	(1)	(2)	(3)	(4)
	$\Delta NDA_{s,t}$	ΔNFA_t	$\Delta NDA_{ns,t}$	ΔNFA_t
ΔNFA_t	-0.218***		-0.755***	
	(0.0281)		(0.0335)	
$\Delta NDA_{s,t}$		-1.005***		
		(0.125)		
$\Delta NDA_{ns,t}$				-0.910***
				(0.0411)
$Y_{c,t-1}$	-1.105**	-1.812*	-0.821	-1.053*
	(0.395)	(0.793)	(0.468)	(0.507)
Δp_{t-1}	-6.019***	-1.602	-3.203***	-1.231
	(0.705)	(1.671)	(0.834)	(0.941)
e_{t-1}	-6.413***	-10.81***	-5.513***	-6.917***
	(0.680)	(1.475)	(0.806)	(0.853)
$\Delta(E_t s_{t+1} +$	-0.0765	-0.0161	-0.249*	-0.127
$r_t^*)$	(0.0969)	(0.190)	(0.115)	(0.124)
$(1-d_1)\sigma_{r,t-1}$	0.492**		0.617**	
	(0.177)		(0.210)	
Constant	49.84***	84.54***	42.99***	54.10***
	(5.298)	(11.46)	(6.273)	(6.634)
N	256	256	256	256
adj. R-sq	0.5351	0.3362	0.7225	0.7135

Standard errors in parentheses * p<0.05 ** p<0.01 *** p<0.001

Table 8.60 Singapore – Estimated Offset and Sterilization Coefficients with the 3SLS Approach

	(1)	(2)	(3)
	ΔNDA_t	ΔNDA_t	ΔNFA_t
ΔNFA_t	-0.944*** (0.0185)	-0.934*** (0.0154)	
ΔNDA_t			-1.019*** (0.0126)
$Y_{c,t-1}$		-0.814**	-0.564**
	-0.592*** (0.165)	(0.255)	(0.178)
Δp_{t-1}	0.539	0.383	0.822*
	(0.342)	(0.395)	(0.320)
e_{t-1}		-0.0822	
	-0.218*** (0.0351)	(0.0756)	-0.159*** (0.0313)
$\Delta(E_t s_{t+1} + r_t^*)$	0.0291	-0.0336	
	(0.0261)	(0.0450)	-0.000993 (0.0276)
$(1-d_1)\sigma_{3m,t-1}$	0.0487* (0.0228)		
		0.105	
$(1-d_1)\sigma_{sora,t-1}$		(0.0570)	
		0.204	
Constant	0.387*** (0.0586)	(0.106)	0.309*** (0.0483)
N	263	191	352
adj. R-sq	0.9279	0.9592	0.9549

Standard errors in parentheses * $p<0.05$ ** $p<0.01$ *** $p<0.001$

Chapter 9 Concluding Remarks

This dissertation examines important aspects of the conclusion of the standard trilemma that independent monetary policy cannot coexist with fixed exchange rates in the absence of capital controls. We emphasize that while the trilemma is a long-run constraint due to the need for an eventual balance of payments adjustment, it must hold, in the short run only if capital mobility is close to perfect. Otherwise, there can be scope for monetary sterilization of reserve flows that allow a country to operate outside of the trilemma constraints for a period of time. Hong Kong with its hard fix to the dollar and almost no capital controls provides a good test of the possibility of violating the trilemma constraints in the short run and maintaining some degree of monetary autonomy.

There are different aspects of monetary autonomy. We first estimate the interest rate pass-through from the U.S. to Hong Kong for both short-term and long-term interest rates. While the HKMA's policy rate typically adjusts quickly and fully to changes in the US rate (it does maintain a relatively constant premium), the pass-through to market rates are generally found to be substantial, but less than one. This is consistent with most previous estimates.

Using an alternative approach, we find that estimates of offset coefficients tend to estimate higher capital mobility, indeed close to perfect capital mobility, but given the findings of considerable sterilization in the same estimations we put less weight on this type of estimates. While there have been a number of previous estimates of interest rate pass-through for Hong Kong, to the best of our knowledge there have been no previous studies of sterilization in Hong

Kong. Here we find that the HKMA has been able to undertake a good deal of sterilization. The actual estimates depend on how the Hong Kong monetary base is measured. Contrary to the standard practice of measurement, the HKMA includes bank-held Exchange Fund Bills as part of its monetary base. Using this definition, we find in our basic estimation that about one-third of reserve flows are sterilized, substantially below full sterilization but still indicating a considerable amount of short-run monetary autonomy of this type. Estimates of roughly this size are also found when a number of robustness tests are undertaken.

When the conventional measure of the monetary base is used as opposed to the HKMA's measure is used much higher estimates are found, indeed indicating close to full sterilization. We do not think that these estimates of almost full sterilization are plausible, but further research is to interpret the results as indicating that it is important for researchers to carefully investigate the institutional arrangements of individual countries when estimating sterilization coefficients.

Another point of interest is that our estimates of interest rate adjustments using daily data found very quick adjustment consistent with efficient market responses in the face of substantial but still limited arbitrage. Some studies, particularly using monthly data, have found substantial lags in adjustment. See Ricci and Shi (2016) and Bowman et al. (2015). Since short lags are more consistent with theory, this suggests that it is important to use daily rather than longer term data but this is an issue that requires further research.

In summary, we have found considerable evidence that despite a credible fixed exchange rate and almost no capital controls, Hong Kong has been able to retain some degree of short-run monetary autonomy. This has several important implications for international monetary research and policy beyond the case of Hong Kong. It suggests that capital controls are not the only factor limiting international capital mobility. This supports the view that sterilized intervention in the foreign exchange market can at times be effective in regimes of fixed exchange rates even in the face of substantial capital mobility. High capital mobility is not the same as perfect capital mobility. However, this does not imply that sterilized intervention can be effective in protecting seriously overvalued exchange rates from strong private sector speculation nor that it allows effective monetary autonomy over the longer run. The ability to sterilize also suggests that many countries have the ability to keep capital flow surges from generating destructive domestic credit booms. Finally, these results suggest that it is important for studies of the trilemma to distinguish between short run and longer run relationships.

This dissertation also compares Singapore to Hong Kong on the two aspects of monetary autonomy. The comparison shows how much extra scope for monetary freedom Singapore with a managed floating exchange rate regime has than Hong Kong with a fixed regime, given the comparable high capital mobility in both economies. We use the government bond yields between Jun. 10, 1991 and Feb. 26, 2021 to estimate the interest rate pass-through and as expected from standard theory find that the estimated pass-through to Singapore is substantially lower than that for Hong Kong. It is on average 0.432 for Singapore and 0.759 for Hong Kong.

We also collect monthly data from Jan. 1992 to Jun. 2021 and estimate Singapore's offset and sterilization coefficients and find that Singapore can undertake full sterilization. All the results show the monetary independence that Singapore has is greater than for Hong Kong and confirms that contrary to the “dilemma not trilemma” hypothesis that exchange rate changes are not effective in generating a degree of monetary autonomy. Flexible exchange rates are indeed able to provide a degree of insulation of the domestic economy from oversea monetary shocks.[77]

We use interest rates with maturities from 1 month to 10 years and divide the entire sample into six subperiods to control the effects of maturity and regional or global factors on international asset substitutability. The estimates show that the short-term interest rate pass-through tends to be lower than the long-term rate pass-through. The results are consistent with limits of arbitrage likely due in part to investors' risk aversion in global financial markets. We find that the estimated interest rate pass-through decreases for Hong Kong but increases for Singapore from the pre-Global Financial Crisis period to the post-Zero Lower Bound era. It indicates less monetary transmission falls on exchange rates in Singapore after the ZLB period than before and implies intensive foreign exchange interventions made by the local monetary authority in response to the US monetary tightening since 2016.

We also use a sample of policy rates and government bond yields with maturities 3 months, 2, 10, and 20 years from Jun. 10, 1991 to Feb. 28, 2023 to estimate the interest rate pass-through and find robust evidence for the main findings. Besides, a non-linear ARDL model which can examine the asymmetric responses of local interest rates to an increase versus a decrease in the foreign monetary policy is employed. The results show significant asymmetry in the level relationship between the US and Hong Kong's 1-, and 10-year interest rates. Hong Kong rates respond more to the US monetary easing than monetary tightening. In the case of Singapore,

[77] Of course, no exchange rate regime can insulate an economy fully from foreign shocks.

however, the long-run asymmetry is significant in 1- and 7-year interest rates. The 1-year Singapore rate responds to the US monetary easing only, and the 7-year Singapore rate responds to the US monetary tightening much more than monetary easing. A 100-basis-point increase in the 7-year Treasury Bond yield can increase the 7-year Singapore Government Security yield by 53.2 basis points (bps) on average, but a decrease of 100 bps in the US rate can make the Singapore counterpart fall just by 22.5 bps.

We also present rolling offset and sterilization coefficients and find variations in the extent of sterilization over time. Nevertheless, the recursive estimates stay below zero, indicating that both Hong Kong and Singapore have undertaken sterilization. The findings are also supported by the estimates with the 3SLS model, which are close to the main results from the 2SLS model.

There are a number of areas for further research. An important one is further analysis the appropriateness of the different measures of the monetary base for Hong Kong. More generally it will be useful to explore the factors that make cross-border capital mobility imperfect and explain the different monetary transmissions across various maturities and subperiods. The asymmetry in sterilization concerning foreign exchange intervention intensity and the direction of capital flows should also be tested.

A final area is to control for domestic factors that influence interest rate policies. Following most of the previous literature we have looked only at the effects of foreign interest rate changes on domestic interest rates. This implicitly assumes that domestic interest rates would not change in response to domestic developments. Where domestic factors are also influencing domestic interest rates than depending on the patterns of these influences, they could lead to either upward or downward biases in the estimates of the influences of foreign rates.

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