The Role of Monetary Policy During a Financial Crisis

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Abstract

This paper examines the impact of monetary policy during a currency crisis using the 1997-98 Hong Kong crisis episode. Specifically, two opposing views are considered. The traditional position posits that a significant rise in the interest rate of the local currency increases the desire to hold that currency and thus deters further speculation. Conversely, the revisionist view favors expansionary monetary policy contending that raising interest rates during a financial crisis causes widespread domestic bankruptcies inducing greater loss of confidence and further depreciation of the currency. Using the exchange market pressure measure as derived by Girton and Roper (1977), I construct VARs that test for consistency with the revisionist view as theorized by Furman et al. (1998). Since speculation against the HK dollar took place in the spot and futures (three- and six-month contracts) markets, the VARs are estimated at the three relevant time horizons: the spot, the three-month and the six-month time periods. The results prove consistent with the revisionist theory.
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1 Introduction

One of the most controversial issues that arose in the aftermath of the 1997-98 Asian financial crisis is the appropriate monetary policy response. More specifically, two arguments have been advanced. The traditional position prescribes a tight monetary policy in defense of the exchange rate; a significant rise in the rate of return of the local currency increases the desire to hold that currency and thus deters further speculation. Conversely, the revisionist view favors expansionary monetary policy much in the manner of the counter-cyclical approach that industrialized nations adopt when faced with financial crises of their own, as illustrated by the 2008-09 crisis. This position contends that raising interest rates during a financial crisis causes widespread domestic bankruptcies inducing further loss of confidence and additional pressure on the exchange rate.

On July 2, 1997 the Thai baht collapsed in the face of speculation, and in a few weeks Malaysia, Indonesia, South Korea, the Philippines and Hong Kong were all hit. Of these, only Hong Kong successfully defended the pre-crisis exchange rate.

Until the Asian episode, the experience of the international community in dealing with financial crises centered on Latin America. Generally speaking, Latin American crisis countries had been characterized by fiscal indiscipline and debt monetization resulting in persistently high inflation. Furthermore, their institutions lacked credibility and confidence; governments were usually embroiled in corruption while financial institutions were neither sufficiently developed nor passably transparent. The traditional view on monetary policy during a financial crisis, whose main proponents have been the IMF and the so-called Washington Consensus, derives its inspiration from this Latin American experience. A tight monetary policy, it is argued, signals to investors the authority’s willingness to bring inflation under control and limit a depreciation-inflation spiral that is common to financial crises. Therefore, it primarily aims to restore confidence in international markets in order to reverse the capital outflow.

The Asian crisis countries, on the other hand, had insignificant fiscal imbalances and kept inflation under control. Consequently, by the eve of the crisis, the Asian monetary authorities had established a reputation for prudent monetary policy. While financial vulnerabilities afflicted their economies, such as currency mismatch in the balance sheets, it is generally accepted that the fundamentals did not warrant either the depth or the potency of
the crisis. Accordingly, the revisionists dismiss the confidence restoration measures that are supported by the traditionalists as excessively painful and unnecessary for Asia.

Critics of the traditional approach justifiably argue that the pre-crisis macroeconomic instability of the Latin American countries was not of relevance to the Asian episode. They add that while Latin America was plagued by excess demand, making a contractionary policy reasonable, the problem with the Asian countries during the crisis was insufficient demand. According to the revisionists, it is this distinction in fundamentals between the two sets of countries that speculators understand causing them to react to an interest rate hike differently than what is prescribed in the traditional view. Additionally, this difference in views applies only during a crisis period.

The failure of the Asian exchange rates to stabilize upon monetary tightening was essentially considered by the revisionists as evidence against the traditional approach, which was advanced by the IMF as part of its programs for the crisis countries. Admittedly, it is difficult to know whether there would have been greater exchange rate depreciations in the absence of interest rate hikes. This type of a counterfactual experiment is hard to conduct. It also has to be noted that the IMF programs for the region were comprehensive in nature that included, in addition to tight monetary policy, a fiscal dimension as well as financial restructuring. They were wholesome packages intended to regain confidence in the affected economies. To many, the final vindication for the IMF approach was the recovery, which was remarkably rapid especially when compared with the Latin American crisis countries of the 1980s. For example, in 1999 the Asian crisis countries regained positive growth with the Korean GDP growth rate rebounding to 9.5% and only Indonesia growing at a low 0.8%. By 2000, all of the Asian crisis countries were growing at a robust if not vigorous rate. On the other hand, Malaysia opted out of the IMF program choosing heterodox policies that included temporary and selective capital controls for which it was heavily criticized by the Washington Consensus. Despite this, Malaysia’s recovery was also brisk and robust with its GDP growing at 6.1% in 1999.

The crisis in Hong Kong provides for additional arguments not previously discussed within the context of the revisionist-traditional debate. In August 1998, speculation against the HK dollar took a distinct form whereby simultaneous attacks were launched on the currency and the stock market. The modus operandi of this so-called double-market play involved selling short the HK dollar on the spot and the forward markets, while simultaneously
shorting Hong Kong stocks on the cash and futures markets. The shorting of HK dollars was expected to squeeze interbank liquidity pushing up the HK Interbank Offer Rate (HIBOR)\(^1\) and in turn inducing a sharp fall in the stock and future markets. In the event that this occurred, speculators could reap high rewards even if the exchange rate held. Facing this prospect, the Hong Kong authorities launched a double-counter play by intervening in both the foreign exchange and the stock market. For a period of ten working days from August 14 until August 28, the Hong Kong Monetary Authority (HKMA) spent a total of HK$118.13 billion (US$15 billion) to directly buy stocks. Hence, in addition to pointing to expectations of widespread bankruptcies as a result of larger country risk premia, the revisionists might also argue that an interest rate defence of the exchange rate during a financial crisis encourages double-market play.

Much of the empirical literature that examines this topic studies the relationship between a measure of monetary policy (interest rates or monetary aggregates) and the exchange rate. In this configuration, movements in the exchange rate are meant to capture speculation, whereby a depreciation indicates speculation against the currency. In effect, the exchange rate is treated as the indicator of speculation. The strategy of this literature is to assess the correlation between the monetary policy measure and the exchange rate during a speculative attack; if interest rates (monetary aggregates) are negatively (positively) correlated with the exchange rate,\(^2\) then that is taken as evidence for the traditional position, while the reverse correlations are evidence in support of the revisionist stance. Typically, these studies have used a sort of exchange rate determination model to derive the relationship between the two variables.

This approach is flawed in that it disregards the impact of foreign exchange interventions that the monetary authority conducts in defense of the exchange rate. That is, to the extent that foreign exchange interventions are effective in this defense, movements only in the exchange rate and the monetary policy measure are not sufficient to capture the dynamics. Another limitation to this approach is that time-series examinations of this relationship are limited to successful episodes of speculative attacks (attacks that result in significant exchange rate depreciations). Unsuccessful episodes can-

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\(^1\)The HIBOR is the rate of interest offered on HK dollar loans by banks in the interbank market.

\(^2\)The exchange rate here is defined as the domestic price of a unit of foreign currency, so that a higher exchange rate indicates a depreciation of the domestic currency.
not be tested using time-series techniques since, having retained stability, the exchange rate would show no significant response to monetary policy. This is at a time when monetary policy was triumphant in the defense of the currency. In response to these concerns, I propose to use exchange market pressure (emp) as the indicator of speculation in place of the exchange rate.

The emp was first constructed by Girton and Roper (1977) as a summary statistic which measures a currency’s total excess demand that is relieved via a combination of exchange rate movements and changes in foreign exchange reserves. The latter is meant to proxy for central bank or government intervention in the foreign exchange market in support of the exchange rate. Formally, in rate of change form,

\[ emp = s - r \] (1)

where \( s \) is the growth rate of the nominal exchange rate (the domestic price of a unit of foreign exchange) and \( r \) denotes the growth rate of foreign exchange reserves that is valued in domestic currency, deflated by the monetary base. According to equation (1), when investors dump the domestic currency and the exchange rate depreciates (\( s > 0 \)) and/or the central bank intervenes and sells foreign exchange (\( r < 0 \)), then there is positive market pressure on the currency, \( emp > 0 \). Conversely, when the domestic currency becomes more attractive for investors to hold and \( s < 0 \) and/or \( r > 0 \), then \( emp < 0 \).

The emp literature is substantial, and within it the relationship between the emp measure and monetary policy is frequently examined even during financial crisis episodes. However, the sample countries and periods have not been optimal for the revisionist-traditional debate since they fail to account for the following combined:

1. Since the contrast between the traditional and revisionist views is much more defined when economic fundamentals do not warrant a financial crisis, the sample country/countries should have such fundamentals.

2. The sample period should be predominantly a crisis period since the revisionist view does not apply during non-crisis periods.

3. Changes in foreign exchange reserves should proxy for interventions by the central bank or government in the foreign exchange market in support of the exchange rate. Generally speaking, reserve management

\[^3\text{Since intervention data are highly confidential, the emp literature has used changes in foreign exchange reserves as a proxy.}\]
is secretive, minimally transparent and is subject to discretionary activity and a local accounting framework. As a result, changes in aggregate reserves might be uninformative of interventions in the foreign exchange market. However, by institution and regulation, a currency board minimizes discretionary activity, maximizes transparency and subjects monetary policy as a whole to a rule that maintains the fixed exchange rate. This makes changes in foreign exchange reserves a more accurate proxy for intervention activity in a currency board setting.

This study complies with the above by choosing Hong Kong as the country under study. Firstly, as with the other Asian crisis countries, and even more so, Hong Kong’s fundamentals were sufficiently strong to deter speculative attacks, or at least to not justify one. For example, Hong Kong’s foreign reserves continued to rise up to October 1997, ranking third largest in the world after Japan and China at the end of November 1998 (at US$88.6 billion). Additionally, at about 2.5% the unemployment rate in Hong Kong before the currency attack was low even by historical standard. Thus, there was no pressure from the employment front to suggest a devaluation of the Hong Kong dollar to reduce unemployment. Secondly, the sample period that is estimated in this study ranges, in monthly frequently, from July 1997, which is usually acknowledged as the beginning of the Asian financial crisis, to December 1999. This minimizes the non-crisis period while providing a sufficient number of observations for estimations using a monthly frequency. Finally, the Hong Kong dollar has been for a considerable time in a currency board relationship to the US dollar at the rate of 7.8 $HK= 1 $US. Moreover, “the fluctuations of the market rate have been held within 1% either way of the parity of 7.8 since October 24, 1983, despite such external shocks as the Asian currency crisis in the summer of 1997” (Jao, 2001, p. 34). Hence, this provides an opportunity to test the revisionist hypothesis during a failed speculative attack.

The purpose of this study is to propose an original method that can empirically test for consistency with the revisionist view, while accounting for the particulars of the Hong Kong case. The emp measure, as explained earlier, can be used as an indicator of speculation against the currency during a financial crisis. However, this is only so when the spot time horizon is being considered. In the case of Hong Kong, speculation was being conducted.

\footnote{This is when the first major currency attack occurred on the HK dollar.}

\footnote{Lui et al. (2000, p. 8).}
using three- and six-month future contracts, making the three- and six-month forward exchange rates superior indicators of speculation to the $emp$ measure for the three- and six-month time periods, respectively.

The Girton and Roper (1977) derivation of the $emp$ measure identifies the variables that compose the VARs in this study. To more accurately describe the Hong Kong episode, the VARs are estimated for the three relevant time horizons: the spot, three-month and six-month time periods. The spot VARs employ the $emp$ measure as the indicator of speculation and the overnight interest rate differential as the monetary policy measure. The three-month VAR accounts for speculation in the three-month forward market. It does so by including the three-month forward exchange rate as the indicator of speculation, and the three-month interest rate differential as the measure of monetary policy. Correspondingly, the six-month VAR includes the six-month forward exchange rate as the indicator of speculation, and the six-month interest rate differential as the measure of monetary policy. The results prove consistent with the revisionist theory.

In section 2, I present the theory and specify the model. Section 3 details the results. A conclusion for this paper is offered in section 4 followed by an appendix that includes an explanation of the data.

2 Theory

2.1 The Revisionism of Furman, Stiglitz, Bosworth and Radalet (1998)

While numerous studies have examined the revisionist approach to monetary policy during a financial crisis, none is as theoretically profound or relevant to the Asian episode, and by extension to other modern financial crises, as Furman et al. (1998). Consequently, this paper is frequently cited when the topic is broached, rendering the theory that the authors establish an important consideration for my model. I begin with a summary of their pertinent discussions.

Furman et al. (1998) challenge the traditional assumption that an interest rate increase during a financial crisis strengthens the spot exchange rate. To do so they begin by considering a conventional formulation for the uncovered
interest parity condition (UIP), which can be written as

\[ 1 + I_t = (1 + I^*_t) \frac{E_t(S_{t+1})}{S_t} \]  

(2)

where \( I \) is the domestic interest rate, \( S \) is the domestic price of a unit of foreign currency, \( I^*_t \) denotes the foreign interest rate and \( E_t \) indicates the expectation at time \( t \).

The authors base their challenge to the traditional approach on three grounds. The first posits that monetary policy has a systematic effect on the expected future exchange rate which might re-enforce the traditional scenario or weaken it. For example, if as a result of the interest rate hike inflation is reduced, then agents might expect a stronger future currency. In this case and for a given \( I^*_t \), the expected future exchange rate appreciation moves to re-enforce the interest rate hike in appreciating the currency today. Mathematically, the increase in \( I_t \) and the decrease in \( E_t(S_{t+1}) \) in equation (2) are offset by a decrease in \( S_t \). Alternatively, if credit tightening reduces the supply of exports for a given exchange rate, then that might diminish the future demand for the currency. This depreciates the expected future exchange rate thus mitigating the effect of the interest rate increase on the spot exchange rate. As a matter of fact, according to equation (2), if the interest rate rise is smaller than the expected depreciation of the future exchange rate, ceteris paribus, then the spot rate also depreciates.

The second reason is that the market may be risk averse as opposed to risk-neutral, as assumed in the conventional UIP condition. Moreover, if the interest rate hike is seen as a move that might induce a recession, then investors’ perceptions of risk and their willingness to bear it change. This suggests that the degree of risk aversion is a function of interest rates and might be especially so during a financial crisis.

The third argument contemplates that what matters finally to investors is not the nominal interest rate but the expected return on the currency, which incorporates the probability of default. Specifically, higher interest rates, even when imposed temporarily, can lead to a permanent or a long-term rise in the probability of default thereby reducing these expected returns. Intuitively, interest rate increases weaken confidence in the economy making it a less attractive place for investments. As a result, investors holding short-term debt are less inclined to roll it over, thus depriving domestic firms of vital credit when they need it the most. Even if the traditional scenario applies and the interest rate rise is less than offset by the rise in the probability
of default, in the long term, when the former is lowered again, the latter remains higher. Hence, the expected long-term return on the currency will be lower. As a result, the expected future exchange rate depreciates causing the spot rate to weaken.

Furman et al. (1998) accordingly adjust the UIP equation to include a measure of risk and the probability of default:

\[(1 - \gamma(I))(1 + I_t) - \nu(I) = (1 + I_t^*) \frac{E_t(S_{t+1})}{S_t}\]  

(3)

where \(\gamma\) is the probability of default and \(\nu\) is the risk premium, both being increasing functions of the interest rate.

2.2 The Model

For this study I adopt the simple monetary model for a small open economy as presented by Girton and Roper (1977) whose derivation I closely follow.

\[H = F + D\]  

(4)

\[M^d = PY^\beta e^{-\alpha I}\]  

(5)

\[Q = S \frac{P^*}{P}\]  

(6)

where \(H\) is the supply of base money issued by the central bank, \(F\) stands for base money created against the purchase of foreign assets (in units of national currency), \(D\) is base money created by domestic credit expansion (in units of national currency), \(M^d\) indicates money demand, \(P\) is the price level, \(Y\) denotes real income, \(\beta\) stands for income elasticity, \(\alpha\) is the interest semi-elasticity of money demand, \(I\) denotes an index of interest rates, \(Q\) is the real exchange rate (the value in local goods of a unit of foreign goods), \(S\) is the domestic price of a unit of foreign exchange and \(P^*\) denotes the foreign price level. Equation (4) posits that the central bank controls the supply of base money via two channels, one external and another internal. The external channel involves trading foreign assets in exchange for domestic money while the internal one entails domestic credit policy. Equation (5) is a standard money demand equation where demand for real balances depends positively on income and negatively on the opportunity cost of holding money. Lastly, equation (6) defines the real exchange rate.\(^6\)

\(^6\)Under the absolute version of the Purchasing Power Parity (PPP) theory \(Q\) is unity.
The externally created component of base money is given by

\[ F = \int_{-\infty}^{t} S(t)R'(t)dt \]  

(7)

where \( R \) is the stock of international reserves (primary assets) held by the authorities and \( R'(t) \) is the time derivative of \( R \) denoting net purchase at time \( t \).

Taking the log of equations (4) and (5) and assuming equilibrium in the money market \( (H = M^d) \) I get

\[ \ln H = \ln(F + D) = \ln P + \beta \ln Y - \alpha I \]  

(8)

The time derivative of (8) is

\[ \frac{1}{H} \frac{dH}{dt} = \frac{1}{P} \frac{dP}{dt} + \beta \frac{1}{Y} \frac{dY}{dt} - \alpha \frac{dI}{dt} \]  

(9)

I substitute equation (7) into (9) to get

\[ \frac{1}{H} \frac{dH}{dt} = \frac{1}{H} \left[ S \frac{dR}{dt} + \frac{dD}{dt} \right] = \frac{1}{P} \frac{dP}{dt} + \beta \frac{1}{Y} \frac{dY}{dt} - \alpha \frac{dI}{dt} \]  

(10)

I now make the following assignments:

\[ h = \frac{1}{H} \frac{dH}{dt}, r = \frac{1}{H} \left[ S \frac{dR}{dt} \right], d = \frac{1}{H} \left[ \frac{dD}{dt} \right], \]

\[ \pi = \frac{1}{P} \frac{dP}{dt}, y = \frac{1}{Y} \frac{dY}{dt} \text{ and } i = \frac{dI}{dt} \]

where \( h \) is the growth rate of base money and, as assumed, is also the growth rate of money demand, \( r \) is the growth rate of foreign exchange reserves valued in domestic currency and deflated by the monetary base, \( d \) is the growth rate of domestic credit also deflated by the monetary base, \( \pi \) is the inflation rate, \( y \) is the growth rate of real income and \( i \) is the change in the interest rate. According to Girton and Roper (1977), by deflating the rate of change of international reserves valued in domestic currency, \( S \frac{dR}{dt} \), by the domestic monetary base \( H \), “a real measure of the balance of payments \( r \) is obtained. It is essential to convert the nominal measure of the official intervention into real terms to determine whether the balance of payments
is large or small” (Girton and Roper, 1977, p. 539). Those assignments are now substituted into equation (10) resulting in

$$h = r + d = \pi + \beta y - \alpha i$$  \hspace{1cm} (11)

Subtracting from equation (11) its foreign counterpart yields

$$h - h^* = r - r^* + d - d^* = \pi - \pi^* + \beta y - \beta y^* - \alpha (i - i^*)$$  \hspace{1cm} (12)

where the assumption $\alpha = \alpha^*$ is made. I now take the log of equation (6), differentiate it, plug it in for the inflation differential in equation (12) and re-arrange to get

$$r - r^* - s = -d + d^* + \beta y - \beta y^* - \alpha (i - i^*) - \theta$$  \hspace{1cm} (13)

where $s = \frac{1}{S} \frac{dS}{dt}$ and $\theta = \frac{1}{Q} \frac{dQ}{dt}$ such that $\theta$ gauges the deviation from the Purchasing Power Parity (PPP) theory.

Girton and Roper (1977) assume that the home economy is small while the foreign economy is sufficiently large to be able to pursue independent monetary policy. The authors make the argument that the small economy carries entirely the burden of adjustment in maintaining a stable exchange rate between the two countries. This corresponds well to Hong Kong as the small economy and the US as the large economy since the US pursues its monetary policy irrelevant of the Hong Kong monetary situation, while the reverse is not plausible. This asymmetry allows the $r^*$ in equation (13) to be considered exogenous and to be shifted over to the right-hand side yielding

$$r - s = -d + h^* + \beta y - \beta y^* - \alpha \delta - \theta$$  \hspace{1cm} (14)

where $h^* = r^* + d^*$ and $\delta = (i - i^*)$. Using the definition of the exchange market pressure ($emp$) from equation (1) we end up with:

$$emp = s - r = d - h^* - \beta y + \beta y^* + \alpha \delta + \theta$$  \hspace{1cm} (15)

To account for the revisionist view, I consider the theory in Furman et al. (1998), as summarized in section 2.1. For that purpose, I augment equation (15) with three proxies – the forward exchange rate, $F$, the stock market index, $K$, and government treasury bill rates, $B$ – employing each alternately.

Assuming risk neutrality and rational expectations, the Unbiased Forward Rate Hypothesis (UFRH) posits that the forward rate is an unbiased
predictor of the future exchange rate. “When tested against the empirical
data, however, most studies not only reject the hypothesis but also find that,
contrary to the common belief, the relationship between the forward rate
and the future spot rate is negative. Such evidence implies that there are
predictable excess returns on foreign currency investment. One explanation
for this predictable excess return (also known as the forward discount puzzle)
in the literature is the existence of a time-varying risk premium” (HKMA,
exchange rate as a function of the expected future exchange rate and the risk
premium. Separately, in their estimations of the impact of monetary policy
on the exchange rate during the Asian financial crisis, Gould and Kamin
(2000) utilize the stock market index and the spread in government treasury
bill rates vis-a-vis the US. The authors explain that $K$ captures expectations
of future profitability in the economy and that the movements in $K$ and
the T-bill spread may be reflective of movements in investor perceptions of
country risks (Gould and Kamin, 2000, p. 3). Recalling from section 2.1, the
expected future exchange rate, the risk premium and expectations of future
profitability are the principle mechanisms with which the revisionists chal-
lenge the traditional theory. $F, K$ and the T-bill spread variables are thus
consistent with the Furman et al. (1998) theory. Furthermore, with regards
to the double-market play that is explained in section 1, $K$ is able to capture
an additional mechanism that is idiosyncratic to the Hong Kong episode and
not typically offered by the revisionists in their challenge, but serves their
cause nonetheless.\footnote{For my sample period, though, the spread in HK T-bill rates vis-a-vis the US proves to be a non-stationary series rendering it unusable in the estimations. As a second choice, I use HK government treasury bill rates and not the spread. This can be justified by noting that the sample period, July 1997 to December 1999, is relatively short and specific to the Asian financial crisis, in which case changes in US T-bill rates would not be significant, and thus, could be assumed constant, relative to changes in HK T-bill rates.}

Based on the above, I can now specify the testable model as

$$emp = s - r = d - h^* - \beta y + \beta^* y^* + \alpha \delta + X + \theta$$

(16)

where the vector $X = (f, -k, b)'$ such that $f = \frac{1}{F} \frac{dF}{dt}$, $k = \frac{1}{K} \frac{dK}{dt}$ and $b = \frac{1}{B} \frac{dB}{dt}$. Therefore, $f, k$ and $b$ denote the growth rates for the forward exchange rate, the stock market index and the yield on treasury bills, respectively.

Furthermore, I do not assume absolute PPP ($\theta = 0$). Instead I make
the less strict proposition that in a financial crisis the variances in all other
variables dwarf that of $\theta$, which has more long-term considerations. This allows me to treat $\theta$ in equation (16) as a constant.

The literature that has tested the impact of monetary policy on the exchange rate has consistently noted an endogeneity problem. Specifically, pressure on the exchange rate and the interest rate might both be reacting to the same indicators, which if not accounted for in the estimation process, could distort the results. To the extent that such indicators are represented by the variables specified in equation (16), this problem is resolved by using VARs composed of these variables. Since the Linked Exchange Rate System (LERS), as the Hong Kong currency board is known, is, in theory at least, maintained through interest rate arbitrage, the indicators that might move both the $emp$ and the monetary policy measures are well proxied by $d$, $k$ and $b$. Another dimension of the endogeneity problem is presented by Gould and Kamin (2000) who assert that causality does not necessarily run from monetary policy to the exchange rate; the reverse is also plausible. That is, when faced with pressures of currency depreciation, central banks that are committed to defending the exchange rate might tighten monetary policy, and when these pressures are relieved monetary policy is relaxed. This causality problem is also overcome by using a VAR technique that includes both the $emp$ and the monetary policy measures. Therefore, VARs composed of the variables specified in equation (16) go a long way to resolving the endogeneity problem.

Another advantage of the VAR technique is that it can generate variable responses to shocks (impulse response functions), which is a relevant dynamic in financial crisis simulations. The VARs used in this study are comprised of the following variables:

- endogenous variables: $emp$, $d$, $y$, $\delta$ and $X$,
- exogenous variables: $h^*$, $y^*$ and $\theta$, where $\theta$ is a constant.

where $emp$ is the exchange market pressure measure, $d$ is the growth rate of domestic credit and $y$ is the growth rate of domestic output; $\delta$ is the interest rate differential vis-a-vis the US and $X$, which has been introduced to account for the revisionist theory, stands for the growth rates for each of the forward

\footnote{Under the LERS, the interest rate arbitrage involves episodes of capital outflows (inflows) that, in consistency with the monetary rule of a currency board, cause the monetary base to contract (expand) and interest rates to rise (fall). This creates the market conditions to offset the original outflows (inflows) easing the pressure on the exchange rate.}
exchange rate, $f$, the stock market index, $k$, and the yield on treasury bills, $b$, alternately; $h^*$ is the growth rate of US base money; $y^*$ is the growth rate of US output and $\theta$, which is assumed constant, gauges the deviation from the Purchasing Power Parity (PPP) theory. The foreign variables are being considered exogenous due to the earlier explained asymmetry in the economic sizes of Hong Kong and the US. Employing the Cholesky decomposition method, an ordering specification for the endogenous variables is chosen as follows:

- $y, d, \delta, X, emp$.

This declares that each of these variables contemporaneously affects those to its right but impacts those to its left only with a lag. For example, domestic real income, $y$, contemporaneously affects all other variables while it is contemporaneously impacted by none. Placing $y$ before the monetary variables ($d$ and $\delta$) assumes that monetary policy impacts income with a lag while income affects liquidity conditions contemporaneously. Since a stock variable is likely to respond more slowly than a financial variable, I assume that $d$ precedes $\delta$. For the order of the remaining variables I consider the revisionist intuition; a liquidity crunch causes expectations of worsening economic conditions, as measured by $X$, which then induces a rise in the $emp$. Note that in accordance with equation (16), all variables contemporaneously determine the $emp$.9

2.3 The Forward Market

The strategy used for speculation against the Hong Kong dollar involved the futures market, especially three- and six-month contracts.10 Speculators sold forwards (futures) opening up a sizable discount – the forward rate minus the spot rate – indicating a possible risk of devaluation. The arbitrageurs profited by selling HK dollars spot for US dollars and investing in US riskless government assets. Simultaneously, they would enter into forward contracts to exchange the US dollars at a specific time in the future using the cheaper forward rates. Thus, speculative pressure on the forwards is transferred into the spot market via this covered interest arbitrage.11 Consequently, for the

9 As a robustness test, an alternative ordering is used by switching the $emp$ measure with the $X$ variables: $y, d, \delta, emp, X$.
10 Source: Jao (2001, p. 60).
11 Source: Goodhart and Dai (2003, p. 151).
non-spot time horizons over which speculation takes place, in this case the	hree- and six-month time periods, the three- and six-month forward ex-
change rates, \( f_{3m} \) and \( f_{6m} \), respectively, are superior indicators of speculation
to the \( emp \) measure. \(^{12}\) Correspondingly, the three- and six-month interest
rate differentials, \( \delta_{3m} \) and \( \delta_{6m} \), are the appropriate measures of monetary
policy for the three- and six-month time periods, respectively.

Based on the above, an accurate study of the Hong Kong crisis episode
should estimate the VARs in the three relevant time horizons: the spot,
three-month and six-month time periods. Table 1 specifies the VARs in this
study by listing for each VAR the endogenous and exogenous variables, as
well as the variable that is the most appropriate indicator of speculation.

Table 1: The VARs in this Study.

<table>
<thead>
<tr>
<th>VAR Name</th>
<th>Endogenous Variables</th>
<th>Exogenous Variables</th>
<th>Indicator of Speculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V(\delta_{1d}, f_{1m}) )</td>
<td>( y, d, \delta_{1d}, f_{1m}, emp )</td>
<td>( h^<em>, y^</em>, \theta )</td>
<td>( emp )</td>
</tr>
<tr>
<td>( V(\delta_{1d}, k) )</td>
<td>( y, d, \delta_{1d}, k, emp )</td>
<td>( h^<em>, y^</em>, \theta )</td>
<td>( emp )</td>
</tr>
<tr>
<td>( V(\delta_{1d}, b) )</td>
<td>( y, d, \delta_{1d}, b, emp )</td>
<td>( h^<em>, y^</em>, \theta )</td>
<td>( emp )</td>
</tr>
<tr>
<td>( V(\delta_{3m}, f_{3m}) )</td>
<td>( y, d, \delta_{3m}, f_{3m}, emp )</td>
<td>( h^<em>, y^</em>, \theta )</td>
<td>( f_{3m} )</td>
</tr>
<tr>
<td>( V(\delta_{6m}, f_{6m}) )</td>
<td>( y, d, \delta_{6m}, f_{6m}, emp )</td>
<td>( h^<em>, y^</em>, \theta )</td>
<td>( f_{6m} )</td>
</tr>
</tbody>
</table>

The top three spot VARs, \( V(\delta_{1d}, f_{1m}) \), \( V(\delta_{1d}, k) \) and \( V(\delta_{1d}, b) \), pertain to
the spot time horizon in which the \( emp \) and the \( \delta_{1d} \) are the most appropriate
indicator of speculation and measure of monetary policy, respectively. In
those VARs, the \( f_{1m} \) proxies for the expected future exchange rate and the
risk premium. \(^{13}\) \( k \) stands for the probability of default and \( b \) is a proxy

\(^{12}\)I now explain why the \( emp \) measure is an inferior indicator of speculation to \( f_{3m} \)
and \( f_{6m} \). With the peg holding, the \( emp \) measure is principally driven by changes in
foreign exchange reserves that are in turn meant to proxy for interventions in the foreign
exchange market in support of the HK dollar. While, as explained in section 1, the
currency board makes the change in foreign reserves a more appropriate proxy for foreign
exchange intervention, it remains an imperfect one. Hence, for the three- and six-month
time periods, \( f_{3m} \) and \( f_{6m} \) are superior indicators of speculation.

\(^{13}\)The one-week forward exchange rate would have been a more appropriate proxy
when considering the spot time horizon. However, unit-root tests found evidence of non-
stationarity in this series rendering it unusable in the estimations. The one-month forward
for both the risk premium and the probability of default, per the theory in Furman et al. (1998) as summarized in section 2.1. I now propose the first hypothesis to be tested.

- **Hypothesis 1** ≡ when using the spot VARs, the \( emp \) measure should react positively and significantly to a positive shock in \( \delta_{1d} \).

That is, when the spot time horizon is considered and the \( emp \) measure is the indicator of speculation, a positive interest rate shock should increase the market pressure on the currency.

The three-month VAR in table 1, \( V(\delta_{3m}, f_{3m}) \), pertains to the three-month time horizon in which \( f_{3m} \) and \( \delta_{3m} \) are the most appropriate indicator of speculation and measure of monetary policy, respectively. I now make my second hypothesis.

- **Hypothesis 2** ≡ when using the three-month VAR, \( f_{3m} \) should react positively and significantly to a positive shock in \( \delta_{3m} \).

In other words, when the three-month time period is considered and the three-month forward exchange rate is the indicator of speculation, a positive interest rate shock should increase speculative activity against the currency in the three-month future market.

Lastly, the six-month VAR, \( V(\delta_{6m}, f_{6m}) \), pertains to the six-month time horizon in which \( f_{6m} \) and \( \delta_{6m} \) are the most appropriate indicator of speculation and measure of monetary policy, respectively. Hence, my third and last hypothesis is

- **Hypothesis 3** ≡ when using the six-month VAR, \( f_{6m} \) should react positively and significantly to a positive shock in \( \delta_{6m} \).

Thus, when the six-month time period is considered and the six-month forward exchange rate is the indicator of speculation, a positive interest rate shock should increase speculative activity against the currency in the six-month future market. In the three- and six-month VARs, the \( emp \) measure still represents spot activity against the currency, but as justified earlier, it is not the most appropriate indicator of speculation. Moreover, since forwards/futures for \( k \) and \( b \) do not exist, they cannot be used in the three- and six-month VARs.
The above three hypotheses are consistent with the revisionist perspective. Subsequently, empirical verification of these hypotheses can be construed as evidence in support of the revisionist position. Section A of the appendix explains the calculations for the variables in this study.\footnote{Additional information on the data can be provided upon request.}

\section{Results}

\subsection{VAR Specifications}

I begin by testing for the unit-root.\footnote{I use the Dickey-Fuller with GLS Detrending (DF-GLS) test, the Phillips-Perron (PP) test and the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test. I consider a variable stationary if this is confirmed by at least two out of the three tests at a 5\% significance level or lower.} The results show that the variables $y, d, \delta_1 d, \delta_3 m, \delta_6 m, f_1 m, f_3 m, f_6 m, k, b, cmp, h^*$ and $y^*$ are all stationary at a 5\% significance level or lower. Furthermore, using the Chow test, I find evidence of a structural break in September 1998\footnote{It was then that the Hong Kong government introduced the so-called \textit{seven technical measures} that were designed to bolster the Linked Exchange Rate system (LERS) during the Asian financial crisis. These measures included a clear undertaking to all licensed banks to convert HK dollars in their clearing accounts into US dollars at the fixed exchange rate. This was intended to clearly demonstrate the government’s commitment to the LERS. Furthermore, a Discount Window was established with no restrictions on repeated borrowing in respect of the provision of overnight HK dollar liquidity through repo transactions using Exchange Fund bills and notes (debt paper issued by the Hong Kong Monetary Authority (HKMA)). This, in effect, broadened the definition of the monetary base to include Exchange Fund paper. Up until this point the monetary base was composed of the total legal tender notes and coins in circulation plus banks’ total balances in their clearing accounts with the HKMA.} for all VARs other than $V(\delta_1 d, b)$ and $V(\delta_3 m, f_3 m)$. For those VARs with evidence of a structural break they are estimated with an additional exogenous dummy variable that consists of ones beginning September 1998 and zeros otherwise. Finally, I conduct serial correlation, heteroscedasticity and normality tests on VAR residuals.\footnote{For this purpose, EViews offers the Breusch-Godfrey Lagrange multiplier test, referred to as the LM test, for serial correlation, multivariate extensions of the Jarque-Bera test to detect normality and the White Heteroscedasticity test.} The results indicate that the residuals are neither serially correlated nor heteroscedastic, but are normal, at the 5\% significance level or lower. The final VAR structures are presented in table 2, in which the structural breaks...
and lag lengths are specified.\textsuperscript{18,19}

Table 2: The Final VAR Structures.

<table>
<thead>
<tr>
<th>VAR Name</th>
<th>Str.Bks.</th>
<th>Lag Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V(\delta_{1d}, f_{1m})$</td>
<td>Sept. 1998</td>
<td>1</td>
</tr>
<tr>
<td>$V(\delta_{1d}, k)$</td>
<td>Sept. 1998</td>
<td>1</td>
</tr>
<tr>
<td>$V(\delta_{1d}, b)$</td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>$V(\delta_{3m}, f_{3m})$</td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>$V(\delta_{6m}, f_{6m})$</td>
<td>Sept. 1998</td>
<td>1</td>
</tr>
</tbody>
</table>

3.2 Impulse Response Functions

Figures 1 through 5 illustrate the impulse response functions (IRFs) of the endogenous variables to positive one standard deviation shocks. To generate the IRFs, I use the Cholesky decomposition method with the ordering specification described in section 2.2: $y, d, \delta, X, emp$.

First, I diagnose the IRFs by checking to see if they replicate certain responses that are believed \textit{a priori}. The most basic of those involves each endogenous variable reacting positively to a positive shock to itself, henceforth referred to as a positive self shock. For instance, if $y$ reacts negatively to a positive self shock, then that would confer serious doubts over the IRFs and could be an indication of a misspecification in the model. However, from figures 1 through 5 it is clear that the endogenous variables react positively to positive self shocks. Another response that might contribute to the IRF diagnosis is that of $d$ to a positive shock to $y$. This response should also be positive since domestic credit is most likely to expand when economic activity surges. This too is confirmed by the IRFs.

Second, I examine the extent to which the IRFs are consistent with the revisionist theory as described by Furman et al. (1998) in section 2.1. Conventional monetary policy stipulates that a positive interest rate shock should

\textsuperscript{18}Detailed results of the unit-root tests, the Chow test and the residual tests can be provided upon request.

\textsuperscript{19}Since the sample period was limited to the financial crisis episode, the long-run equilibrium relationship between the variables of each VAR is not represented by the data. Consequently, there is no need to conduct cointegration tests on the VARs.
Figure 1: IRFs for VAR $V(\delta_{1d}, f_{1m})$, where di and f1 Denote $\delta_{1d}$ and $f_{1m}$, Respectively.
Figure 2: IRFs for VAR $V(\delta_{1d}, k)$, where $di$ Denotes $\delta_{1d}$. 

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Figure 3: IRFs for VAR $V(\delta_{td}, b)$, where $di$ Denotes $\delta_{td}$. 
Figure 4: IRFs for VAR $V(\delta_{3m}, f_{3m})$, where di3 and f3 Denote $\delta_{3m}$ and $f_{3m}$, Respectively.
Figure 5: IRFs for VAR $V(\delta_{6m}, f_{6m})$, where di6 and f6 Denote $\delta_{6m}$ and $f_{6m}$, Respectively.
induce a decline in economic activity. This dynamic is a pillar for the revisionist theory in Furman et al. (1998) affecting expectations of the future exchange rate, the risk premium and the probability of default. Evidence in favor of conventional monetary policy is clear from the IRFs where positive shocks to the interest rate differential variables reduce $y$ by between 2.3% to 4% in four to six months.\footnote{These numbers represent the accumulated IRF values.} The sensitivities of these responses are striking when considering that the magnitudes of the positive one standard deviation shocks in $\delta_{1d}$, $\delta_{3m}$, and $\delta_{6m}$ are 1.96%, 1.49% and 1.26%, respectively. That is, assuming that the foreign interest rate is unchanged, an increase of 196, 149 and 126 basis points in the overnight, three-month and six-month HIBOR, respectively, cause the growth rate in real income to decline by between 2.3% to 4% in four to six months. Furthermore, Furman et al. (1998) hypothesize that credit tightening reduces the supply of exports for a given exchange rate, thus diminishing the future demand for the currency. Evidence in support of this is found in the IRFs for VAR$_{V}$(\textit{$\delta_{1d}$}, \textit{f$_{1m}$}), where the one-month forward exchange rate\footnote{Recall that \textit{f$_{1m}$} proxies for the expected future exchange rate and the risk premium per the theory in Furman et al. (1998) that is summarized in section 2.1.} depreciates in response to a positive shock in the overnight interest rate differential. However, the change in \textit{f$_{1m}$} is minute, reflecting strong confidence in the LERS.

Furman et al. (1998) also suggest that, during a financial crisis, the risk premium and the probability of default are positively related to interest rates. To the extent that these factors are proxied by \textit{k} and \textit{b}, the IRFs support this claim with the latter proxy being the more sensitive of the two to the monetary shock; \textit{k} falls by 4.1% while \textit{b} surges by 8.4%\footnote{These numbers represent the accumulated IRF values.} in response to a positive shock to $\delta_{1d}$. Once again, the sensitivities of these responses are striking; the responses of \textit{k} and \textit{b} are, respectively, two and four times the magnitude of the shock to $\delta_{1d}$. The negative response of the stock market index confirms the speculators’ motivation for their August 1998 double-market play.\footnote{Double-market play is explained at the end of section 1.}

The main hypotheses of this study, which were presented in section 2.3, are now examined. The IRFs distinguish the relationship between the \textit{emp} measure and the monetary policy measure over the time horizon. In the spot time horizon and when the overnight interest rate differential is used in combination with \textit{k} or \textit{b} [VARs $V(\textit{$\delta_{1d}$}, \textit{k})$ and $V(\textit{$\delta_{1d}$}, \textit{b})$], this relationship
is positive and borderline significant, thus validating hypothesis 1. When using the overnight interest rate differential in combination with $f_{1m}$ [VAR $V(\delta_{1d}, f_{1m})$], the $emp$ response to a positive monetary shock is positive but insignificant. The reason could be that $f_{1m}$ projects too much into the future to be considered for the spot time horizon.\footnote{As mentioned earlier, the one-week forward exchange rate would have been a more appropriate proxy when considering the spot time horizon. However, unit-root tests found evidence of non-stationarity in this series rendering it unusable in the estimations. The one-month forward rate was the next available.}

In the three- and six-month horizons, the $emp$ measure reacts insignificantly to a positive monetary shock. This could be evidence in support of this study’s claim that the $emp$ measure becomes an inferior indicator of speculation when using the three- and six-month VARs. This also can be seen from comparing the response of the $emp$ measure to a positive monetary shock in $V(\delta_{1d}, f_{1m})$ to those in $V(\delta_{3m}, f_{3m})$ and $V(\delta_{6m}, f_{6m})$. The responses become more insignificant and negative in the latter two VARs indicating once again the relevance of the time horizon on the inferiority of the $emp$ measure as an indicator of speculation. Instead, as argued in section 2.3, at the three- and six-month time horizons the indicators of speculation are $f_{3m}$ and $f_{6m}$, respectively. Finally, the IRFs illustrate that $f_{3m}$ and $f_{6m}$ in the three- and six-month VARs, respectively, react positively and significantly to a positive monetary shock, thus validating hypotheses 2 and 3.\footnote{To test for the robustness of the results, the IRFs are regenerated using an alternative ordering specification for the Cholesky decomposition method: $y, d, \delta, emp, X$. The results explained in this section hold.}

### 3.3 Variance Decomposition

Figures 6 through 10 present the variance decompositions for the five VARs. These figures confirm that most endogenous variables are affected by their self shocks more so than by the other shocks. Let us examine specific decompositions that are relevant to the story that is being told in this study. To begin with, the interest rate shock is relatively important to affecting $y$ in all of the VARs, signalling the relative importance of conventional monetary policy.

The variance decompositions also reflect the particulars of the Hong Kong monetary structure, specifically, the discipline imposed by the LERS. In affecting $d$, the relative importance of an innovation in $y$ is second only to
Figure 6: Variance Decompositions for VAR $V(\delta_{1d}, f_{1m})$, where $d_i$ and $f_1$ Denote $\delta_{1d}$ and $f_{1m}$, Respectively.
Figure 7: Variance Decompositions for VAR $V(\delta_{1d}, k)$, where $d_i$ Denotes $\delta_{1d}$. 
Figure 8: Variance Decompositions for VAR $V(\delta_{1d}, b)$, where $di$ Denotes $\delta_{1d}$. 
Figure 9: Variance Decompositions for VAR $V(\delta_{3m}, f_{3m})$, where di3 and f3 Denote $\delta_{3m}$ and $f_{3m}$, Respectively.
Figure 10: Variance Decompositions for VAR $V(\delta_{6m}, f_{6m})$, where $d_{i6}$ and $f_{i6}$ Denote $\delta_{6m}$ and $f_{6m}$, Respectively.
the importance of the self shock, while an innovation in the interest rate differential is relatively unimportant. This is evidence that the HKMA does not regulate domestic credit using conventional monetary tools, and instead allows \( d \) to accommodate the level of economic activity. This finding is consistent with the LERS whereby the monetary authority should not behave as a conventional central bank.

The relative importance of innovations in \( d \) to affecting interest rate differentials depends on the time horizon; in the spot time horizon [VARs \( V(\delta_{1d}, f_{1m}) \), \( V(\delta_{1d}, k) \) and \( V(\delta_{1d}, b) \)], the relative importance of these innovations are second only to the importance of the self shock. Once again, this is a consequence of the LERS where the overnight HIBOR reacts automatically to liquidity conditions. In the longer time horizons [VARs \( V(\delta_{3m}, f_{3m}) \) and \( V(\delta_{6m}, f_{6m}) \)], innovations in \( d \), relative to the other innovations, are either moderately important or unimportant to affecting \( \delta_{3m} \) and \( \delta_{6m} \).

Figures 6 through 10 also vindicate the inclusion in the VARs of the forward exchange rates, \( f_{1m}, f_{3m} \) and \( f_{6m} \), as well as, \( k \) and \( b \) for the purpose of examining the impact of interest rate shocks. These figures illustrate that innovations to the interest rate differentials are either the most important shocks to affecting the forward exchange rates, \( k \) and \( b \), or are second to the importance of the self shocks.

Finally, let us take a look at the variance decompositions related to the \( emp \) measure. Firstly, shocks to the \( emp \) measure are relatively unimportant to affecting the other endogenous variables. Secondly, \( \delta_{1d} \) innovations are relatively important to affecting the \( emp \) measure while \( \delta_{3m} \) and \( \delta_{6m} \) innovations are relatively unimportant. This is evidence in support of this study’s claim that the \( emp \) measure becomes an inferior indicator of speculation along the three- and six-month time horizons. Thirdly, innovations in the forward exchange rates, \( f_{1m}, f_{3m} \) and \( f_{6m} \), as well as, innovations in \( k \) and \( b \) are relatively important in affecting the \( emp \) measure further vindicating their inclusion in the VARs for the purpose of examining the response of the \( emp \) measure.\footnote{To test for the robustness of the results, the variance decompositions are regenerated using an alternative ordering specification for the Cholesky decomposition method: \( y, d, \delta, emp, X \). The results explained in this section hold with the following exception: innovations in the forward exchange rates, \( f_{1m}, f_{3m} \) and \( f_{6m} \), as well as, innovations in \( k \) and \( b \) are relatively unimportant in affecting the \( emp \) measure.}
4 Conclusion

The purpose of this study is to propose an original method that can empirically test for consistency with the revisionist view, while accounting for the particulars of the Honk Kong case. The discipline imposed by the currency board system of Hong Kong makes it appropriate to utilize changes in foreign exchange reserves as a proxy for foreign exchange interventions. Consequently, the \textit{emp} measure, as constructed by Girton and Roper (1977), can be used as an indicator of speculation against the currency during a financial crisis. However, this is only so when the spot time horizon is being considered. In the case of Hong Kong, speculation was being conducted using three- and six-month future contracts, making the three- and six-month forward exchange rates superior indicators of speculation to the \textit{emp} measure for the three- and six-month time periods, respectively. Hence, to more accurately describe the Hong Kong episode, the VARs were estimated for the three relevant time horizons: the spot, three-month and six-month time periods.

The impulse response functions (IRFs) are shown to be consistent with the revisionist view; a positive interest rate shock increases speculative activity against the currency along all three time horizons. Furman et al. (1998) also suggest that the risk premium and the probability of default are positively related to interest rates. To the extent that these factors are proxied by the stock market index and HK treasury bill rates, the IRFs also support this claim. The particulars of the Hong Kong monetary structure, specifically, the discipline imposed by the LERS, are reflected in the variance decompositions. They prove consistent with the LERS whereby the monetary authority should not behave as a conventional central bank. The variance decompositions also show evidence in support of this study’s claim that the \textit{emp} measure becomes an inferior indicator of speculation when using the three-month and six-month VARs.

In reflecting the above-specified characterizing features of the LERS, the IRFs and the variance decompositions suggest that the model is properly specified. In conclusion, this study generates evidence that is consistent with the revisionist theory as prescribed by Furman et al. (1998).
A Data

This study uses monthly observations spanning the period July 1997 to December 1999. In addition, and based on an earlier justification, I use the US for the foreign country variables of equation (16). The data were obtained from the databases of the HKMA, the IFS and the HK Census and Statistics Department.\(^{27}\)

A.1 Variable Calculations

The severity of the Asian financial crisis, including the Hong Kong episode, induced high volatility in the macroeconomic variables. For example, the annual growth rate of the GDP in Hong Kong went from 5.1% in 1997, to \(-6.0\%\) in 1998 and then to 2.6% in 1999. This volatility dwarfs seasonality issues with the data. Consequently, all Hong Kong variables used in this study are seasonally unadjusted. For the sake of consistency, US variables are also seasonally unadjusted. The following is a description of the calculations for each variable.

- \(s\): This is the percentage change in the spot exchange rate for HK$/US$.
- \(r\): This is the first difference in the foreign currency reserve assets series for Hong Kong reported in US dollars and converted into HK dollars by multiplying by the spot exchange rate and then divided by the one period-lagged monetary base.
- \(emp\): \(emp = s - r\).
- \(d\): This is the first difference in the domestic credit series for Hong Kong divided by the one period-lagged monetary base.
- \(y\): This is the growth rate of the annualized monthly industrial production index for Hong Kong.\(^{28}\)

\(^{27}\)A more detailed explanation of the data, sources and calculations can be provided upon request.

\(^{28}\)Industrial production data were available only in a quarterly frequency. Monthly retail sales were used to interpolate the industrial production series to convert it to a monthly frequency.
• $i$: This is the first difference in the HK interbank offer rate series (HIBOR).\textsuperscript{29}

• $i^*$: This is the first difference in the US federal funds or LIBOR rate series.

• $\delta$: $\delta = i - i^*$.

• $f$: This is the growth rate of the forward \$HK/\$US exchange rate.

• $k$: This is the growth rate of the HK share price index.

• $b$: This is the growth rate of the yield on the 91-day HK exchange fund bills.

• $h^*$: This is the growth rate of US reserve money.

• $y^*$: This is the growth rate of the US industrial production index.

References


\textsuperscript{29}According to the HKMA website, the HIBOR is the rate of interest offered on Hong Kong dollar loans by banks in the interbank market for a specified period ranging from overnight to one year.
