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The Dampening Effect of Bank Foreign Liabilities on Monetary Policy: Revisiting Monetary Cooperation in East Asia

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Abstract

This paper addresses the cost of formal monetary cooperation from the perspective of monetary policy effectiveness. As banks tend to borrow from abroad in foreign currencies to fund domestic lending, monetary policy may have a reduced effect on the credit market and the economy. Results derived from bank-level data in East Asia indicate that bank foreign liabilities significantly reduce the effectiveness of the credit channel of monetary policy, implying a relatively low cost of giving up monetary autonomy.

1. Introduction

Since the 1997 Asian crisis, there has been an increased interest in monetary cooperation in East Asia.[1] Formal monetary cooperation, such as monetary union, reduces the cost of intra-regional trade and promotes economic integration, while its major cost is the loss of monetary policy autonomy. Existing literature on the feasibility of a monetary union or a common currency peg in East Asia often takes an indirect approach to address the cost. A common approach in empirical studies is to examine the similarity of shocks across the region in order to understand the need for monetary policy autonomy.

In contrast to the existing literature, this paper addresses the cost of forming a monetary union through the effectiveness of individual economies' monetary policy. The cost of abandoning monetary autonomy is directly associated with the effectiveness of monetary policy. Losing a highly effective monetary policy is, of course, costly. However, monetary policy in many emerging and developing countries is ineffective. The ineffectiveness may be caused by many factors. For example, in China, the government often directly intervenes in bank lending in favor of state enterprises; banks' practice of maintaining large amount of excess reserves also plays a role (Goodfriend and Prasad, 2006). This paper proposes that foreign liabilities held by banks undermine monetary policy effectiveness, implying a relatively low cost of giving up monetary autonomy. Thus, when considering forming a monetary union, the issue of monetary autonomy

[1] See reviews in, for example, Kawai and Takagi (1999), Fabella (2002), Wilson (2006), and Chung and Eichengreen (2009).

should be less of a concern for these economies. To date, this point has not been established in the literature on the feasibility of monetary union.

The issue of bank foreign liabilities is particularly relevant to East Asia. Emerging economies, including those in East Asia (even though some of them are now classified as high income economies), continuously face the "original sin" problem and the threat of sudden stops of financial inflows. The lack of sufficient flexibility in their exchange rate regimes encourages banks to borrow from abroad in foreign currencies to fund domestic lending, and lending booms may occur in the absence of monetary stimulation. When international funding dries up, the problem of balance sheet mismatches (in currency and maturity) is exposed, especially when accompanied with an exchange rate crisis. In such circumstances, banks are forced to cut loans, or even become insolvent. Thus, the cycles of dollarized borrowing create lending cycles and interfere with the normal functioning of the credit channel of monetary policy.

This paper also contributes to the understanding of liability dollarization and the monetary transmission mechanism in emerging economies. Particularly, the connection between the two has not been explored much in existing studies. Through the study of the role of foreign liabilities in the functioning of the credit channel for eight East Asian economies (China, Hong Kong, Korea, Indonesia, Malaysia, Philippines, Thailand, and Singapore), where external liabilities are generally dollarized (as in other emerging economies), this paper can shed some new light on these issues.

The remainder of the paper is organized as follows. Section 2 discusses the weakness of the East Asian exchange rate arrangements and the justification for considering monetary cooperation. Here, the literature related to this paper is also reviewed. Section 3 presents a testable model and describes the data. Section 4 discusses the diagnostics of the empirical model and reports the results. Section 5 contains the conclusion and final discussions.

2. Bank Foreign Liabilities, Sudden Stops, and Exchange Rate Regimes

Recent financial crises in emerging economies (for example, the Asian Crisis in 1997-98, Russia in 1998, and Argentina in 2001) are often preceded by buildups of foreign liabilities prior to the crises and accompanied by sudden stops of financial inflows. Sudden stops are viewed as both a symptom and a cause of financial crises, and can lead to current account reversal, real exchange rate swings, and growth slowdown. Facing the "original sin" problem and unable to borrow in their own currencies, emerging and developing economies' foreign liabilities are generally in foreign currencies, a phenomenon termed liability dollarization[2]. Liability dollarization contributes to and magnifies the effect of sudden stops, as demonstrated in the literature, such as the theoretical work by Arellano and Mendoza (2003) and the empirical work by Calvo *et al.* (2004).

[2] More precisely, it is external liability dollarization, as opposed to domestic liability dollarization (domestic banks' deposit dollarization).

Before the 1997 crisis, most East Asian economies (including both crisis and non-crisis economies) witnessed a surge in financial inflows when banks and firms over-borrow from abroad in foreign currencies. The inflows reversed during and immediately after the crisis. East Asia's experience shows that when dollarized foreign liabilities are used to finance domestic credit growth, severe bank balance sheet mismatches can occur, and the ups and downs of foreign liabilities can create credit cycles. The changes in foreign liabilities and the association with domestic credit growth for these economies between 1989 and 1999 are illustrated in Figures 1-3 in the Appendix.

A natural question to ask is: what exchange rate arrangement is more prone to sudden stops and financial crises? A few studies point out that no magic exchange rate regime can remove the threat of sudden stops or liability dollarization (see Honig, 2009; Berkmen and Cavallo, 2007). However, as argued by Calvo *et al.* (2004), fixed exchange rates can contribute to sudden stops by concealing the risks of liability dollarization and fiscal disequilibrium. While empirical research has not reached a consensus, weak evidence has been found that rigidity of exchange rate regimes is a determinant of sudden stops (see, for example, Cavallo and Frankel, 2008; Eichengreen *et al.*, 2006). In addition, liability dollarization and rigidity of the exchange rate system can reinforce each other in the sense that the former can in turn be a source of the latter (Honig, 2005).

East Asian economies had various exchange rate arrangements and all were caught in the crisis to different extents with the symptoms of liability dollarization and sudden stops. The two economies that fared best were China and Singapore, one with a very rigid system (China), and one with a managed float (Singapore). Other economies with *de jure* floating exchange rates are widely believed to have *de facto* fixed exchange rates. As pointed out by McKinnon (2002a, 2002b), this practice is problematic. Although "fear of floating" is justifiable for emerging economies, which suffer credit constraint and are incapable of borrowing in their domestic currencies, informal pegs without a commitment to long term exchange rate stability, coupled with a lack of prudent regulations, is the root of the crisis, since they magnify moral hazard and invite speculative attacks. McKinnon (2002b) also maintains that in limiting moral hazard a floating regime is not clearly superior to a truly sustainable fixed regime. Choi and Cook (2004), however, argue that a permanent and credible fixed exchange rate is better in stabilizing bank balance sheets.

More than a decade after the end of the 1997 crisis, the question of what exchange rate arrangement East Asia should adopt remains unresolved, and interest in regional exchange rate and monetary cooperation continues to rise. Malaysia turned to a fixed peg system for a sustained period before moving to a managed floating regime; Hong Kong continued with the same currency board arrangement; China moved to a crawling peg system and gradually increased flexibility, but reverted to a more rigid regime during the recent 2008-2009 global recession. Other countries either have managed floating (Thailand and Singapore) or independently floating regimes (Korea, Indonesia, and Philippines). However, despite the increased number of floating regimes, fear of floating continues to exist. Ogawa and Yang (2008) presented evidence that the floating regimes are not truly floating, and flexibility reduced in the several years after the crisis. In

addition, the accumulation of foreign exchange reserves and dollarized liabilities may prompt East Asia to return to *de facto* pegs. They also argue that the diversification of exchange rate arrangements in the region causes relative price changes when the U.S. dollar fluctuates, creating pressure to engage in competitive devaluation.

Research interest in the feasibility of monetary cooperation, such as forming a monetary union, centers on the cost of losing monetary autonomy for individual economies. A common approach is to apply the optimum currency area criteria to assess similarity of economic structures by examining correlation of shocks or co-movements of macroeconomic variables, such as GDP growth, inflation and real exchange rates among candidates. The rationale is that if the economies have similar structures and business cycles, giving up individual monetary autonomy and adopting a single monetary policy across the region would not be too costly. Many of the results conclude that the region is not an optimal currency area (for example, Chow and Kim, 2003; Wilson and Choy, 2007), but some suggest that certain small sub-regions (for example, Zhang *et al.*, 2004; Safarzadeh *et al.*, 2005; Sato and Zhang, 2006; Jeon and Zhang, 2007) and even a broader set of economies (for example, de Brito, 2004; Mishra and Sharma, 2010) are potential candidates for currency arrangements.

This paper takes a different approach in addressing the cost of monetary cooperation. By assessing the effectiveness of monetary policies under the influence of banks' foreign liabilities, it draws implications for the cost of giving up monetary autonomy. That is, ineffective monetary policy implies a relatively low cost. Specifically, it builds a model and empirically tests whether banks' foreign liabilities weaken the credit channel of monetary policy using bank level data. Banks play crucial roles in the monetary policy transmission mechanism. Take the credit channel as an example. Following a contractionary monetary policy, banks' credit supply shifts down, since bank deposits are the main source of credits and raising alternative funds is costly due to the adverse selection problem caused by information asymmetry.[3] The effect is transmitted to firms and households (who also face information asymmetries) through credit contraction, depressing investment and consumption. Thus, the effectiveness of monetary policy hinges crucially on the responsiveness of bank lending to monetary policy changes.

External borrowing provides an alternative source of funds to deposits. As Romer and Romer (1990) point out, when close substitute funds are available to banks, bank lending may not be directly affected by monetary policy changes. Thus, when banks borrow from abroad extensively in foreign currencies to finance domestic credit, monetary policy may have a lessened influence on the credit market and the economy. For emerging economies, the limited availability of domestic funds renders external borrowing more important than in economies with more mature financial markets. Thus, foreign liabilities may affect domestic lending and weaken its responsiveness to monetary policy to a greater extent in emerging economies. During a contraction of bank foreign liabilities or, in a severe case, a sudden stop, an expansionary monetary policy may not lead to domestic credit expansion. Likewise, a credit expansion may occur during a boom in external borrowing, regardless of monetary policy stance.

[3] See explanation by Stein (1998).

This paper is also related to the literature on liability dollarization and monetary transmission in emerging economies. The role of liability dollarization has attracted increased attention in the growing literature on financial crisis and sudden stops. Some of the studies considered the effect of liability dollarization on the central bank. For example, Calvo (2006) concludes that the role of the central bank as the lender of last resort is undermined in the presence of sudden stops and liability dollarization. Levy-Yeyati (2006) suggests that domestic financial dollarization may lower central banks' capacity to control inflation due to increased volatility of money demand. However, the role of bank foreign liabilities (which are generally dollarized in emerging economies) in monetary policy transmission has not been addressed in previous studies. Thus, this paper will contribute to the literature by filling this gap.

3. Model Specification and Data

The following simple model illustrates the role of foreign liabilities in the transmission mechanism of monetary policy, expanded from Ehrmann *et al.* (2003)[4]. Consider a bank facing a loan demand function as follows:

$$L^d = -a_0 r_L + a_1 y + a_2 p \qquad (1)$$

where L^d is loan demand, r_L is loan rate, y is real GDP, p is the price level, and $a_0, a_1, a_2 > 0$.

The bank lends at the optimal level so that its profit is maximized. Let S represent its risk-free security holdings, C capital, D deposits (secured funding), B domestic non-secured funding, and F foreign non-secured funding (external dollarized liabilities). The balance sheet identity is then:

$$L + S = C + D + B + F \qquad (2)$$

For simplicity, assume security holdings S is proportional to deposits, as governed by the bank's liquidity risk management, and bank capital C is proportional to loan size, as required by banking regulations:

$$S = sD \qquad (3)$$

$$C = kL \qquad (4)$$

where s and k are positive parameters. Banks' security assets S are risk free and bear an interest rate r, the monetary policy rate. Deposits are interest free and inversely related to the monetary policy rate (which represents the opportunity cost to depositors). Assume deposits are exogenous to banks.

[4] The theoretical model by Ehrmann *et al*. (2003) is based on Stein (1998), and serves the foundation of a collection of empirical papers on monetary transmission edited by Angeloni *et al*. (2003).

The gap between the bank's assets, capital, and deposits ($L + S – C – D$) is funded by unsecured borrowing domestically and internationally. Let f denote the ratio of foreign liabilities over loans. Domestic unsecured funding is then $B = L + S – C – D – f \cdot L$. Note that f represents the extent to which bank lending is funded by foreign liabilities. It is affected by banks' appetite for international borrowing and reflects their risk taking, such as exposure to balance sheet mismatches in currency and maturity. It is also affected by domestic regulations and the supply of loanable funds in the international market. With these considerations, f is assumed to be independent of L.

Both domestic and international unsecured borrowing incurs interest charges. The interest rate on domestic borrowing, r^B, depends on, and is higher than, monetary policy rate, r, because of a positive risk premium. The risk premium is inversely related to an observable bank creditworthiness indicator, x, such as size, liquidity, and capital adequacy. Large banks and banks with more liquid assets and higher equity ratios face a less severe problem of adverse selection and it is cheaper for them to raise unsecured funds. Thus,

$$r^B = r \cdot (\mu – cx) \tag{5}$$

where μ and c are positive parameters, and $\mu – cx > 1$. Note that the risk premium $r^B – r = r \cdot (\mu – cx – 1)$ increases with r. This assumption is consistent with the adverse selection theory. As interest rate increases, borrowers are inclined to take on more risks, therefore subject to higher risk premiums.

The interest rate on foreign liabilities is formulated similarly based on the risk free international interest rate, r^w. It also includes a premium for country risk, v, of which an important source is exchange rate volatility. For simplicity, assume v does not change with r^w:

$$r^F = r^w \cdot (\mu – cx) + v \tag{6}$$

The bank's profit is given by:

$$\pi = r^L L + rS – r^B B – r^F F – \psi$$

where ψ represents the bank's operating cost, such as overhead cost. Applying the equilibrium condition ($L = L^d$) and equations (2) – (4),

$$\pi = (1/a_0)(– L + a_1 y + a_2 p)L + rsD – r^B[(1 – k – f)L – (1 – s)D] – r^F f L – \psi$$

From the first order condition for profit maximization, $d\pi/dL = 0$, the optimal loan size is:

$$L = ½[a_1 y + a_2 p – a_0(1 – k – f)r^B – a_0 f r^F]$$

Substituting (5) and (6) in the above function:

$$L = \tfrac{1}{2}[a_1 y + a_2 p - a_0 \mu(1-k)r + a_0 c(1-k)xr + \\ + a_0 \mu \cdot fr - a_0 c \cdot fxr - a_0 \mu \cdot fr^w + a_0 c \cdot xfr^w - a_0 \cdot fv] \quad (7)$$

Consistent with the standard macroeconomic theory, the above equation shows that banks cut loans in response to an increase in monetary policy rate, as represented by the negative parameter for *r*. The positive slope for the interaction term *xr* indicates that the response differs among banks of different qualities. Banks with a better creditworthiness indicator *x* are capable of raising unsecured domestic funds more easily and cheaply. They rely less on insured deposits for funding and their lending is sheltered to some extent from monetary policy shocks. In other words, they respond to monetary policy changes to a lesser extent. In contrast, banks with a lower value of *x* would have to cut lending more after a monetary tightening. The differentiated response is considered as an indication of effective monetary policy transmission in the empirical papers in Angeloni *et al.* (2003).

The last five interaction terms represent the role of bank foreign liabilities in bank lending. Foreign liabilities provide an additional source to insulate bank lending from monetary policy changes. The weakened bank responsiveness to monetary policy is captured by the positive slope of *fr,* which is opposite to that for *r*. The term *fxr* can be interpreted as the interaction of foreign borrowing, *f*, with the term representing the response differentiation to monetary policy among banks, *xr*. If banks borrow more from abroad, there is less need for domestic funding, leading to less differentiated responses.

The interaction terms fr^w and xfr^w indicate that the more banks engage in external borrowing, the greater the impact of international interest rates is on domestic lending. In addition, banks with a lower quality indicator would reduce lending by more after an increase in international interest rates, due to increased risk premiums.

Lastly, a higher country risk raises the risk premium, which is part of the cost of external borrowing. The negative effect on bank lending is magnified if banks borrow more internationally. This effect is embodied by the last term *fv*.

Of course, the above model is extremely simple and far from complete as a theoretical illustration of monetary policy transmission mechanism. For example, it assumes exogeneity of deposits and foreign liabilities, and does not consider competition between banks. The appeal lies in its testability, however.

Based on the above model, the empirical model for bank *i*'s loan size *L* at time *t* is constructed as follows. Note that as a remedy for the simplicity of the theoretical model, the size of bank foreign liabilities and other variables in the interaction terms in equation (7) are also included as standalone items to capture their direct effects. The lagged dependent variable is included as a regressor because of the stock feature of outstanding loans.

$$L_{it} = \beta_0 + \beta_1 L_{i,t-1} + \beta_2 y_t + \beta_3 p_t + \beta_4 f_t + \beta_5 r_t + \beta_6 r^w{}_t + \beta_7 x_{it} + \beta_8 x_{it} \cdot r_t + \beta_9 f_t \cdot r_t +$$

$$+ \beta_{10} f_t \cdot x_{it} \cdot r_t + \beta_{11} f_t \cdot r^w{}_t + \beta_{12} f_t \cdot x_{it} \cdot r^w{}_t + \beta_{13} v_t + \beta_{14} f_t \cdot v_t + \varepsilon_{it} \quad (8)$$

In the above equation, L represents bank i's outstanding loans in year t; y is GDP, p is price (GDP deflator), f is bank foreign liabilities (the ratio to broad money M2), r is monetary policy rate, r^w is world interest rate (London interbank offer rate on 3-month U.S. dollar deposits, LIBOR), x is a bank specific quality indicator (total earning assets, liquidity ratio, or equity ratio), and v represents country risk (exchange rate volatility). The error term ε_{it} includes a bank-specific effect and an idiosyncratic disturbance term.

The parameters that represent monetary policy effectiveness are β_5 (negative, if effective) and β_8 (positive). The undermining effect of foreign liabilities on the lending channel of monetary policy is represented by β_4 (positive), β_9 (positive), and β_{10} (negative). The parameters β_6, β_{11}, β_{13} and β_{14} (all negative) also indicate the influence of foreign liabilities on bank lending directly or indirectly.

The above model is estimated for eight East Asian economies (China, Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore, and Thailand) during the period between 1989 and 1999. This period covers the years prior to the 1997 crisis when bank foreign liabilities built up, as well as the years during and immediately after the crisis, when a sharp reversal of foreign liabilities occurred. The choice of some of the variables and the processing of the data are discussed next.

Since data for foreign liability holdings at the bank level is not available, f is the ratio of economy wide depositary banks' foreign liabilities to broad money, M2, a major source of domestic funding.[5] In the estimations, f is rescaled to units of 10 percentage points (i.e., 1 unit represents 10%). As noted by Eichengreen and Hausmann (1999), almost all non-OECD countries' external debts are in foreign currencies. Thus, f is also a close measure of the degree to which banks' external liabilities are dollarized. A significant effect of f on domestic lending would indicate that a given monetary policy is more difficult to achieve a desired effect on the economy.

Central banks' discount rate is used as the monetary policy rate r. For the economies whose discount rate data is unavailable, money market rates are used as a substitute. As described above, the economies in East Asia considered in this paper desired exchange rate stability. The autonomy of monetary policy is preserved to various degrees through capital controls, except for Hong Kong, which, due to the currency board arrangement, does not actively use monetary policy to respond to economic conditions. During the decade prior to the crisis, monetary policy operating targets ranged from monetary aggregates (China, Korea, the Philippines, and Malaysia before mid-1990s) and monetary base (Indonesia) to short-term interest rates (Malaysia after the mid-1990s and Thailand)

[5] This measure has been used in the existing literature, such as Cavallo and Frankel (2008). One concern is that there may be a strong positive correlation with the policy rate (as r increases, M2 decreases and the ratio increases). However, the data shows a negative correlation between the two (-0.35), a sign that the theoretical relationship is weak in the data. An alternative measure (log of foreign liabilities) is also adopted as a robustness check. Other alternatives, such as foreign liability-to-loan ratio or foreign liability-to-non-deposit domestic liability ratio, have data availability and endogeneity concerns.

and exchange rates (Hong Kong and Singapore).[6] The monetary authorities used a variety of instruments to achieve their objectives, including open market operations, reserve requirements, discount rate, and foreign exchange market operations, and so on. All monetary authorities directly controlled or intervened in policy rates, such as the central bank discount (or lending) rate (China, Hong Kong, Indonesia, Korea, the Philippines, and Thailand) and short-term interbank rates (Malaysia and Singapore).

As for the bank specific quality indicator, x, three choices are considered: equity-to-asset ratio (representing capital level), the ratio of liquid assets (such as cash, reserves, and government securities) to customer and short-term funding[7] (representing liquidity, measuring the portion of assets that are readily available to pay for deposits on demand), and total earning assets[8] (representing size: a larger bank may be more reputable and have better access to unsecured funding). Estimation is carried out with the three variables included separately; but the results with all three variables in the same regression are also reported as a robustness check. Following Ehrmann *et al.* (2003), the three bank characteristic variables are normalized so that the means across all banks in the sample are zero and estimation results are easier to interpret. That is, the values are transformed by subtracting the means. The variable of total earning assets is normalized to zero for each year in order to detrend.

Volatility of exchange rate is used as a proxy for country risk, v. If the international lending market perceives higher exchange rate volatility as an indication of greater country risk, the parameters β_{13} and β_{14} should both be negative. In this case, a more flexible exchange rate regime may dampen the effect of foreign liabilities on domestic lending. As in the literature (see, for example, Tenreyro, 2003), exchange rate volatility is measured as the standard deviation of the first difference of logged monthly exchange rates (against the U.S. dollar), so that only unexpected exchange rate volatility is considered. Note that this indicator mainly reflects the rigidity of the exchange rate regimes rather than capture the overall exchange rate volatility.

The monthly exchange rate data is obtained from the Federal Reserve Economic Data collection and the websites of the central banks of each economy. Other macroeconomic data (including bank foreign liabilities) are from *International Financial Statistics* and *World Economic Outlook,* both published by the International Monetary Fund. The bank level data is from the Fitch IBCA and Bureau van Dijk's Bankscope database. Central banks, specialized governmental credit institutes, and multi-lateral governmental banks are excluded. Negative loans and the top 1% and bottom 1% values for all bank specific variables are dropped to limit data errors. The remaining data set includes 4,011 banks in total (233 from China, 1,064 from Hong Kong, 617 from Indonesia, 453 from Korea, 515 from Malaysia, 282 from the Philippines, 546 from Singapore, 301 from Thailand). Summary of the data is reported in table 1. All data in national currency is converted to

[6] There are numerous reviews on the monetary policy framework in East Asia. See, for example, Bank for International Settlements (2006), McCauley (2002), and Kamin *et al.* (1998).
[7] Customer and short-term funding includes interbank, demand, savings, and time deposits, etc.
[8] Alternatively, total assets can be used. The results will not be affected. The correlation between total assets and total earning assets is 0.999.

U.S. dollar denominations using either end-of-year exchange rates (for stock variables) or period averages (for GDP). Loans, total earning assets, real GDP, and GDP deflator are all logarized in estimations.

Table 1. Descriptive Statistics

	Full sample				Non-sudden stop sample			
	Mean	St. dev.	Min.	Max.	Mean	St. dev.	Min.	Max.
r (%)	8.51	5.40	2.04	38.44	8.03	3.98	2.04	18.83
r^w (%)	5.48	1.40	3.29	9.28	5.47	1.50	3.29	9.28
f (%)	46.73	70.28	3.22	295.83	46.60	74.13	3.22	295.83
v	0.020	0.04	0.00	0.28	0.0102	0.019	0.00	0.12
Earning assets (bil. US$)	1,726	4,580	0.05	43.47	1,728	4,750	0.05	42.88
Liquidity ratio (%)	34.86	34.10	0.00	309.12	34.72	32.55	0.00	309.12
Equity ratio (%)	13.65	12.98	0.28	92.24	13.23	12.14	0.47	92.24

4. Estimation Results

Estimations are conducted for the full sample and the sub-sample for the years without sudden stops. The full sample has more observations, but is blemished by the unusual circumstances during sudden stops, like currency crisis and the responding government measures (such as emergency capital controls). Except for China and Singapore, the East Asian economies all experienced sudden stops in both 1997 and 1998. The large foreign exchange reserves and long term tight capital controls helped to shield China from a sudden stop. Singapore experienced a sudden stop only in 1998 during the crisis, but it had a previous episode in 1994 (as did Malaysia), according to Guidotti *et al.* (2004).

4.1 Diagnostics

Due to the dynamic panel data specification, the lagged dependent variable is correlated with the error term in equation (8). In addition, the bank specific variables x_{it} may also bear influences of heterogeneous characteristics of banks and therefore are likely to be correlated with the bank specific effect. The endogeneity of these regressors makes the OLS estimator, the Within estimator, and the random effects estimator all biased and inconsistent. Although the problem diminishes for the OLS and the Within estimators if T (number of time periods) is large, this data set does not have such advantage with a large N (number of panels) and a small T. Thus, to obtain consistent estimates, the Arellano and Bond GMM estimator for a dynamic panel data model is employed, which removes the panel effect through first-differencing transformation of the initial model.

Diagnostics for the Arellano-Bond estimator is mainly based on Arellano and Bond (1991), Bond (2002), and Roodman (2009). The Sargan test and autocorrelation test statistics are reported in Table 2. Since the Arellano-Bond test assumes the disturbances in the initial model are not serially correlated, the disturbances in the first-differenced equation should not be correlated at an order higher than 1. The Sargan test verifies the joint validity of the instruments.

Column (1) in Table 2 contains the results for the full sample with the one-step estimator. All possible instruments are included for the endogenous regressors (i.e., lagged values dated *t-2* and before for the lagged dependent variable and all regressors involving the bank-specific variables). The AR(2) result after the one-step estimator rejected second order serial correlation at least at the 5% significance level. However, the Sargan test of overidentifying restrictions rejected the joint validity of the instruments in all three cases. One possible cause is that the disturbances in equation (8) have a moving average serial correlation. In this case, values of the dependent variable lagged 3 periods or more (if it is MA(1)) are suitable instruments. However, with a MA(1) or MA(2) assumption, there is again a categorical rejection of the validity of instruments when liquidity ratio or equity ratio is used as the bank-specific variable (results are not reported in the table).

Another likely culprit for the rejection of the Sargan test is heteroskedasticity. The Sargan test is known to over-reject in the presence of heteroskedasticity. The Breusch-Pagan Lagrange multiplier test after the OLS regression conditional on the bank characteristic variables confirms a strong presence of heteroskedasticity. Thus, the two-step estimator, which is robust to heteroskedasticity, is employed and the Sargan test results are reported in column (2). The chi-square statistics indeed declined greatly, but not enough for an acceptance at the 5% significance level in two of the three cases.

To alleviate heteroskedasticity, the tests are re-run for the non-sudden stop subsample. In this case, the Sargan test fails to reject in all three cases (column (3)). The AR(2) results also continue to support the validity of the estimator. Thus, this points to the heteroskedasticity of the data being the cause of the rejection of the Sargan test for the full sample with the one-step estimator. Note that AR(1) shows no correlation for the subsample at least at the 5% significance level, indicating the errors in equation (8) possibly follow a random-walk process, in which case the GMM estimator remains consistent (Arellano and Bond, 1991).

A final consideration is possible under-rejection of the Sargan test with the two-step estimator when there are too many instruments. After the number of instruments is greatly reduced by restricting the instruments for the lagged dependent variable to be the values of *t-2* and *t-3* only, the test results (column (4)) indicate that this issue is not of concern here. Thus, the validity of the model specification is accepted. Since the drawback of the two-step estimator is its possibly unreliable asymptotic standard errors, all following estimation results are derived from the one-step estimator with the standard error estimations robust to heteroskedasticity. All estimations also include year dummies to reduce correlation in the disturbances, as suggested by Roodman (2009).

Table 2. Diagnostic Statistics
(P-values in parentheses)

	Full sample		Sub-sample[1]	
Estimator	One-step	Two-step	Two-step	Two-step with fewer instruments[2]
	(1)	(2)	(3)	(4)
x variable:				
Total earning assets				
Sargan test	0.000	0.698	0.401	0.272
AR(1)	0.012	0.008	0.107	0.104
AR(2)	0.061	0.062	0.063	0.061
Liquidity ratio				
Sargan test	0.000	0.000	0.704	0.626
AR(1)	0.023	0.008	0.273	0.304
AR(2)	0.230	0.232	0.116	0.107
Capital ratio				
Sargan test	0.000	0.029	0.202	0.045
AR(1)	0.003	0.003	0.068	0.074
AR(2)	0.170	0.184	0.177	0.162

Note: 1. For non-sudden stop years. 2. Instruments for the lagged dependent variable are the values of $t-2$ and $t-3$ only.

4.2 Estimation Results

Table 3 reports the coefficient estimation results for the full sample and the sub-sample (for the non-sudden stop periods) along with the Wald chi-square statistics, which indicate the joint significance of the regressors. Note that the coefficient for the lagged dependent variable is rather small. This means the weak instrument issue that arises from a highly persistent dependent variable when using the Arellano-Bond estimator is not a concern.

The coefficient for the policy rate *r* has wrong signs in all cases, an indication of possible ineffectiveness of monetary policy. In contrast, the direct effect of bank foreign liabilities *f* is positive and significant, suggesting banks' heavy reliance on foreign liabilities to fund lending. This is echoed by the negative (and significant in most cases) coefficient for r^w, which represents lending responses to international interest rates. As expected, the positive coefficient for *x*r* indicates that larger, more liquid banks and those with higher equity ratios are less likely to respond to monetary policy changes as desired. The coefficient estimation for the interaction terms between the foreign liability ratio *f* and other variables mostly have signs consistent with equation (7), except for the term *fr*. A

possible cause of the inconsistency is the inclusion of the standalone item *f* in the regression.

Table 3. Regression results
(P-values in parentheses)

	Full sample			Non-sudden stop sample		
	(1)	(2)	(3)	(4)	(5)	(6)
L_{t-1}	0.317 ***	0.262 ***	0.333 ***	0.159 *	0.049	0.265 ***
	(0.000)	*(0.001)*	*(0.000)*	*(0.067)*	*(0.675)*	*(0.000)*
y	-0.017	0.141 **	0.120	-0.094	0.206	0.338 **
	(0.890)	*(0.038)*	*(0.430)*	*(0.515)*	*(0.276)*	*(0.039)*
p	-0.002 **	-0.003 ***	-0.002 **	0.002	0.007 **	0.004
	(0.018)	*(0.000)*	*(0.013)*	*(0.390)*	*(0.014)*	*(0.153)*
f	0.023 **	0.061 ***	0.055 ***	0.042 ***	0.078 ***	0.049 ***
	(0.035)	*(0.000)*	*(0.000)*	*(0.004)*	*(0.000)*	*(0.001)*
r	0.021 ***	0.023 ***	0.030 ***	0.021 ***	0.025 ***	0.030 ***
	(0.000)	*(0.000)*	*(0.000)*	*(0.001)*	*(0.007)*	*(0.001)*
r^w	-0.118 ***	-0.065 **	-0.067 ***	-0.102 ***	-0.050 *	-0.035
	(0.000)	*(0.013)*	*(0.004)*	*(0.000)*	*(0.056)*	*(0.116)*
x	0.886 ***	-0.007 ***	-0.016 *	0.804 ***	-0.007 ***	-0.022 **
	(0.000)	*(0.001)*	*(0.066)*	*(0.000)*	*(0.002)*	*(0.015)*
*x*r*	0.002 **	0.000 **	0.000	0.004 ***	0.000 **	0.001
	(0.040)	*(0.043)*	*(0.983)*	*(0.000)*	*(0.046)*	*(0.289)*
*f*r*	-0.004 **	-0.005 ***	-0.008 ***	0.001	-0.004	-0.003
	(0.038)	*(0.004)*	*(0.000)*	*(0.752)*	*(0.256)*	*(0.220)*
*f*x*r*	-0.001	0.000	0.000	-0.002 ***	-0.000	0.000
	(0.123)	*(0.870)*	*(0.682)*	*(0.000)*	*(0.889)*	*(0.109)*
$f*r^w$	0.000	-0.002	0.002	-0.006 **	-0.003	-0.001
	(0.933)	*(0.289)*	*(0.203)*	*(0.015)*	*(0.309)*	*(0.491)*
$x*f*r^w$	0.001	0.000	-0.000	0.002 ***	0.000	-0.000
	(0.128)	*(0.638)*	*(0.522)*	*(0.003)*	*(0.550)*	*(0.103)*
v	-0.977 **	-2.356 ***	-2.482 ***	-0.432	-1.222	-0.441
	(0.039)	*(0.000)*	*(0.000)*	*(0.411)*	*(0.112)*	*(0.526)*
*f*v*	0.003	-0.553 **	-0.542 **	-0.170	0.550	-0.384
	(0.987)	*(0.016)*	*(0.012)*	*(0.661)*	*(0.291)*	*(0.439)*
Wald chi2 (22)	2932.7	1593.8	1595.6	2908.1	854.0	1419.5
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*

Note: Results for the year dummies are omitted. *f* is in 10 percentage points; *x* is total earning assets in (1) and (4), liquidity ratio in (2) and (5), and capital ratio in (3) and (6). *** indicates estimation is significant at the 1% level, ** 5% level, and * 10% level.

The negative coefficient of *v* and *f*v* in most regressions can be explained as the dampening effect of exchange rate volatility on the influence of foreign liabilities on domestic lending. The estimation is more consistent and significant for the full sample than for the sub-sample, probably due to the effect of sudden stops. This is consistent

with the theory that exchange rate rigidity encourages external borrowing by concealing risks.

To see more clearly the effect of domestic policy rate, international interest rate, bank foreign liabilities, and exchange rate volatility on lending, the marginal effects of these variables are summarized in Table 4, given that other relevant variables are at their average levels (note that x is normalized to zero). The positive marginal effect for the domestic policy rate in most of the regressions suggests that monetary policy does not produce a desired effect. The estimation is more consistent and has larger magnitudes during normal times (the non-sudden stop sub-sample), when the average response to a one percentage point increase in policy rate is not loan contraction, but a 1-3% loan increase. A likely cause is that when the domestic interest rate increases, pushing up lending rates, domestic lending becomes more lucrative when it is funded by international funds. Thus, loan volume may increase as a result of monetary tightening. In contrast, the marginal effect of r^w consistently indicates that an increase in LIBOR would lead to contractions in domestic loans. The undesired response of bank lending to domestic monetary policy and its sensitivity to international interest rates indicate not only ineffectiveness of monetary policy, but also the vulnerability of the banking sector to international shocks. This phenomenon is also evidenced by the marginal effect of f during normal times (derived from the non-sudden stop sample), when a 10 percentage point increase in the foreign liability ratio can lead to a 2-4% increase in loans. However, the marginal effect of f for the full sample has opposite signs, which are probably caused by the unusual circumstances during sudden stops.

Table 4. Marginal Effects

	Full sample			Non-sudden stop sample		
	(1)	(2)	(3)	(4)	(5)	(6)
r	0.002	0.000	-0.007	0.026	0.006	0.016
r^w	-0.118	-0.074	-0.058	-0.130	-0.064	-0.040
f	-0.011	-0.004	-0.013	0.016	0.035	0.016
v	-0.963	-4.940	-5.015	-1.224	1.338	-2.230

Note: f is rescaled to units of 10 percentage points. x is total earning assets in (1) and (4), liquidity ratio in (2) and (5), and capital ratio in (3) and (6).

4.3 Robustness check

To check the robustness of the results, some variations of the models and an alternative measure of the variable foreign liabilities are considered. The results for the variables relevant to the calculation of marginal effects are reported in Tables 5-6.

In column (1) of the two tables, all three bank-specific variables and the corresponding interaction terms are included in the regression. In columns (2)-(4), the regressions include the lagged monetary policy rate to account for possible delays in bank responses.

The parameters, significance levels, and marginal effects generally resemble the results in Tables 3 and 4, except for the variables r^w and v in column (1). The marginal effects[9] are also similar to those reported in Table 4 except that the signs are reversed for r^w in the regression with all bank-specific variables and for v in the regression with the liquidity ratio for the sub-sample. The parameter for the lagged monetary policy variable (including the interaction terms) is not significant, and the magnitude is small.

Table 5. Results of Alternative Regressions - Full Sample
(P-values in parentheses)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
f	0.010 **	0.022 *	0.057 ***	0.052 ***	0.121 **	0.462 ***	0.345 ***
	(0.030)	*(0.057)*	*(0.000)*	*(0.000)*	*(0.045)*	*(0.000)*	*(0.000)*
r	0.006	0.019 ***	0.021 ***	0.029 ***	0.043 **	0.079 ***	0.093 ***
	(0.413)	*(0.001)*	*(0.001)*	*(0.000)*	*(0.046)*	*(0.000)*	*(0.000)*
r_{t-1}	-	*0.001*	-0.002	-0.003	-	-	-
		(0.851)	*(0.713)*	*(0.613)*			
r^w	0.080 ***	-0.170 ***	-0.088 *	-0.113 **	-0.109 ***	-0.068 **	-0.095 ***
	(0.000)	*(0.000)*	*(0.090)*	*(0.011)*	*(0.002)*	*(0.022)*	*(0.001)*
$f*r$	-0.001	-0.004 **	-0.005 ***	-0.008 ***	-0.009	-0.025 ***	-0.029 ***
	(0.517)	*(0.050)*	*(0.008)*	*(0.000)*	*(0.168)*	*(0.000)*	*(0.000)*
$f*r_{t-1}$	-	-0.001	*0.001*	-0.000	-	-	-
		(0.468)	*(0.439)*	*(0.796)*			
$f*r^w$	*-0.002*	0.001	-0.002	0.003	-0.013	-0.007	0.001
	(0.167)	*(0.752)*	*(0.169)*	*(0.159)*	*(0.153)*	*(0.294)*	*(0.898)*
v	0.893 **	-1.078 **	-2.287 ***	-2.584 ***	-4.097 ***	-7.944 ***	-8.473 ***
	(0.082)	*(0.030)*	*(0.000)*	*(0.000)*	*(0.006)*	*(0.001)*	*(0.000)*
$f*v$	-0.988 ***	0.047	-0.648 ***	-0.504 **	0.865 **	1.316 *	1.367 ***
	(0.000)	*(0.775)*	*(0.003)*	*(0.019)*	*(0.023)*	*(0.062)*	*(0.005)*

Note: Results for other variables are omitted. f is foreign liability-to-M2 ratio in 10 percentage points in (1)-(4) and log of foreign liabilities in (5)-(7). In (1), all three bank specific variables and the corresponding interaction terms are included. Only total earning assets are included in (2) and (5), liquidity ratio in (3) and (6), and equity ratio in (4) and (7). *** indicates estimation is significant at the 1% level, ** 5% level, and * 10% level.

In columns (5)-(7), f represents logarized foreign liability levels, as an alternative measure.[10] The estimations for other variables largely resemble previous results. The marginal effects of the policy rate r and LIBOR r^w are also similar to previous results in terms of signs and magnitudes. The marginal effect of bank foreign liabilities is between 0.04 to 0.24 (except in column (5) for the full sample), suggesting that a 10% increase in foreign liabilities leads to a 0.4-2% increase in bank loans.

[9] Results are available on request.
[10] The correlation between this measure and the foreign liability-to-M2 ratio is 0.91.

Table 6. Results of Alternative Regressions - Non-sudden Stop Sample
(P-values in parentheses)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
f	0.008	0.039 ***	0.066 ***	0.040 ***	0.178 ***	0.260 ***	0.196
	(0.896)	*(0.005)*	*(0.001)*	*(0.005)*	*(0.008)*	*(0.000)*	*(0.001)*
r	-0.000	0.020 ***	0.022 **	0.027 ***	0.021	-0.012	0.017
	(0.987)	*(0.001)*	*(0.035)*	*(0.005)*	*(0.207)*	*(0.594)*	*(0.362)*
r_{t-1}	-	*(0.002)*	-0.006	-0.004	-	-	-
		(0.622)	*(0.360)*	*(0.467)*			
r^w	0.055 ***	-0.139 ***	-0.054	-0.081 **	-0.040	0.058 *	0.010
	(0.000)	*(0.000)*	*(0.299)*	*(0.029)*	*(0.287)*	*(0.061)*	*(0.683)*
$f*r$	0.004 *	0.001	-0.001	-0.001	0.001	0.010	0.003
	(0.100)	*(0.691)*	*(0.861)*	*(0.798)*	*(0.866)*	*(0.129)*	*(0.612)*
$f*r_{t-1}$	-	0.000	*0.004* **	0.003	-	-	-
		(0.917)	*(0.025)*	*(0.134)*			
$f*r^w$	-0.005 **	-0.006 **	-0.007 ***	-0.004 *	-0.028 ***	-0.031 ***	-0.018
	(0.045)	*(0.041)*	*(0.003)*	*(0.072)*	*(0.005)*	*(0.000)*	*(0.003)*
v	1.808 **	-0.507	-0.512	-0.126	-3.368 *	-0.172	-3.719
	(0.017)	*(0.334)*	*(0.444)*	*(0.864)*	*(0.096)*	*(0.959)*	*(0.065)*
$f*v$	-0.776 *	-0.096	-0.063	-0.703	0.835	-0.040	0.855
	(0.066)	*(0.804)*	*(0.896)*	*(0.189)*	*(0.155)*	*(0.967)*	*(0.150)*

Note: Results for other variables are omitted. f is foreign liability-to-M2 ratio in 10 percentage points in (1)-(4) and log of foreign liabilities in (5)-(7). In (1), all three bank specific variables and the corresponding interaction terms are included. Only total earning assets are included in (2) and (5), liquidity ratio in (3) and (6), and equity ratio in (4) and (7). *** indicates estimation is significant at the 1% level, ** 5% level, and * 10% level.

5. Conclusion and Final Discussions

In emerging and developing economies, banks tend to borrow in foreign currencies from abroad to fund domestic lending, resulting in currency and maturity mismatches in their balance sheets and high risks of capital flight and financial crisis. The "soft peg" system in most East Asian economies further exacerbated the problem, as witnessed by the 1997 crisis. The crisis spurred much discussion in monetary cooperation in East Asia. Existing research on the cost of monetary cooperation commonly considers the need of maintaining monetary policy autonomy by assessing similarity of shocks across the region. This study takes a unique approach and considers the cost from the perspective of monetary policy effectiveness. The rationale is that with an ineffective monetary policy, the cost of forming a monetary union would be relatively low.

The results reveal evidence of dysfunction in the credit channel of monetary transmission in East Asia due to interference from banks' external borrowing. There is a direct link between bank lending and their foreign liability holdings, especially during normal times when the economy is not experiencing a sudden stop. As a result, banks do not respond to the monetary policy rate as desired; instead, they are responsive to the international interest rate. This result indicates the central banks' weakened ability to use monetary policy to stabilize the economy. Thus, the cost of sacrificing monetary autonomy to form

a monetary union is lower for these economies than when monetary policy is effective. In addition, for the purpose of limiting liability dollarization and the associated risks, the results on the role of exchange rate volatility also suggest the form of monetary cooperation or joint exchange rate arrangement should allow flexibility of the exchange rate, as it discourages excessive external borrowing.

Formal monetary cooperation fosters financial integration and can have a number of benefits. The depth of the Asian financial markets may increase with the size of the integrated market. As a result of increased financial flows within the region, members may have less need to rely on external borrowing outside of the region, therefore reducing the degree of liability dollarization.

Another benefit is that East Asian economies can reduce costly holdings of large amounts of reserves, while simultaneously enhancing their ability to protect themselves against financial and exchange rate crises. After the Asian crisis, these economies built up a safety net at the cost of holding massive low return reserves.[11] By alleviating the problem of liability dollarization through fostering intra-regional lending, monetary cooperation may reduce their vulnerability to sudden stops, thus reducing the size of reserves needed for crisis insurance purposes. In addition, preparation for monetary cooperation will introduce the idea and practice of centralized decision making, which can expedite the establishment of a more effective reserve pooling institution - such as the Asian Monetary Fund[12] - than the current facility under the Chiang Mai Initiative. As a result, individual economies will have less need to rely on their own reserves for self-insurance. Stronger regional support will also increase their ability to guard against crises.

A well designed integration process can establish credibility of the monetary system and strengthen financial institutions in the region. The resulting stronger reputation of the common currency may further reduce the risk of sudden stops by increasing the members' capability to borrow in their own currency. As a result, the need for formal or informal pegs may be reduced, and the common currency can adopt an independently floating system, which facilitates the retention of monetary policy as a stabilizing instrument. In this case, by abandoning ineffective independent monetary policy, these economies may gain a more effective regional cooperative monetary policy.

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[11] Total reserves (excluding gold) held by the eight East Asian economies studied in this paper reached $4.1 trillion in 2010, which was about 128% of their reserve money (calculated from data in International Financial Statistics, published by the International Monetary Fund).

[12] It was initially proposed by Japan during the Asian crisis but never materialized (Lipscy, 2003). A recent survey indicates strong current support among researchers, policy makers, and business leaders for its future establishment to supplement the International Monetary Fund (Mun *et al.*, 2011).

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Appendix

Figure 1. Bank Foreign Liabilities
(Bil. of US$. Vertical lines indicate sudden stop episodes)

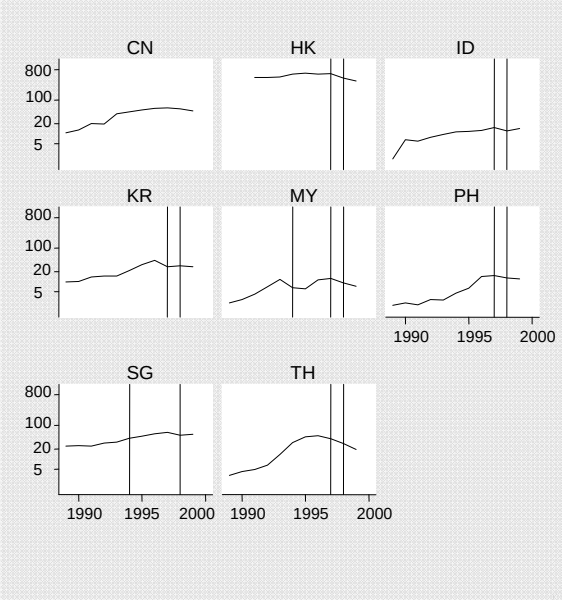


Figure 2. Bank Foreign Liability Growth and Domestic Private Credit Growth
(Average by year)

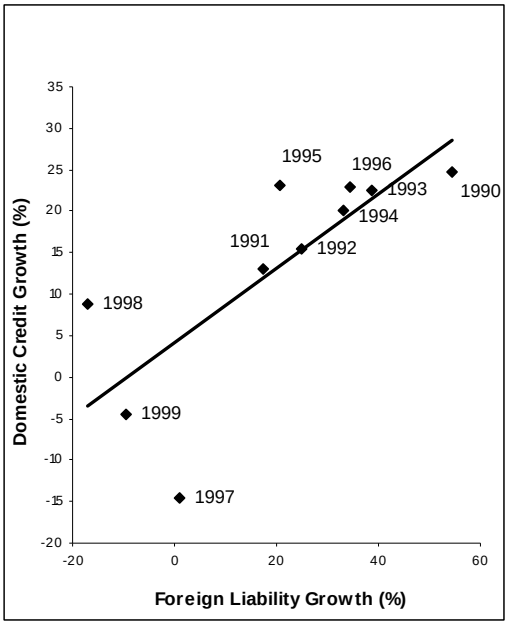
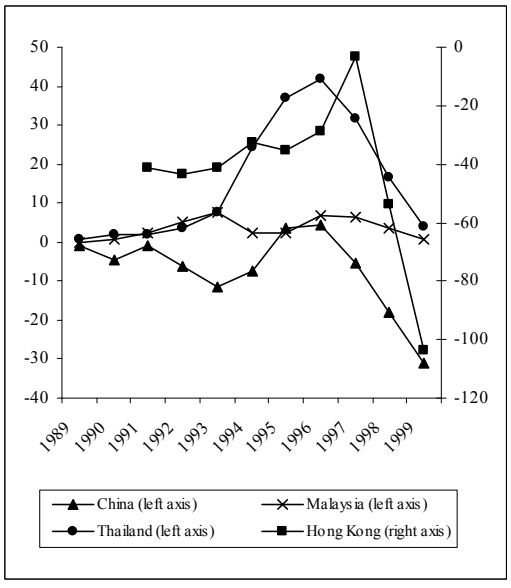


Figure 3. Foreign Liabilities in Excess of Foreign Assets for Deposit Money Banks
(Billions of US$)

a. China, Malaysia, Thailand and Hong Kong



b. Indonesia, Korea, Philippines, and Singapore