Central bank balance sheets and foreign exchange rate regimes: understanding the nexus in Asia

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Introduction

Central bank balance sheets in emerging Asia have been expanding rapidly for the past decade, driven primarily by the accumulation of foreign exchange reserves (Graph 1). Some of the expansion reflects efforts to increase the buffer stock of reserves in the aftermath of the 1997-8 Asian crisis. Increasingly, however, the reserve accumulation has been the by-product of exchange rate regimes that have in practice tended to resist appreciation.[2] At the same time, policymakers in the region have been able to maintain price stability and bolster its financial stability.

This policy experience in Asia is changing the consensus about the tradeoff between fixed and floating exchange rate regimes. At one time, it was thought that the choice was either-or: either freely float or fix. The past decade has shown that a third, intermediate, approach has emerged in practice as being both feasible and, by revealed preference, desirable.

However, this third way is not without its costs. The resistance to exchange rate appreciation has led to record sizes of central bank balance sheets in the region. Concerns have risen about the implications for macroeconomic and financial stability. Looking forward, it is natural to ask how much longer this rapid, and costly, asset accumulation can and should go on. And, if rapid foreign asset accumulation can't go on forever, what are the implications of a cessation of the accumulation and even significant shrinkage?

This paper explores the challenges that the expansion of central bank balance sheets pose for emerging Asian policymakers. We first look at the experience of reserve accumulation, focusing on the implications for monetary and financial conditions through the lens of the size and complexity of central bank balance sheets. Then we look at the challenges in managing the assets and liabilities of these large central bank balance sheets, before drawing some conclusions about sustainable Asian monetary policy and exchange rate regimes.

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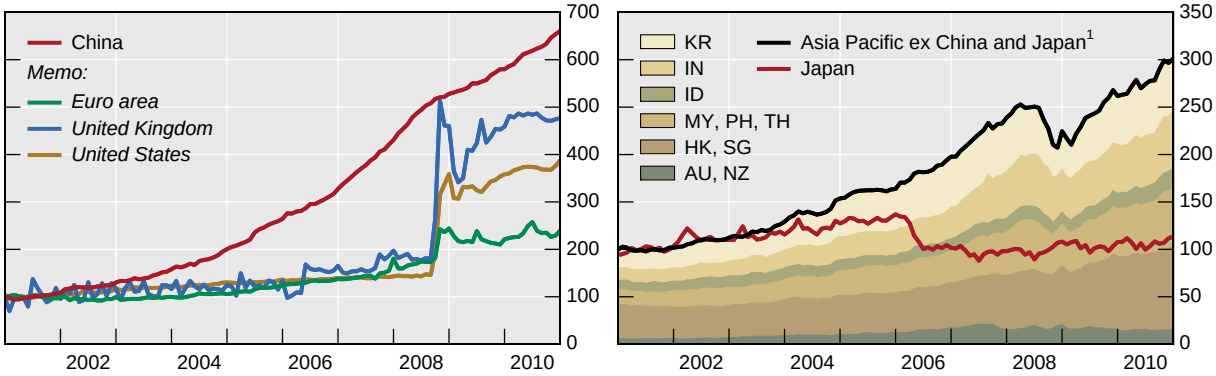
[2] In the West, by way of contrast, policy actions taken in response to the recent international financial crisis account have also resulted in a sharp expansion in central bank balance sheets, but the driving causation has been quite different. The Federal Reserve, Bank of England and the European Central Bank (ECB), for example, have seen their balance sheets jump sharply since mid-2008, as they adopted extraordinary measures to combat the unusual economic and financial conditions associated with the lingering effects of the international financial crisis and the sovereign debt problems in Europe. For Japan, the relevant period is in the late 1990s and early 2000s.

Graph 1

Central bank total assets

2001 = 100



AU = Australia; HK = Hong Kong SAR; ID = Indonesia; IN = India; KR = Korea; MY = Malaysia; NZ = New Zealand; PH = Philippines; SG = Singapore; TH = Thailand.

[1] Sum of listed economies.

Sources: Datastream, IMF, *International Financial Statistics*; BIS, national data.

I. The expansion of Asian central bank balance sheets

The rapid expansion of Asian central bank balance sheets has been driven primarily by exchange rate concerns. Early in the post-Asian Crisis period, economies in the region took to heart the importance of having a sufficient war-chest of reserves. The reserves at least in theory were there to be used in the case of a run on the currency. Reserve adequacy also helped to assure markets that the exchange rate regime was sound in an *ex ante* sense. Indeed, credit rating agencies took reserve holdings as one of the key factors determining an economy's credit rating, and influencing the cost of local currency borrowing.

By the second half of the 2000s, Asia as a whole was seen as having ample reserves, based on conventional import and external debt metrics (right-hand panel of Graph 2 and Table A1 in the Annex). With reserves adequate (or more than adequate), the rationalisation for the continuing accumulation for reserves was to resist exchange rate appreciation (Graph 2, left-hand and middle panels).

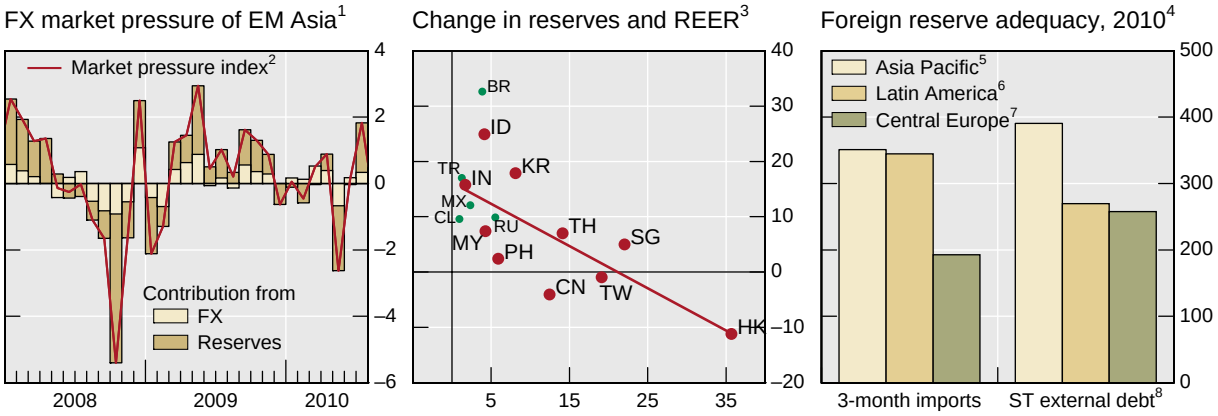
In resisting exchange rate appreciation, this was not a reversion to fixed exchange rates. One of the central lessons of the Asian crisis was that fixed exchange rates were hard to defend in the face of large volatile foreign capital flows and substantial changes in sentiment. But nor did the authorities accept the argument that those countries which could not credibly peg indefinitely should float freely.[3]

The record in Asia suggests that reality is not so simple. While Malaysia continued its peg until 2005, China had periods of fixity, Hong Kong SAR maintained a fixed rate via its currency board, and Singapore chose a targeted approach, most countries of the region adopted a flexible exchange rate framework. They did not, however, choose a purely free float. The exchange rate regime of choice was a managed float, where the degree of market-determination varied across economies and over time. There were also times of heavy intervention to resist sharp depreciations, notably in Korea and Indonesia during the recent International Financial Crisis. But the more typical mode was 'leaning against the wind' in the face of appreciation pressure, which helps to account for the trend accumulation of reserves.

[3] See Fischer (2001) for a discussion at the time of the range of views on bipolar exchange rate regimes.

Graph 2

Reserves and exchange rates



BR = Brazil; CL = Chile; CN = China; HK = Hong Kong SAR; ID = Indonesia; IN = India; KR = Korea; MX = Mexico; MY = Malaysia; PH = Philippines; RU = Russia; SG = Singapore; TH = Thailand; TR = Turkey; TW = Chinese Taipei.

[1] China, Hong Kong SAR, Indonesia, India, Korea, Malaysia, Philippines, Singapore and Thailand. [2] Defined as sum of normalized change in nominal exchange rate against US dollar and ratio of normalized change in international reserves to narrow money. [3] Vertical axis: percentage change in real effective exchange rate (REER) from 2009 Q1 to 2010 Q3 (increase = appreciation); horizontal axis: change in foreign reserves from 2009 Q1 to 2010 Q3 as a percentage of GDP. [4] In per cent; average of the economies in the region. [5] Australia, China, Hong Kong SAR, Indonesia, India, Japan, Korea, Malaysia, New Zealand, Pakistan, Philippines, Singapore and Thailand. [6] Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela [7] The Czech Republic, Hungary and Poland. [8] Short-term external debt measured as consolidated international claims of BIS reporting banks with a maturity up to and including one year, plus international debt securities outstanding with a maturity up to one year.

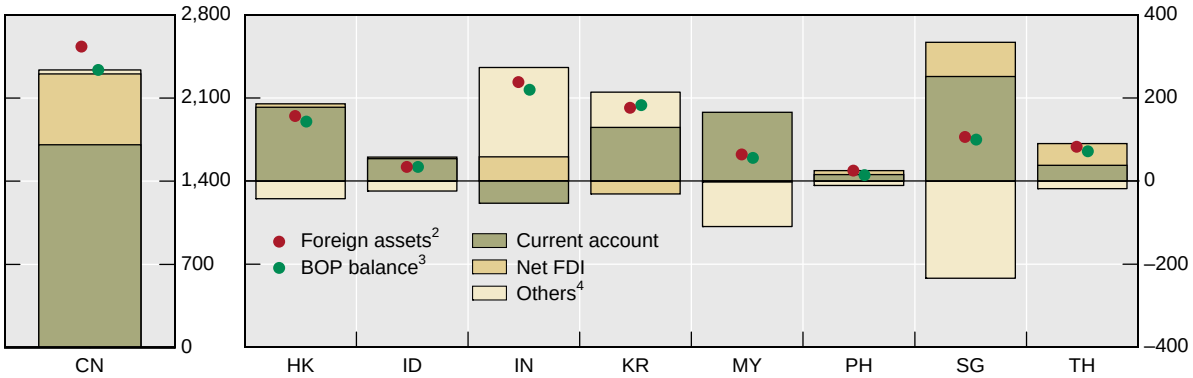
Sources: IMF *IFS*; Datastream; BIS; national data.

Another manifestation of this overall policy approach was current accounts which, having generally been in deficit before the crisis, moved substantially in the direction of surplus (Graph 3). While the international policy debate has raised questions about the persistence of these surpluses, the countries affected by the Asian crisis were keenly conscious of the vulnerability which goes with external deficits. Thus the foreign exchange reserve increase generally reflected *both* current account surpluses and strong capital inflow. There were, of course, exceptions to the generalisation. For example, India's current account was in deficit and both Singapore and Malaysia had net capital outflows over the period.

Graph 3

BoP and foreign assets, cumulative change from 2000 to 2009[1]

In billions of USD



[1] Data as of end 2008 for Indonesia, India, Malaysia, Philippines and Thailand. [2] Changes in foreign assets (line 11 IFS) over the observation period. [3] Sum of overall balance for the observation period. [4] Net sum of BOP components other than current account and direct investment.

Source: IMF IFS.

To explore the linkages between the expansion of central bank balance sheets and foreign exchange rate regimes, we start by reviewing how foreign exchange intervention activities of central banks affect the size of its balance sheet and how the activities alter the composition of the central banks' assets and liabilities.

Central bank assets and liabilities: the facts

How does the increase in foreign reserves fit into the central banks' balance sheets? A simplified central bank balance sheet is given in Table 1. Central bank assets consist of net foreign reserves and domestic assets; its liabilities comprise currency in circulation, bank reserves, deposits of other institutions (including government), its own securities and other liabilities and equity capital. Equity capital represents government transfers to the central bank (plus accumulated profits and losses). Without increased equity capital, the accumulation of assets requires financing in some form. The details of the expansion of Asian central bank balance sheets, both the range of assets and liabilities, also offer insights into the policy choices of the monetary authorities.

Table 1

A central bank balance sheet

Assets	Liabilities and capital
Foreign assets	Reserve money
Domestic assets	Currency in circulation
Claims on government & public enterprises	Reserves of commercial banks
Claims on the private sector	Foreign liabilities
Claims on domestic money banks	Other deposits of commercial banks, etc
Claims on other financial sector entities	Central bank securities, etc
	Government deposits
	Others
	Equity capital

Assets

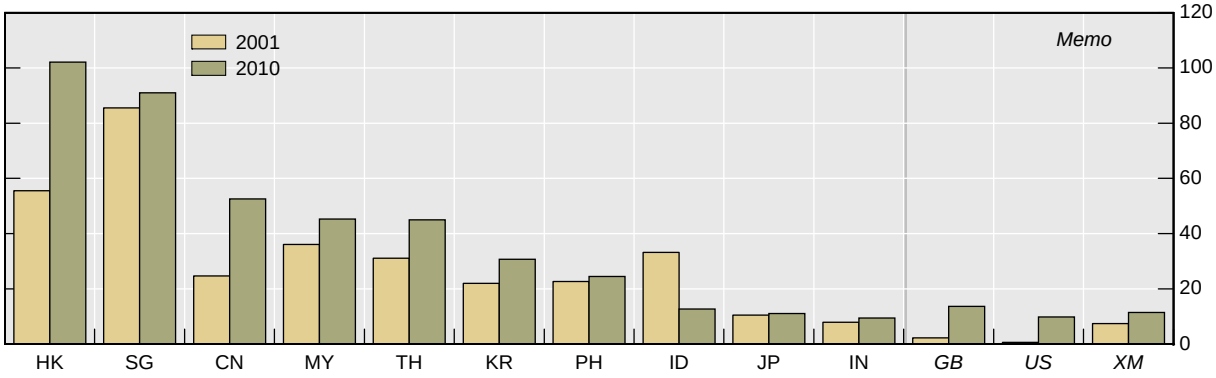
In emerging Asia, the increase in net foreign reserves has come to dominate the balance sheets of all the central banks. After a decade or more of these policies, the sheer magnitude of the foreign exchange reserve holdings now has macroeconomic implications for a number of countries in the region. Singapore and Hong Kong SAR, for example, have reserves of around 100% of GDP; and China, Malaysia and Thailand have reserves equal to around half of GDP (Graph 4 and Table A2).

Table 2 provides a cross-country perspective on the assets on the balance sheet of the region's economies; Graph 5 illustrates quite vividly the dominant role foreign exchange assets has played in accounting for the cumulated *change* in the asset side of the central banks' balance sheet from 2002 to 2010. All the other types of assets played a relatively small role in the expansion of emerging Asia's central bank balance sheets. Some view this behaviour as one-sided and aimed to keep exchange rates undervalued.

Graph 4

Central bank assets[1]

As a percentage of GDP



CN = China; HK = Hong Kong SAR; GB = United Kingdom; ID = Indonesia; IN = India; JP = Japan; KR = Korea; MY = Malaysia; PH = Philippines; SG = Singapore; TH = Thailand; US = United Kingdom; XM = euro area.

[1] Net of currency in circulation.

Sources: IMF, *International Financial Statistics*; national data.

It is also important to note that the accumulation process was not one-sided over the whole period. Some of the central banks experienced a sharp transitory reduction during the international financial crisis (right-hand panel of Graph 1).[4] For example, the Bank of Korea shrank its balance sheet at the end of 2008 as did the Central Bank of Malaysia and the Reserve Bank of India. But this was a transitory experience as depreciation pressures rose: foreign assets still dominate the balance sheets.[5] This underscores the point that even though the foreign asset change has been large and mainly one-sided over the past decade, the region is open to running down assets when there are depreciation pressures. This supports the view that the intervention policy in emerging Asia should be seen as symmetric but the shocks to the exchange rate have been one-sided. This view argues that foreign reserve accumulation will eventually reverse naturally as appreciation pressures subside, fully recognising that this process may take considerable time.

[4] In addition to reducing foreign currency assets on their balance sheet, many central banks reduced off-balance sheet foreign exchange claims. In some cases, the drawdown of net foreign exchange forward positions during the crisis was larger than the change in the on-balance sheet long foreign exchange positions (Graph A1).

[5] The one exception in the 2000s is the case of Japan and this illustrates the role of a central bank's balance sheet in addressing the liquidity needs of the general public and financial institutions. To meet this need, central banks have traditionally relied on open market purchases of securities. From the mid-1990s to the mid-2000s, the Bank of Japan tripled the size of its balance sheet from about 10% of GDP to 30% of GDP. This expansion reflected the extreme financial conditions that first led the central bank to adopt innovative policies in the form of the zero interest rate policy in 1999 and then quantitative easing in 2001. In particular, the quantitative easing programme aimed to support financial market functioning by targeting monetary policy operations at the level of outstanding current account balances of the private sector held at the Bank of Japan. These efforts were also augmented with what is now referred to as credit easing in the form of outright purchases of Japanese government bonds, purchases of asset-backed securities and asset-backed commercial paper, commercial paper repos and equity purchases from financial institutions. While contracting somewhat since the mid-2000s, the Bank of Japan's balance sheet measured in relation to GDP is comparable to that of Federal Reserve (not including the likely increase in size associated with the latest large-scale asset purchase programme) and larger than those of the ECB and Bank of England.

Table 2

The composition of central bank assets[1]

As a percentage of total assets

	Foreign assets		Domestic assets; Claims on							
			Government[2]		Private sector		Banks[3]		Others[4]	
	2001	2010	2001	2010	2001	2010	2001	2010	2001	2010
China	46.5	85.6	6.6	6.1	0.5	0.0	26.5	3.8	20.0	4.5
Hong Kong SAR	100.0	100.0	…	…	…	…	…	…	…	…
Indonesia	48.5	74.4	42.9	24.0	5.8	1.1	2.8	0.4	…	…
India	56.1	77.6	37.5	22.0	…	…	1.7	0.3	4.7	0.1
Korea	86.7	93.4	6.3	4.5	…	…	7.1	2.1	…	…
Malaysia	78.4	84.3	1.0	0.6	18.4	2.7	2.3	12.4	…	…
Philippines	74.1	87.5	18.1	8.7	2.8	2.7	5.1	1.1	…	…
Singapore	95.7	97.5	4.3	2.5	…	…	…	…	…	…
Thailand	73.2	94.3	6.2	5.4	18.4	0.0	2.2	0.2	…	…

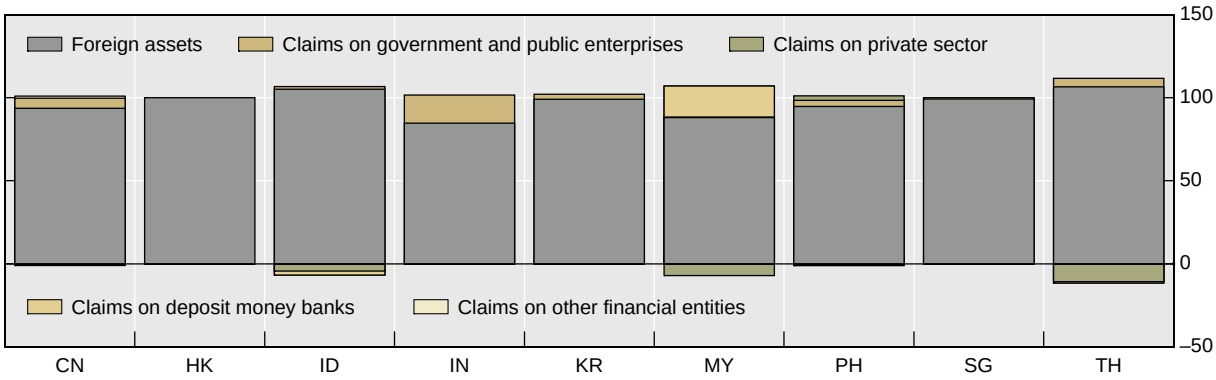
[1] Data less than 0.04 is shown as 0.0; unavailable data is shown as '…'. [2] Claims on government and public enterprises. [3] Deposit money banks. [4] Other financial sector entities.

Sources: IMF *IFS*; national data.

Graph 5

Change in composition of central bank assets in Asia, 2002 - 10

As a percentage of change in total assets



CN = China; HK = Hong Kong SAR; ID = Indonesia; IN = India; JP = Japan; KR = Korea; MY = Malaysia; PH = Philippines; SG = Singapore; TH = Thailand;

Source: IMF *IFS*.

Liabilities

For completeness, it is useful to review the structure of the liabilities side of the balance sheet. The liability side provides a glimpse into the choice of central bank policy instruments that have been used to sterilise the impact of the foreign exchange intervention. Across the region, central banks have various instruments to drain the additional liquidity that is pumped into the economy as central banks buy foreign exchange.

Given the various options, it is not surprising that the impact of the expansion of the central bank balance sheets on the liabilities side of Asian central banks has been more diverse than that of assets (Table 3 and Graph 6). Currency and reserve money have risen sharply across most of the region, reflecting the strong underlying economic growth in Asian economies. The rise in reserve money also reflects the growth in commercial bank deposits with the central bank. In part this reflected financial system deepening; in part, commercial banks had no better use of the funds. In addition, several central banks have imposed higher reserve requirements in order to curb the growth of bank lending. Greater issuance of central bank paper (eg in China and Indonesia) and the use of deposit facilities at central banks also show

up significantly. Changes in government deposits are important sources of change in some economies, reflecting both the traditional mandate of central banks as the government's banker and the use of government deposits as a means to sterilise foreign exchange intervention.

Table 3

The composition of central bank liabilities[1]

As a percentage of total assets

	Reserves of commercial banks[2]		Deposits of commercial banks		Central bank bonds		Government deposits		Others[3]	
	2001	2010	2001	2010	2001	2010	2001	2010	2001	2010
China	56.5	55.9	…	0.3	…	16.1	6.7	9.6	–2.0	–0.3
Hong Kong SAR	15.6	40.3	…		…	…	46.3	29.1	–16.1	–9.2
Indonesia	14.3	17.8	8.9	32.3	…	5.4	14.9	7.9	8.5	1.3
India	20.5	22.5	…	…	…	…	0.0	5.7	20.3	17.4
Korea	8.7	10.4	0.0	0.0	57.4	47.9	4.5	1.7	0.6	26.1
Malaysia	9.8	1.4	38.1	60.1	…	…	16.9	3.7	1.1	0.8
Philippines	7.2	16.6	10.2	50.3	…	…	7.9	3.5	1.5	0.4
Singapore	5.6	6.1	…	…	…	…	58.2	44.0	27.1	41.0
Thailand	2.6	1.6	10.9	41.7	5.5	21.3	1.4	7.3	–20.8	0.0

[1] Data less than 0.04 is shown as 0.0; unavailable data is shown as '…'. [2] Reserves money other than currency in circulation. [3] Including loans and other items (net).

Source: IMF *IFS*.

The decade in retrospect

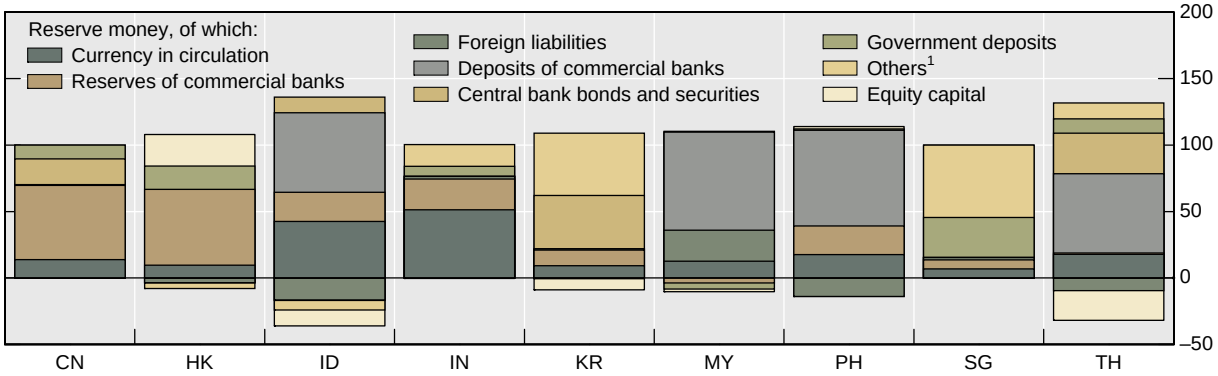
Overall, this post-Asian Crisis period has been one of successful policymaking for the central banks of the region. Inflation remained fairly low and stable and growth was strong. Financial stability concerns, while present as financial liberalisation continued apace, did not materialise to the extent seen in the West. It is important to note that central banks never have any *technical* difficulty in funding their balance sheet expansion (when they intervene, they issue a liability which has always acceptable in the market). Given this record, one might be tempted to conclude that the rapid expansion of central bank balance sheets via foreign exchange reserve accumulation is relatively benign.

However, such a conclusion may be premature. There are a number of risks that may yet prove disruptive – as balance sheets continue to expand. On the macroeconomic side, questions remain about the implications of a large increase in reserve (base) money for inflation. On the financial side, questions remain about whether the liabilities central banks use to fund the purchase of foreign reserve assets can lead to greater elasticity of the credit supply from banks. In addition, there are concerns that expansion of 'other liabilities' (not technically part of reserve money) could 'crowd out' other asset holdings in the financial intermediation process. On the central bank balance sheet management side, does the huge currency mismatch between the asset and liability sides of the central banks' balance sheets raise concerns? This paper explores these issues. To a great extent, the answers to these issues are inexorably linked to the choice of exchange rate regimes in the region that relies on active use of foreign exchange intervention, which we turn to in the next section.

Graph 6

Change in composition of central bank liabilities in Asia, 2002 - 10

As a percentage of change in total assets



CN = China; HK = Hong Kong SAR; ID = Indonesia; IN = India; JP = Japan; KR = Korea; MY = Malaysia; PH = Philippines; SG = Singapore; TH = Thailand.

[1] Including loans and other items (net).

Source: IMF *IFS*.

II. Money, credit, the Impossible Trinity and central bank balance sheets: lessons learnt and policy challenges ahead

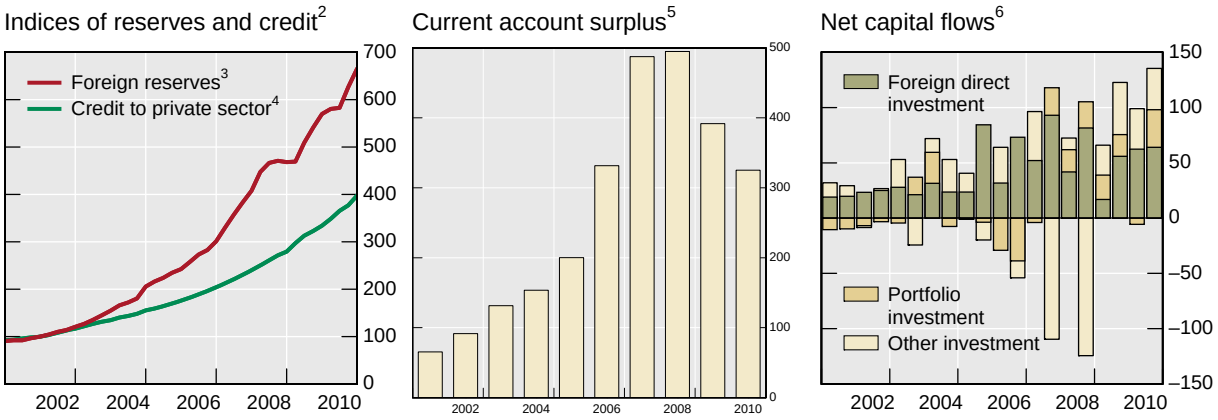
The main arguments for free floating after the Asian financial crisis were supported by two related analytical ideas. First, proponents of the 'corner solutions' view argued that the middle ground of managed exchange rates was untenable. Countries had to adopt hard fixes or free floats. Second, a more general version of this argument was contained in the Impossible Trinity doctrine: those countries which were open to international capital flows could choose a fixed exchange rate or an independent domestic monetary policy, but could not have both (Calvo (1991), Aizenman (2010)). The warning was that intermediate exchange rate regimes in emerging market economies raised the risk of excessive reserve money and credit creation, which in turn boosted risks of inflation and financial instability.

At first sight, this seems a familiar story to observers of Asia over the past decade. In the region, the fourfold increase in foreign exchange reserves in the seven years shown was accompanied by a three-fold increase in credit (Graph 7). It might seem that these substantial increases were related, as the Impossible Trinity suggests.

However, the apparent link to the doctrine is weaker than first meets the eye. In the rest of this section of this paper we explore the empirical links from foreign reserve accumulation to money and credit during the past decade. As we shall see, even with the huge increase in foreign exchange reserves, the rise in reserve money was modest (weakening the direct link between foreign reserve increase and credit) and inflation remained well contained. For credit, the supporting evidence is somewhat more favourable to the Impossible Trinity doctrine but, in the end, argues for a new way of thinking about the linkages among foreign reserve accumulation, central bank balance sheets and macroeconomic/financial stability.

Graph 7

Foreign reserves, credit and capital flows in Asia[1]



1 China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand. [2] End – 2001 = 100. [3] In US dollar terms; sum of the economies listed. [4] Weighted average based on 2005 GDP and PPP exchange rates. [5] In billions of USD; sum of economies listed. [6] Positive (negative) indicates inflows (outflows).

Source: IMF *IFS*.

Central bank balance sheet expansion, money and inflation – the elusive nexus

The Impossible Trinity view envisaged that if countries attempted to prevent their exchange rates from appreciating, current accounts would move into surplus and foreign exchange reserves would rise. This would boost reserve money and bring about credit expansion, stronger economic activity and inflation, which would result in an appreciation of the real exchange rate, frustrating the attempts to maintain international competitiveness. The prospect of this adjustment would also attract foreign capital inflows, further boosting foreign exchange reserves and reserve money. Any attempt to respond to inflationary pressures by raising interest rates would prove counterproductive, encouraging even more capital inflows.[6]

Graph 8 illustrates quite convincingly that the transmission mechanism from foreign exchange asset accumulation to reserve money growth to inflation was not in operation in emerging Asia during much of the 2000s. The correlation between the growth in central bank assets and reserve money was virtually zero[7]; in the middle-panel in Graph 8, the broad monetary aggregates show some tendency to be positively related but upon close inspection the slope of the line is largely determined by the observations for China and India. Finally, the correlation with inflation, if anything, is modestly negative.

Overall, these results are consistent with the findings of Aizenman et al (2008) – emerging Asian economies have been able to adopt intermediate exchange rate regimes (ie managed float) while retaining some degree of monetary autonomy, even as greater financial openness was achieved. Sizable international reserves have been a critical part of the success of this approach. In other words, the direct monetary effect on inflation of the increase in foreign exchange reserves was effectively sterilised in most countries.

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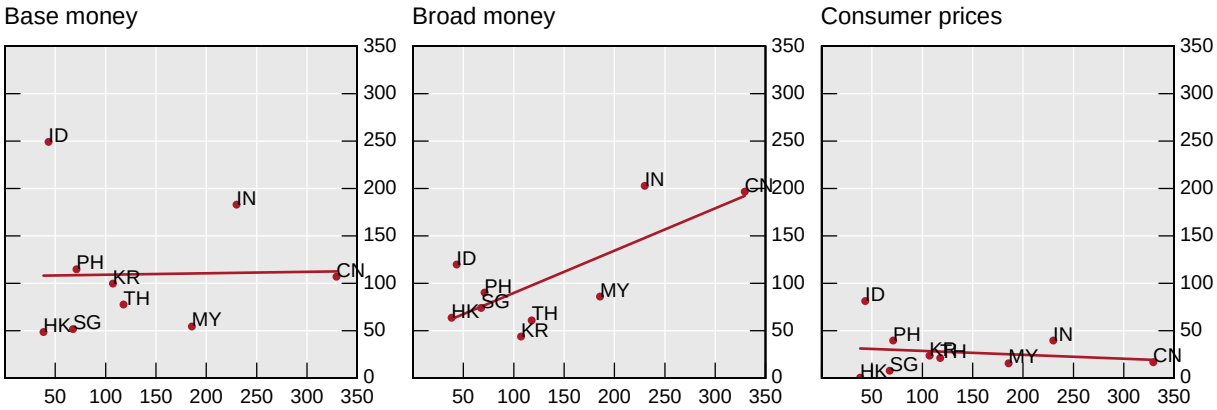
[6] It was assumed that foreign and domestic assets were close substitutes in this integrated world, so there would be large inflows in response to even minor interest differentials.

[7] The correlations with net foreign assets are similar; see Graphs A2 and A3 in the Annex.

Graph 8

Growth of central bank assets relative to the growth of money and consumer prices[1]

2001 – 07; in per cent



[1] The horizontal axis show change in central bank total assets; the vertical axis represents the change in the variables shown at the panel title.

Sources: Datastream; IMF *IFS*; national data.

Defying the Impossible Trinity: evolving views on the monetary transmission mechanism

How did these emerging Asian economies avoid the apparently inexorable forces of the Impossible Trinity, and occupy the supposedly untenable middle ground of the 'corner solutions' argument?[8]

In a nutshell, the key monetary transmission mechanism envisaged in the Impossible Trinity, whereby the rise in foreign exchange reserves causes reserve money to rise and the credit multiplier process to operate, was not, in general, in operation. In retrospect, maybe this should not come as a big surprise. This traditional transmission channel belongs to an earlier era where monetary policy was implemented via control over reserve money, with the growth of credit set via the credit multiplier. In that world, monetary policy operates by restricting the *supply of reserve funds* to the banking system.

Today, this monetary transmission mechanism is much less relevant, even in the emerging market economies. Central banks generally use interest rates as the policy instrument. In other words, central banks set policy interest rates and supply financial markets with the liquidity they want at that price. This has important implications for a central bank's balance sheet when sterilising the accumulation of foreign exchange sterilisation operations. In theory, any increase in domestic liquidity that is not consistent with the policy interest rate setting will flow back to the central bank via domestic liquidity management. In other words, central banks generally, and virtually automatically, sterilise any excess liquidity supplied through foreign exchange intervention.[9]

The developments on the liability side of central bank balance sheets (see Table 3 and Graph 6) illustrate this tendency, as central banks chose various means at their disposal to fund their expanding foreign asset holdings. For all these countries, strong underlying growth in activity raised the public's demand for currency, providing a source of zero-interest rate

[8] Others who have looked at these issues in recent years include BIS (2009) and Aizenman and Glick (2009).

[9] It is technically relatively easy for the authorities to manage the liquidity requirements of the financial system provided the central banks has available suitable instruments for sterilisation, such as the ability to issue their own bonds. The central bank's foreign exchange intervention leaves the banks with excess liquidity, so there is a ready demand for these stabilisation instruments from the commercial banks.

funding. The extent of this currency-funding was, of course, determined by the public's demand for currency, and was not under the direct control of the central bank. This funding source was especially important for India and Indonesia.

More widely apparent was the rise in the other element of reserve money – banks' deposits at the central bank. Some of this reflected the normal rise in the demand for bank reserves as the financial sector grows and broadens. It also reflects the reliance of some Asian central banks on the use of the required reserves in their monetary policy frameworks (eg Ma et al (2011) and Montoro and Moreno (2011)). For some Asian central banks, this instrument had become unfashionable during the shift towards a more market-oriented deregulatory approach. More recently, there has been renewed interest in it as a way to help neutralise the build-up of reserve money and short-term liquidity without having to resort to increases in policy interest rates.[10]

There were two important technical developments during the decade on the liability side of central bank balance sheets. First, central banks increasingly issued their own securities. This represents a powerful sterilisation tool. None of the central banks in our sample had enough domestic government securities on their balance sheets to run these down in open-market operations – the conventional text-book liquidity-reducing practice. Thus their ability to issue sterilisation instrument has been a key element of the sterilisation story. Bank Indonesia has issued SBI for this purpose since the 1980s and central bank bonds also have a long history in Korea, but other central banks came to use them extensively in the 2000s. Thailand's capacity to issue was progressively enlarged during the past decade; the PBC began issuing its own paper in 2003; and Malaysia's capacity to use this instrument was greatly enhanced with new legislation in 2006.[11]

The other important innovation was the payment of interest on excess reserves held at the central bank.[12] This facility was put in place in Malaysia in 2004, Singapore in 2006 and Thailand in 2007 (see Ho (2008)). These two sterilisation innovations broadened the array of market-oriented sterilisation instruments and allowing them to avoid reliance on less market-friendly measures such as increased required reserves. Thus the technical means of sterilisation have been substantially strengthened over the past decade. Where reserve money was not directly sterilised, the commercial banks were offered an incentive (in the form of interest paid on deposits held with the central bank) to go on holding excess reserves, rather than expand their balance sheets through lending.

There was a further powerful channel of sterilisation not usually found in the text-books. Both India and Singapore issue government securities ('overfunding the budget'), with the cash counterpart of the issue being placed on deposit at the monetary authority: this formed the bulk of the sterilisation funding in Singapore and was an important recent (2004) innovation in India. This underscores the nontrivial interactions of central bank balance sheet management and sovereign debt management that have garnered particular attention recently (eg Turner (2011)).

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[10] In addition, it has also have been justified in prudential terms although the degree to which it has been used surpasses any prudential requirement. China, India, and the Philippines have all relied on this approach with some. Substantial reserve requirements distort financial intermediation by putting what is in effect a tax on the banking system. Nevertheless it is an attractive option as it is a low-cost (sometimes zero-cost) source of funding.

[11] See Glick and Hutchinson (2008) and Mehrotra (2011, forthcoming).

[12] It had been a key element of the credit multiplier story that reserves were unremunerated. This discouraged banks from holding excess reserves and thus gave the central bank leverage to restrain the commercial banks' balance sheets when necessary.

Additional implications

Of course, this may not be the end of the story, even for those countries where sterilisation seems fairly complete. The sterilisation process often involves changes in the composition of balance sheets of both central banks and their financial system counterparts, the banks. Growth in central bank liabilities leads to growth of the balance sheet of the commercial banks which, in turn, might affect incentives for lending. In other words, as central banks sterilise foreign exchange interventions, they alter the bank lending channel and provide incentives to expand credit at some point in time.[13] For example, when sterilisation takes the form of central bank/government securities, the banks take on highly liquid securities on their balance sheets. This could at a later date be the basis for further expansion of their balance sheets if they choose to leverage up on this relatively safe asset by expanding credit to the private sector.[14]

In the absence of the traditional credit multiplier process, there are also possible effects via *relative price changes* possible within the financial sector. These relative price changes might alter banks' funding costs (and their lending margins), and their cost of raising capital (Borio and Zhu (2008) and Disyatat (2010)). While such changes no doubt have occurred, these are such subtle influences that they could be hard to disentangle from large changes in bank margins caused, for example, by the stickiness of lending rates in response to changes in the policy rate (which have been found to be on the order of 200-300 basis-point changes in bank margins over the course of the business cycle in some cases).

Central bank balance sheet, credit, asset prices and financial stability

Perhaps surprisingly given the growth in the aggregate credit data shown in Graph 7, when credit growth as a percent of GDP is examined country-by-country the picture is not particularly clear that credit growth has been a persistent problem in the region that would suggest a systematic build-up of financial imbalances. In the first part of the 2000s, only two economies (Korea and India) show substantial growth (Graph 9). Korea, in particular, has seen a credit card boom gone bad during this period and property price bubbles were a policy concern. The majority of the other countries show credit expanding not much faster than nominal GDP.

Moreover, we cannot rule out special factors that could account for part of the rapid credit growth in these two economies. They began the decade with an unusually low level of

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[13] Before addressing that question, we might also ask whether loading up the asset side of the banks' balance sheets with central bank paper might, in fact, have had the opposite effect of 'crowding out' other lending, with the banks content to hold this high-quality paper, with little incentive to expand their balance sheets through increased lending. It seems unlikely, however, that the sterilisation bonds 'crowded out' credit growth that would otherwise have occurred. The initial source of the foreign exchange reserve increase added to the funding side (deposits) of the banks' balance sheets. If the source of the upward pressure on the exchange rate was a current account surplus, the net export earnings created bank deposits, at least initially. In macro terms, there was a positive savings/investment balance which was available to fund the reserve build-up. In the case of foreign capital inflow, the foreigners initially sold their foreign exchange to a commercial bank which sold it to the central bank. The commercial bank had more deposits and held the central bank sterilisation bond. Of course this is not the end of the story, but it suggests that the commercial banks can fund their holdings of sterilisation securities without crowding out their lending. There is the interesting case where the sterilisation bonds are sold to the non-bank public. The new purchaser pays by running down a deposit, which would, at least initially, contract both sides of the commercial bank's balance sheet, but leave loans untouched.

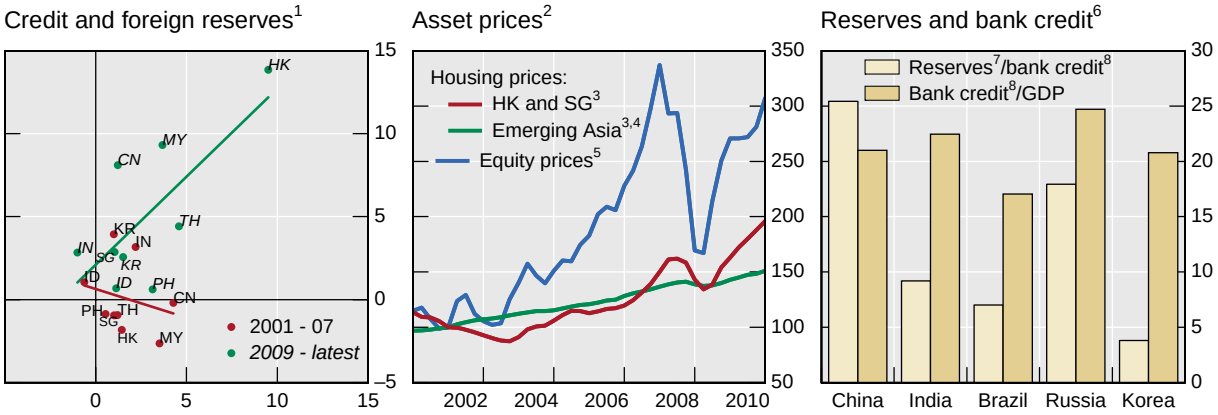
[14] There would be no effects only in the case where the exporters/foreigners held all the sterilisation bonds. But if the foreigners want to hold other assets, relative prices will have to change to facilitate these shifts in asset holding, and these relative price changes may well affect credit growth. While foreigners didn't hold *all* the sterilisation bonds, they did hold some: in Indonesia, for example, foreigners hold nearly 30 percent of SBIs (Bank Indonesia's sterilisation instrument) and government securities.

credit/GDP, by international norms. For Korea, one element of the story is that businesses obtain a substantial part of their funding from sources other than the domestic banking system. But even with this caveat, the fast credit growth in both these countries can partly be explained in terms of the transition towards a normal level of bank intermediation. This, of course, still raises important policy issues about the speed of transition, the dangers inherent in the transition process and the difficulty of identifying when the transition has run its course. These judgements are difficult because credit has to grow faster than GDP in order to achieve a new normal.[15]

However, recent trends suggest the relatively benign assessment for the earlier part of the decade may be too favourable. Since the trough of the business cycle in early 2009, credit growth in the region has been surging as has foreign reserve accumulation (Graph 9, left-hand panel). China, Malaysia, Hong Kong and Thailand stand out in this respect. At the same time, this surge in credit creation and foreign reserve accumulation has corresponded with robust growth in housing and equity prices (middle panel, Graph 9).

Graph 9

Foreign reserves, credit and asset prices



1 Horizontal axis shows foreign reserves as percentage of GDP; the vertical axis represents credit to the private sector as percentage of GDP; annual average change in the ratios. 2 End – 2001 = 100. 3 Weighted average based on 2005 GDP and PPP exchange rates. 4 China, Hong Kong SAR, Indonesia, Korea, Malaysia, Singapore and Thailand. 5 MSCI emerging Asia in local currency. 6 Increase, in percentage points; end-2002–latest available data. 7 Foreign exchange reserves minus currency in circulation. 8 Bank credit to the private sector.

Sources: Bloomberg; CEIC; IMF *IFS*; national data.

The elasticity of lending capacity and financial stability concerns

Is it possible that the decade of rapid foreign reserve accumulation has contributed to surge in lending activities and reveal vulnerabilities of the financial systems in Asia?[16] In other

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15 In several of these countries (notably Korea and Indonesia), one of the legacies of the Asian financial crisis was that bank lending to corporations and businesses fell away (for both demand and supply reasons) and banks saw households as more bankable customers. As a result, there are policy issues in Korea relating to the growth and extent of household debt (eg Chung (2009)). Household debt grew from one-quarter of total lending in 1999 to nearly one-half by 2002. This took household debt from 50 percent of GDP to over 70 percent, and as a percent of household disposable income, it rose from 80 to 130. Since then it has levelled out as a percent of GDP and household income. The same trends can be seen in Malaysia: banks' loans to households grew from one-third of total loans in 1997 to 56 percent in 2007 (Endut and Hua (2009)). In Thailand, the ratio of debt to household income rose from 40 percent in 1998 to 58 percent in 2004 (Subhanij (2009)). The focus here, however, is on the development of the overall credit aggregates.

16 Here we can see an important distinction between sterilisation by means of issuing central bank paper, and sterilisation via increased reserve requirements. The former, while more market-friendly, gives commercial

words, did the increase in liquid assets associated with sterilisation operations, in practice, help shape this environment of rapid credit growth?[17]

One view is that the growth of credit during most of the decade has been largely demand-determined, rather than determined by the availability of funding via sterilisation operations. In most Asian economies (eg Indonesia, Korea, Malaysia, the Philippines, Thailand, Hong Kong SAR and Singapore), commercial banks continuously held substantial excess reserve money and stabilisation instruments on their balance sheets. If they had expanded their balance sheets in the way envisaged by the traditional credit multiplier process, these holdings would have been taken up in the form of additions to required reserves and public currency holdings, as credit growth pushed well beyond the growth of nominal GDP.

Another view would argue that these vulnerabilities were largely dormant during much of the 2000s but nonetheless grew. Indeed, we cannot exclude the possibility (even likelihood) that *some* of the rapid credit growth that was seen at times arose from the elastic supply of bank lending. Again, Korea's experience points in this direction. By and large, however, most of the liquidity associated with the foreign exchange intervention appears to have found a home in the form of currency or required reserves. The situation now seems more worrisome.

The critical question is whether this increased elasticity of the credit supply can quickly lead to unstable financial conditions that promote excess credit expansion, rapid asset price growth and eventually financial instability.

The concerns associated with this view take on considerable importance now given the state of Asian commercial bank balance sheets. Graph 10 shows that commercial banks in all of these economies (with the possible exception of China) have accumulated substantial holdings of the near-reserve-money instruments: central bank or government paper, or foreign currency.

Moreover, Graph 11 underscores the potential lending elasticity of Asian financial systems even under the new financial regulatory regime being put in place internationally. It shows that capital reserves of the Asian banking systems are well in excess of the Basel requirements (ie Asian banks on the whole are not particularly capital constrained)[18], and that for all except Korea and perhaps Thailand, the loan/deposit ratio suggests that bank lending is not constrained by a shortage of deposit funding.

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banks the funding liquidity that would allow them to expand their lending, should they decide to do so, while the cruder instrument of reserve requirements exercises more direct restraint on banks' balance sheet expansion. The large volume of 'lazy assets' (in the form of low-yield sterilisation bonds) on the balance sheets of the banks in five of the countries in this group provides the funding by which these banks could expand credit. Where banks have no room to profitably increase their lending, they are captive holders of these instruments, and the authorities can use this fact to cut the interest rate on these instruments thus reducing the cost of their sterilisation operations. But such a strategy will give banks greater incentives to find new lending opportunities. Over time there will be pressure to replace these low-return assets with high-earning loan assets. The presence of these low-risk assets may encourage banks to take on higher-risk alternative assets (offering loans to customers previously considered to be not bankable). To keep these instruments 'bedded down', the authorities have to offer a full market return, and this makes the sterilisation operation more expensive. Even where the instruments offer the full policy rate, there is often a substantial margin between the policy rate and the lending rate, providing incentives to replace the sterilisation instruments with loans.

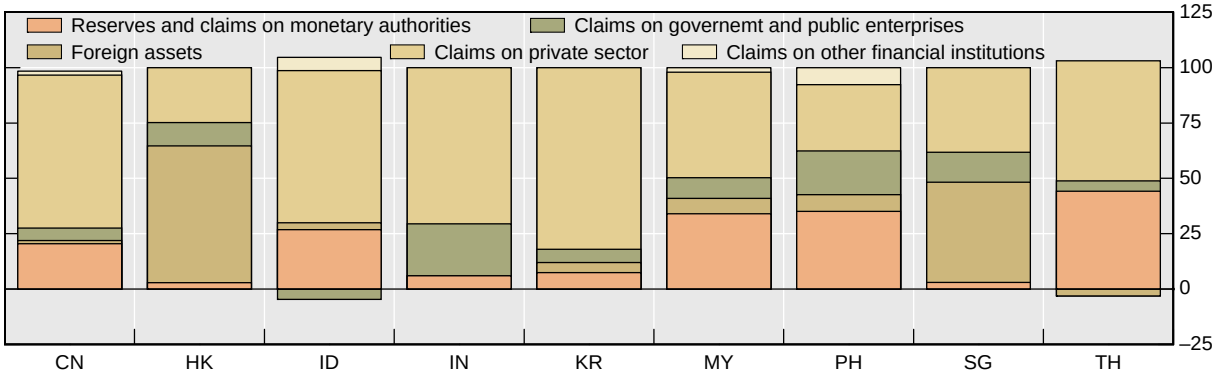
[17] For a detailed discussion of these issues, see Mohanty and Turner (2006).

[18] The one exception is China in 2006.

Graph 10

Change in assets of deposit money banks, 2002 – 10

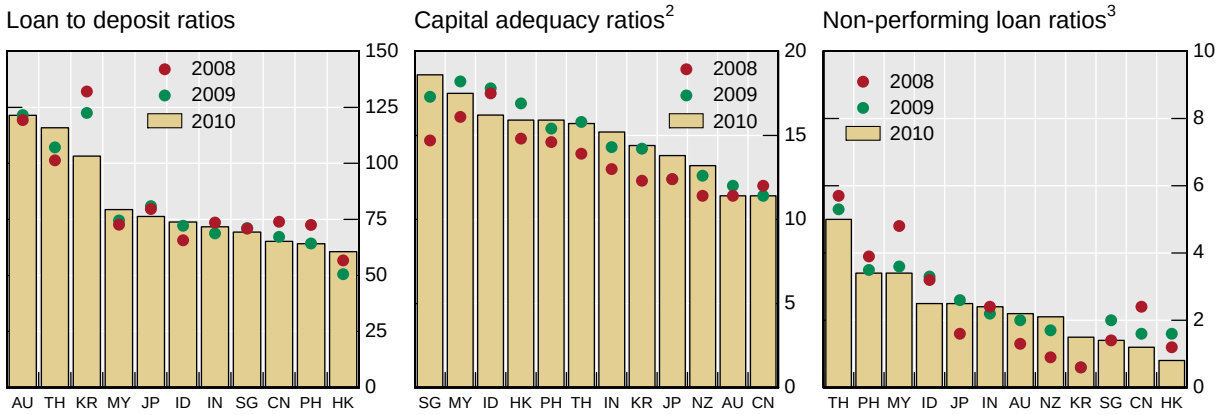
As a percentage of change in total assets



Source: IMF *IFS*.

Graph 11

Bank soundness indicators[1]



AU = Australia; CN = China; HK = Hong Kong SAR; IN = India; ID = Indonesia; JP = Japan; KR = Korea; MY = Malaysia; NZ = New Zealand; PH = Philippines; SG = Singapore; TH = Thailand.

[1] In percent. [2] Total capital as a percentage of total risk-weighted assets. [3] Definitions may vary across countries.

Sources: Bloomberg; CEIC; IMF; national data.

Some tentative lessons learnt: four aspects of the policy tradeoffs in this environment

The demise of the bipolar view associated with the canonical Impossible Trinity doctrine begs the question of what replaces it. Here we offer four important aspects of an environment in which the constraints of the Trilemma are relaxed. Though not mutually exclusive, they provide a more empirically appealing way to think about the policy tradeoffs facing Asian central banks. First, foreign reserve asset accumulation may be an effective, though partially, independent policy tool. Second, macroprudential policy tools and capital flow management tools offer effective ways to constrain excessive money and credit growth. For these two possibilities, questions arise about whether they can be effective beyond the short term. Third, the greater use of monetary conditions indexes (MCIs) in the formulation of monetary policy may be warranted. Fourth, active foreign exchange intervention implicit in intermediate exchange rate regimes may pose more significant macroeconomic-financial stability risks than have been experienced in the past decade.

1. Foreign exchange reserve accumulation: a partially independent policy tool

The Asian experience suggests that central banks in the region can intervene in the foreign exchange market and resist nominal appreciation pressures while at the same time liberalising financial markets and retaining some degree of central bank independence for considerable periods of time. In other words, foreign exchange rate intervention seems to have had some success in influencing exchange rates without sacrificing the ability of credible, low inflation monetary policy frameworks to deliver price stability.

It is worth noting that inflation did pick up in 2008 and again recently. As in Aizenman (2010), this may suggest that while accumulating foreign reserves may loosen some of the constraints of the Impossible Trinity doctrine in the short term, but there are limits. Establishing those limits in practice for both price stability and financial stability may prove to be quite difficult to know with confidence.

2. *Monetary policy is not alone: factoring in other policy tools that can constrain credit growth*

One might argue that easy monetary policy during the period was kept relatively accommodative but other policy tools which are now often referred to as macroprudential tools were used successfully to rein in supply of credit. Graph 12 suggests that, judged by this measure of the real policy rate, the stance of policy was generally accommodative in recent years. This is consistent with the view that relatively conservative financial system practices were adopted in the aftermath of the Asian Financial Crisis in the late 1990s and that this was sufficient during much of the decade to prevent the financial instability associated with rapid credit and asset price growth. In other words, the somewhat easy monetary conditions were kept from spilling over to credit markets above and beyond what was justified by the strong underlying growth fundamentals in the region during most of the decade.

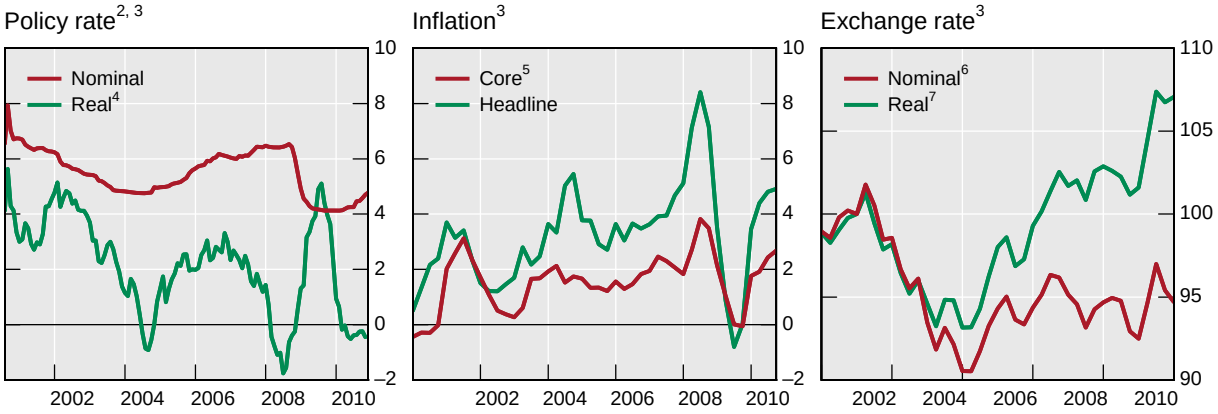
There is the question of why policymakers chose to kept policy rates relatively accommodative and rely more heavily on non-price policy tools. There were two possible explanations for this, related to the choice of exchange rate regime. First, authorities may have been concerned about disruptive capital inflows. An often heard risk from Asian central bankers in recent years is that higher interest rates would attract even larger foreign inflows, which would not only intensify upward pressure on the exchange rate but would also subject their economies to a greater vulnerability for a disruptive sudden stop of capital flows in the future. Second, some central banks argued that real exchange rate appreciations would eventually achieve the external restraint in a less costly manner than relying on appreciation of the nominal exchange rate. This later explanation has taken on greater significance in 2010-11.

Whatever the case, one view argues that macroprudential policy tools and capital flow management tools can effectively relax the constraints of the Trilemma. But can they do so over the medium- and long-term? The jury is still out but recent developments suggest that such tools can only buy time and are not effective substitutes over the longer term. The continued frothiness in property markets in Hong Kong SAR and Singapore underscore the limitations of macroprudential tools to fine tune the relationship between credit supply and credit demand.

Graph 12

Monetary policy and central bank balance sheets in emerging Asia[1]

In per cent / index



[1] China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand. [2] For China, one-year lending rate; for Hong Kong SAR, base rate; for India, reverse repo rate; for Indonesia, one-month SBI rate; for Korea, overnight call rate; for Malaysia, overnight policy rate; for the Philippines, overnight reserve repo rate; for Singapore, three-month interbank offered rate; for Thailand, 14-day repo rate before 17 January 2007, overnight repo rate thereafter. [3] Weighted average of listed economies based on 2005 GDP and PPP exchange rates. [4] Policy rates or their proxies minus 12-month change in CPI. [5] Headline inflation excluding food and energy. [6] Nominal effective exchange rate; an increase indicates an appreciation. [7] Real effective exchange rate; an increase indicates an appreciation.

Sources: Bloomberg; CEIC; BIS; national data.

3. The stance of monetary policy and the return of the MCI

In addition, some years ago it was common practice to assess the stance of monetary policy in terms of a Monetary Conditions Index (MCI), combining both the level of interest rates and the exchange rate. The rationale was that if the market had brought about an appreciation of the exchange rate, this appreciation would be restraining domestic demand and exerting direct restraint on prices, so a lower interest rate would be consistent with the same policy stance. The use of the MCI has become less common, as it came to be recognised that the MCI can give misleading signals on the appropriate stance of policy when the terms of trade change.[19]

In fact it may be useful to bring this MCI idea (with its prominent role for the exchange rate) back from the wilderness when assessing whether recent monetary policy has been appropriately set. Graph 13 summarises the results of a Taylor Rule regression which incorporates the exchange rate both as a policy objective (on the right-hand side of the equation) and as a policy instrument (on the left-hand side of the equation).

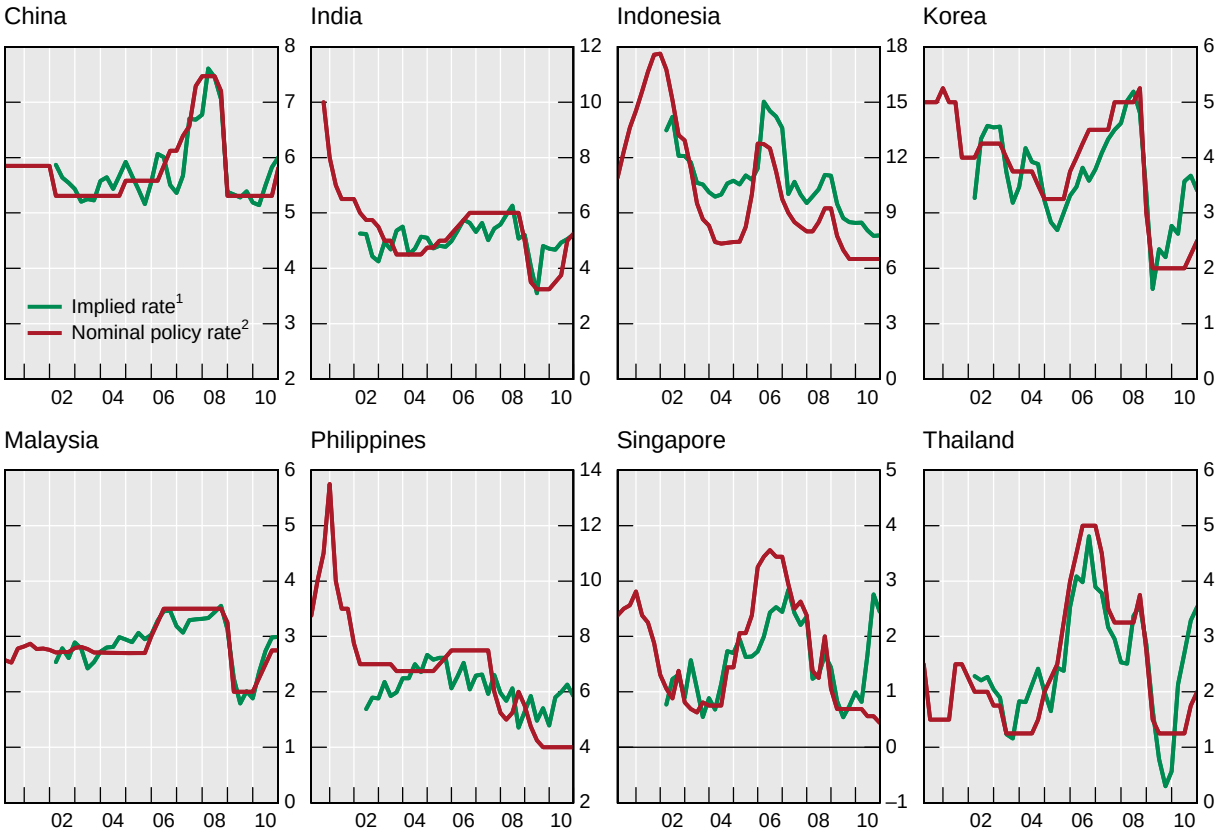
Of course these sorts of Taylor Rule estimations only show how policy at a particular point of time compares with what it would have been if the authorities responded to the objectives in the way they have done on average over the estimation period. But it suggests that, for most of these countries, recent policy settings as measured by an MCI are quite accommodative.

[19] If the exchange rate appreciation reflects stronger terms of trade (eg higher export commodity prices), it would not be appropriate to lower interest rates in order to keep the MCI stable. A higher MCI would be appropriate, and policymakers still have to make this judgment. Similarly, when the market delivers a lower exchange rate, it is not always appropriate to keep the MCI constant by raising interest rates.

Graph 13

Policy rates and those implied by the Taylor Rule

In per cent



[1] Fitted values of model $R_t = \alpha + \beta(\pi_{t-1} - \pi^T_{t-1}) - \gamma(y_{t-1} - y^*_{t-1}) + \mu f_t + \eta f_{t-1} + \varepsilon_t$, excluding the period Q1 2008 – Q3 2009 and previous crises. *R* is the nominal policy rate; π is the headline inflation rate; π^T is the inflation target for inflation targeting countries; the 5-year moving average of headline inflation is taken to be a proxy for the inflation objective in the other economies; *y* is output; y^* is the output trend estimated with a Hodrick-Prescott filter (smoothing parameter 1,600); *f* is the year-on-year nominal effective exchange rate change. [2] For China, one-year lending rate; for India, reverse repo rate; for Indonesia, one-month SBI rate; for Korea, overnight call rate; for Malaysia, overnight policy rate; for the Philippines, overnight reserve repo rate; for Singapore, three-month interbank rate; for Thailand, 14-day repo rate before 17 January 2007; overnight repo thereafter.

Sources: © Consensus Economics, Bloomberg; Datastream, national data.

4. *Macro-financial risks arising from possible misperceptions*

The choice of an intermediate exchange rate regime requires greater reliance on foreign exchange intervention both on the upside and the downside of the exchange rate pressure cycle. In the past decade, the appreciation pressures in Asian were symptomatic of emerging market economies experiencing strong economic growth. If the shocks hitting these economies are largely permanent, potential output grows quickly, and this calls for considerable credit expansion to finance the increased activity. This situation is consistent with upward trend in private credit in Graph 7 in the 2000s.

A more worrisome situation could arise if the supply shocks prove to be transitory but were thought to be permanent. In this case, a pickup in productivity growth would draw in capital flows and would boost bank lending and aggregate supply. The resulting growth in supply would help to hold down goods and services prices while at the same time to boost equity and housing prices. All this would tend to confirm a view that potential growth of the economy was on a higher trajectory in the short term. However, in the case where this higher trajectory is transitory and disappoints expectations, the additional credit growth and associated investment could prove to be considerably in excess. Depending on the extent of the

excesses, this credit cycle gone bad could lead to a collapse of confidence, a recession and a sudden stop of capital flows.

All this suggests that correlations between foreign exchange intervention and credit need not suggest imperfect sterilisation at all. The correlations could simply reflect a tendency for policymakers to assume that "this time it is different" and to put too much weight on the possibility that a run of good outturns is symptomatic of a permanently new trajectory of economic activity. Over the whole cycle, which admittedly can be long in the case of emerging market economies, this could lead to excessive debt accumulation domestically and to foreign investors, which can end badly. Emerging Asian economies must remain vigilant against this possibility.[20]

III. The costs of holding foreign exchange reserves in Asia

In the previous section, it was argued that it is possible for policy to influence the exchange rate to some degree and at the same time to maintain an independent monetary policy. Even though feasible, is it a good idea? One important consideration in this decision is the cost associated with holding these very large investments in foreign reserves – can the continued expansion be justified in terms of the costs and benefits? Arguably, these costs will play an increasingly important role in determining when to stop accumulating, and even when it would be appropriate to reverse current trends.[21]

The average running-cost ('quasi-fiscal costs' represented by the differential between domestic and foreign interest rates) of reserve-holding has been relatively modest over the past decade, and the benefits of substantial foreign reserve-holdings were demonstrable during the International Financial Crisis (especially for Korea, Malaysia and Indonesia). But this interest differential is only one component of the cost of reserve-holding: the central bank incurs a capital loss when the domestic currency appreciates, which has been the case for almost all these economies. Allowing for this, the cost of reserve-holding is roughly twice as large as the interest-differential measure of quasi-fiscal costs. A series of factors seem likely to raise the net cost of reserve-holding in the future, thereby raising questions about how much longer the current trends can be sustained.

Costs of reserve holding

The net cost of foreign exchange reserve-holding is usually measured in terms of the interest differential between the foreign-exchange-denominated reserve asset and the domestic funding cost (Graph 14). There are various ways of calculating this: simple interest differential; opportunity cost of funding; opportunity cost in terms of the marginal productivity of capital (Genberg et al (2005)). It could be done as an average of the various funding sources, or as the cost of the marginal (most expensive) funding source. For our purposes here it will be enough to compare a measure of the income on reserve holdings with the cost

[20] As Reinhart and Rogoff (2009) remind us, "Policymakers should not have been overly cheered by the absence of major external sovereign defaults from 2003 to 2009 after the wave of defaults in the preceding two decades. Serial default remains the norm, with international waves of defaults typically separated by many years, if not decades."

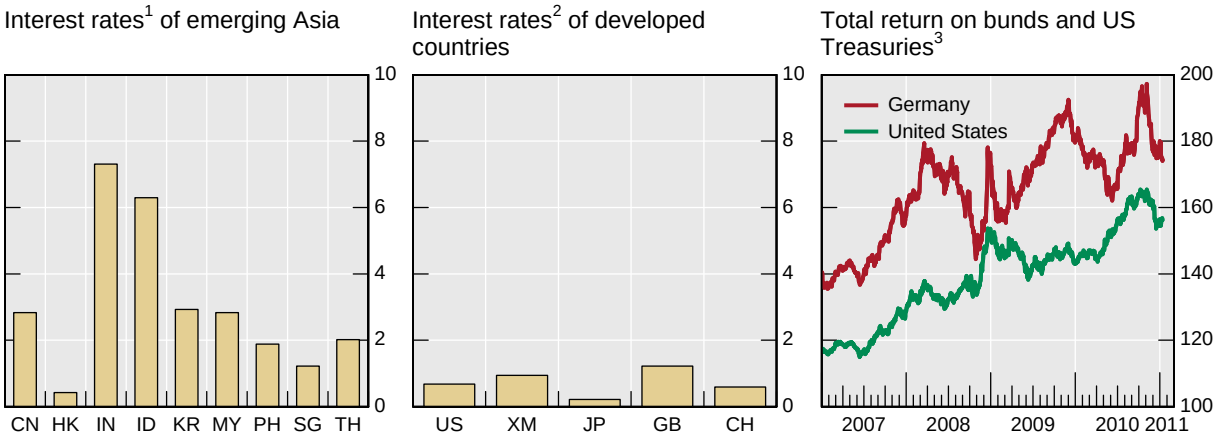
[21] While central banks in the West have typically seen domestic assets rising over time, the Swiss National Bank is an exception. In recent years, it has intervened in its foreign exchange markets and has amassed a large quantity of foreign exchange reserves. Danthine (2011) stresses that the losses associated with holding such reserves should be evaluated over the whole risk cycle. Nonetheless, significant losses in the short-term can raise questions of the appropriate degree of central bank independence.

of official debt.[22] For most countries in this group during the past decade, domestic interest rates have been historically low (reflecting in part the slow recovery from the 1997-8 Asian crisis). With the exceptions of India and Indonesia, the differential with foreign rates has been less than two percent.

Graph 14

Interest rates and total bond returns

In per cent / index



CH = Switzerland; CN = China; HK = Hong Kong SAR; GB = United Kingdom; ID = Indonesia; IN = India; JP = Japan; KR = Korea; MY = Malaysia; PH = Philippines; SG = Singapore; TH = Thailand; US = United States; XM = euro area.

[1] Latest observed yields of available three-month, six-month, one-year, five-year and 10-year government bills and bonds; weighted average based on amount issued in 2010. [2] Simple average of one-year to three-year government bonds. For Switzerland, average of one- and two-year bonds. [3] GBI global traded total return index level, seven-to-10 year, in US dollar terms; 2000–06 = 100.

Sources: Bloomberg; Datastream; JPMorgan Chase; national data; BIS calculations.

This, however, is an incomplete measure of the costs of holding reserves. If uncovered interest parity (UIP) held, this measure would overstate the cost where domestic interest rates were higher than the foreign interest return: the capital gains on holding the foreign assets would precisely offset the interest differential. While UIP clearly doesn't hold (see Engel (1996)), the capital gains/losses should be included in the calculation of the cost of reserve holding. In fact the lesson of the failure of UIP is that the high-interest currencies routinely depreciate substantially less than the UIP interest differential would imply, and often even appreciate.[23] The capital gains and losses should be taken together with the net interest cost in calculating the costs of maintaining foreign exchange reserves. Graph 14 (right hand panel) illustrates that in recent years low interest rates in the West have meant considerable capital gains on longer term bonds; of course, this will reverse as central banks normalise policy rates.

Table 4 shows the change in exchange rates over the past decade. The precise result depends on the period chosen, but the trend and broad message is clear enough: for most of

[22] As a rough measure of the financial opportunity cost of holding the foreign exchange assets: if the foreign exchange reserves had not been held, this debt could have been redeemed.

[23] The net of the interest differential and the exchange rate change have tended, for much of the time, to provide a positive return to those who held the high-interest currency. This has led to the popularity (and profitability) of the currency carry trade: borrowing in low interest currencies and holding high-interest currencies. In effect, building up official foreign exchange reserves puts the authorities in the recipient countries on the other side of the carry trade transactions: the authorities are borrowing in the high-interest-rate domestic currency which is usually appreciating (perversely for UIP) and holding assets in the low-interest currencies which are losing value.

the countries in this group, investing in USD loses around 2 percent per year, calculated in terms of the domestic currency of these countries.[24] For India and Indonesia, the capital appreciation cost has been smaller than the group average but the interest-differential cost has been higher. For the others (except for Hong Kong SAR with its fixed rate), taking into account the currency appreciation cost roughly doubles the overall cost of reserve holdings.

Table 4

Bilateral exchange rates versus the US dollar

	Percentage changes, end-2001 to latest[1]
CNY	21.53
HKD	0.21
IDR	16.18
INR	2.34
KRW	10.46
MYR	21.12
PHP	13.78
SGD	36.53
THB	41.50

[1] July 2010 for Indonesia; August 2010 for others.

Source: IMF IFS.

Capital losses of this nature do not limit the central bank's ability to intervene to restrain an appreciation and to sterilise the effect of that intervention, but they do cause asset-valuation losses which weaken their profit-and-loss accounts or their balance sheets. The capital losses on appreciations either diminish profits or are taken into the balance sheet in the form of reductions to reserves.

For most countries, the costs of reserve holding will impinge on the central banks' balance sheets which typically do not have large capital to absorb such losses, especially on an on-going basis. The dominant position of foreign exchange holdings on these balance sheets makes them susceptible to huge losses from currency appreciation: their balance sheets are much more vulnerable and fragile than would be permitted for a commercial bank.[25]

In all the countries of this group, the foreign exchange reserves are held by the central bank. Accounting conventions differ from institution to institution, but a bank applying IFRS should

[24] Behind these figures is a more fundamental story of structural change: most of these countries show trend appreciation in their real effective exchange rate (see BIS data), reflecting the Balassa-Samuelson structural effects of higher productivity. For those countries which have maintained low inflation, this is reflected in appreciating nominal exchange rates as well. For some countries (e.g. Indonesia, Hong Kong SAR), the real appreciation took the form of a faster rate of inflation, relative to the US. The outcome, in terms of cost of holding reserves, is reflected in a different form of cost: higher-inflation countries pay a larger interest-differential on their reserve holdings but experience a smaller capital loss.

[25] Ho and McCauley (2007) discuss central bank balance sheet losses from appreciation for three countries, including Korea and Thailand.

bring the capital losses associated with appreciation into its P&L each year.[26] The public reporting of the weakened P&L may diminish the central bank's reputation. Even when these losses are taken into revaluation reserves rather than brought into the P&L, currency appreciation reduces reserves and net capital.[27] If the central bank has to go to cap-in-hand to the Ministry of Finance and Parliament to approve capital replenishment, the reputational damage may be accompanied by weakening of independence.

The costs of reserve holdings are likely to rise in the future. First, the greater size of the foreign exchange reserves relative to GDP will increase costs. Second, the funding interest differential between domestic and foreign rates seems likely to widen, with interest rates in the reserve-currency countries likely to stay low for quite some time, while regional domestic rates are likely to rise as faster economic activity resumes: the differential will widen from the abnormally small levels seen over much of the past decade. A large inflow will be attracted by this wider interest differential, accelerating the accumulation. As well, there is the prospect of further up-grades from the credit-rating agencies, belatedly adjusting to the region's stronger prospects. Lastly, to the extent that exchange rates will unwind any existing undervaluation, this will make reserve holding more costly in terms of capital losses.

Benefits of reserves

Weighed against these net holding costs are the benefits of *precautionary reserves* and the *macro-benefits* from resisting an unwelcome appreciation.

There is a large literature on how much reserve holding is needed for precautionary purposes.[28] The usual measures are unsatisfactory.[29] A more useful approach would be to see what degree of reserve usage was practiced in those countries which came under pressure in the international financial crisis, with scenario-simulations replacing these arbitrary rules-of-thumb (Table A1). This sort of country-by-country stress testing might take into account the experience of Korea and Indonesia during the international financial crisis, when the market focused on (and was alarmed by) the *fall* in reserves rather than being

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[26] For discussion of cross-country information on the institutional settings for monetary, exchange rate and intervention policies, see Moser-Boehm (2005).

[27] As well, year-by-year variations in exchange rates can bring about distribution of capital gains, with depreciations of the domestic currency giving rise to foreign exchange revaluation gains which are recorded as profits and transferred to the budget. Subsequent appreciations impose losses which will diminish capital over time.

[28] Of course this intervention could be done through official foreign borrowing at the same time as the intervention (running up liabilities rather than running down assets). A number of these countries have, in fact, used the forward markets for intervention rather than draw on reserve holdings (see Graph A1). That said, most countries feel the need to have a substantial level of reserves ('in the shop window') to demonstrate their ability to intervene, and not all countries can be confident of being able to borrow under very adverse circumstances.

[29] Early criteria, relating reserves to months of imports, are much less relevant when the capital account provides much of the volatility in the balance of payments. Measures in terms of M2 seem to imply that all those holding domestic currency will seek to convert their currency holdings, whereas the experience is that this does not happen, even in severe crises such as the Asian financial crisis. The Guidotti/Greenspan ratio suggests that countries should hold reserves equal to all the foreign debt falling due over the next year. This might make sense in those countries (eg Latin America) where there are significant longer-term overseas borrowings, where this ratio is designed to enable the country to remain solvent even if borrowers cannot roll-over the foreign debt for a year. This metric, however, makes little sense in response to short-term capital inflows: it suggests, in effect, that the short-term inflow should be entirely used to build up foreign reserves, against the possibility that this same inflow proves to be volatile. Rather than the official sector taking on the risks associated with private short-term capital inflows in this way, there is a compelling logic to discourage this sort of inflow.

reassured by the substantial level of reserves still remaining. This might suggest that large reserve holdings are not a very effective way of providing support to market confidence.[30]

The macro-motivation for persistent intervention is harder to quantify analytically. There is certainly a perception that a significantly stronger exchange rate would restrain growth in the most dynamic part of the economy – the export sector – and there is some literature suggesting that the export-led strategy has been beneficial (Rodrik, 2008). There is also the example of Japan's 'lost decade/s', which many observers see as demonstrating (a least in part) the dangers of rapid exchange-rate appreciation under circumstances where other instruments to offset deflationary pressures are lacking. In an earlier era, Japan's experience during the Bretton-Woods period also supports the idea that an under-valued exchange rate is good for growth.

Against this, there is the near-inevitability of some structural appreciation over time, encapsulated in the ideas of the Balassa/Samuelson mechanism. As these countries close the technological gap with the mature countries over time, their equilibrium real exchange rates will appreciate. To resist this rise in the equilibrium rate is ultimately futile and expensive (in terms of the cost of reserve-holding, especially valuation losses) in the meantime.

The broad conclusion might be that these countries already have ample reserves and have no prudential reason to accumulate more. The macro-motivation is an on-going tread-mill: just to stay in the same place requires continuous (and probably increasing) accumulation. The further reserve holdings go above a broad notion of the necessary precautionary requirements, the more these reserve holdings have to find their justification in terms of investment returns and national-level portfolio diversification. For many of the countries of the region, there seem to be intrinsic factors which make reserve holding a poor investment. A four percent cost (reflecting a two percent interest differential plus a trend appreciation of two percent) combined with reserve holdings equal to half of GDP would result in a cost of roughly two percent of GDP per year. Whether this is calculated as a financial cost (as reflected in the central bank's balance sheet) or in terms of opportunity cost (the benefits which would have accrued had this investment been in a higher-return asset), the message is the same: large reserve holdings have serious macro implications. Whatever justifications there may be for current levels of reserve holdings, there are, for many of the countries in this group, serious questions raised by a continuation of current policies which will take reserves above levels which can be justified in terms of precautionary benefits.

IV. Towards a sustainable macroeconomic configuration

We noted above that the build-up in foreign exchange reserves has not yet caused serious financial pressures. The growth in credit has been seen by the authorities as benign, a position that has been supported by strong balance of payments and moderate inflation. But this situation is changing. In 2010-11, inflation pressures have been building significantly, in part because of the advanced stage of the Asian business cycle and in part because of the sharp rise in food and energy prices. And, a soft patch in global economic activity in 2011 has led to a marking down of the underlying momentum in the advanced and emerging market economies alike.

[30] This may suggest that multilateral sources (eg liquidity facilities available through the Chiang Mai Initiative and the International Monetary Fund and central bank swap arrangements) might be more effective, especially when viewed in combination with ample domestic foreign reserve assets.

Looking ahead, a continuation of these easing monetary policies seems neither desirable nor sustainable. With inflation now showing more clearly, substantially less monetary policy accommodation is needed in various jurisdictions in Asia to ensure price stability (Graph 13). But, these firmer monetary policies will likely intensify currency appreciation pressures and the current response – to resist this by accumulating foreign exchange reserves – will become increasingly costly and threaten the integrity of central bank balance sheets. More worrisome is the possibility that the substantial volume of 'lazy assets' (in the form of low-return sterilisation assets) on the balance sheets of the commercial banks gives these banks the incentive to lower credit standards and expand credit faster.

To the extent that foreign reserves serve a precautionary purpose, facilitating two-sided intervention which nets out over time, this is sustainable and presents no serious policy conflicts. Intervention in response to an exchange rate which is departing from equilibrium should prove profitable when the exchange rate returns to equilibrium. Variations around the equilibrium present an opportunity for central banks to make profits while at the same time stabilising the currency. This profit can offset the costs of reserve-holding. Examples of this sort of exchange rate management can be seen in Korea, Indonesia and Malaysia in 2008.

These examples are, however, the exception in the past decade. Most intervention has been predominantly on one side – to resist appreciation – hence the trend accretion in foreign reserves.

This does not necessarily imply that the best alternative is a free-floating exchange rate. Rather, it suggests that intervention should be based on an assessment of where the fundamental equilibrium exchange rate (FEER) might lie. This assessment in turn would be based on estimates of the sustainable current account position, and the capital flows which are the counterpart of this position. Of course the precise value of this FEER will be uncertain, so it might best be seen as a band or range, perhaps quite wide if the uncertainties are great.[31] The band should be wide enough to accommodate the expected changes in the equilibrium over the course of the business cycle (appreciating in the strong phase of the cycle, weakening in the trough). For countries with terms-of-trade cycles, the band might similarly be wide enough to accommodate the cyclical shift in the equilibrium exchange rate implied by the commodity-price cycle. The band might also appreciate gradually over time, to accommodate the Balassa/Samuelson effect, and be modified when evidence suggested that the equilibrium was not well-centred in the middle of the band.[32]

In this framework, the role of foreign reserve accumulation is clear and rule based. When the exchange rate approaches the edges of the band, there would be a presumption that intervention would occur. If the band is centred on the FEER, over time the interventions would be two-way, roughly symmetric, and profitable. This strategy requires that foreign reserves (under the 'precautionary' rationale) should be ample not just to fund the intervention, but also to support the intervention-credibility of the authorities. Of course, the costs of carrying these reserves on the central banks' balance sheet must be factored into the calculation, over the whole risk cycle.

This approach needs to be embedded in a broader macro-strategy which identifies what a sensible sustainable current account would be for the country. Current account surpluses

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[31] See Williamson's BBC proposals (Williamson (2000)).

[32] Detailed specification of this FEER strategy is not explored here. Within this approach, there is room for the edges of the band to be flexible, to be announced or unannounced. The key point here is that successful intervention requires some view on where the equilibrium exchange rate lies, and some ideas about the best tactics for effective intervention around this rate. When floating was seen as the best approach, there was no need to have a notion of what the equilibrium exchange rate might be. But, if a managed float is to make sense, assessments of the equilibrium are needed.

have been typical in the region over the past decade, perhaps still reflecting the disastrous vulnerability which external deficits demonstrated in the 1997-8 Asian crisis. But there is a powerful argument that capital should 'flow downhill' from the mature countries towards the greater productivity and profitability inherent in the emerging countries as they move towards the technological frontier. This implies a shift in current accounts in the direction of deficit, through an increase in investment (ie the savings/investment balance has to change). In this scenario, the exchange rate would be allowed to appreciate so that its level is consistent with this new, more sustainable current account configuration.[33]

Foreign capital flows need to match these current accounts if sustainability is to be achieved. While foreign capital shortages are part of the legacy mind-set of many policy-makers in the region, inflows are much more likely to be excessive.[34] The progressive shift towards the technological frontier gives the prospect of high productivity and profitability for some decades ahead. With closer global integration, foreign investors are increasingly responding to this underlying profitability differential.

How could these excessive inflows be constrained? This might require a range of capital account management approaches. There is now a greater readiness to accept some controls on capital inflows as being a legitimate part of the policy took-kit, especially when there controls are market-friendly (eg Chilean-style interest rate taxes) and focussed on short-term inflows, which probably provide the least benefit and greatest volatility risk. At the same time countries receiving excessive inflows might have to be prepared to see some of their asset prices rise above equilibrium. Such over-priced assets present foreign investors with a downside risk of reverting towards their lower equilibrium level, and thus might discourage further inflows. Asset prices in this category would include the exchange rate (thus the authorities might have to accept some degree of persistent overvaluation)[35], but would also include equity prices and commercial and residential property, especially those high-end developments favoured by foreign investors.

Conclusion

Our starting point might seem to be the same over most of the region – fast build-up of foreign exchange reserves as countries intervened to offset foreign capital inflows combined with rapid, perhaps excessive, credit growth. But closer examination suggests differences rather than commonality. Several countries have had capital outflows rather than inflows (with their foreign exchange accumulation reflecting big current account surpluses rather than capital inflows). While the reserve build-up is large for five of the countries, it is modest for the others. Credit growth is clearly faster than nominal GDP in several of the economies. The policy response also differs: most notably, two countries have monetary approaches which give policy no influence over interest rates, with the only effect on credit growth being via prudential policies and suasion.

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[33] The sterilisation of existing capital inflows is, in effect, a conscious avoidance of the real resource transfer which these financial flows potentially represent. An alternative policy would recognize the benefits of a higher level of investment (with both the funding and real resources coming from overseas). This alternative would also acknowledge that (China and India aside) rates of investment (and GDP growth) have been substantially lower since the Asian crisis of 1997-8. This different macro configuration would have more-appreciated exchange rates, current account deficits, larger investment and faster growth.

[34] This conclusion is consistent with the broad historical record for emerging market economies presented by Reinhart and Rogoff (2009).

[35] One classical motivation for a transitory exchange rate overshoot of this type is given by Dornbusch (1976). However, the transition may prove to be much longer-lived than in the conventional application of the model.

Yet a common message does come out of this exploration. All these countries now have foreign exchange reserve levels which are adequate or more than adequate (in some cases, much more). While these countries have, in general, been able to sterilise the impact of foreign exchange reserve build-up, they do not seem to be able to use the interest-rate setting vigorously enough to impinge on the demand for credit when it is growing strongly. They are in transition, not only in their financial sectors, but in their monetary policy. Control over reserve money growth is no longer an effective fulcrum for constraining the growth of bank balance sheets, but they have not yet put in place the full institutional backing (including one that addresses the political economy constraints) for operating monetary policy through interest rates.

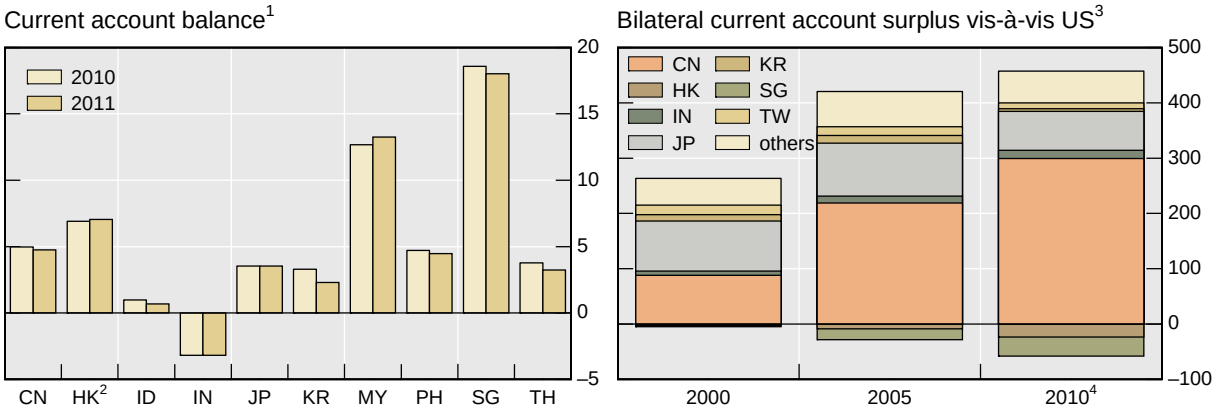
Foreign exchange reserve levels in many emerging Asian economies are now at levels which raise important policy questions about the return on this national investment in foreign reserves. With the possible exception of China, all these countries would seem to benefit from allowing the real resource transfer corresponding to capital inflow to occur to a greater extent (i.e. to move the current accounts in the direction of deficit), using the extra real resources for investment. This investment is likely to be more socially beneficial than the current alternative of holding low-return foreign reserve assets.

This provides the starting point of an overall macro-response. Current accounts moving towards deficits (with higher investment and faster GDP growth) point to more appreciated exchange rates. This does not require abandoning the successful policy, over the past decade, of managing the exchange rate to achieve stability and prevent a disruptive pace of appreciation. If the authorities are managing the exchange rate so that it is somewhere near the equilibrium consistent with a sustainable current account position, the Impossible Trinity would not be violated. Pressures on this strategy may come from excessive capital inflows, but these can be addressed by accepting some over-valuation of assets, together with active discouragement of short-term capital inflows.

Finally, even though this paper has focused on the issues in emerging Asia, the actions taken by policymakers in the region have significant implications for the global economy. Graph 15 highlights the fact that current account surpluses in general have been large and in particular substantial and growing with the United States. One issue that we have not addressed in this paper is whether the prolonged and large-scale foreign exchange intervention strategy followed in Asia has effectively worked against the inherent features of the international adjustment mechanism to promote an orderly resolution to global imbalances. To fully understand this important issue, policy spillovers from both sides have to be evaluated. While Asia has certainly pursued exchange rate regimes based on heavy intervention, the West has pursued policies (eg quantitative easing and fiscal deficits) that arguably destabilised the global macroeconomic environment and pushed capital flows into the dynamic emerging market economies. From this perspective, the exchange rate regimes adopted in Asia may be a second best approach to address these global frictions.

Graph 15

Current account imbalances in Asia



CN = China; HK = Hong Kong SAR; ID = Indonesia; IN = India; JP = Japan; KR = Korea; MY = Malaysia; PH = Philippines; SG = Singapore; TH = Thailand; TW = Chinese Taipei.

[1] Surplus as a percentage of GDP; Consensus Economics and IMF estimates. [2] Goods and services balance. [3] In billions of USD. [4] 2010 Q4 estimates are average of 2010 Q1-Q3.

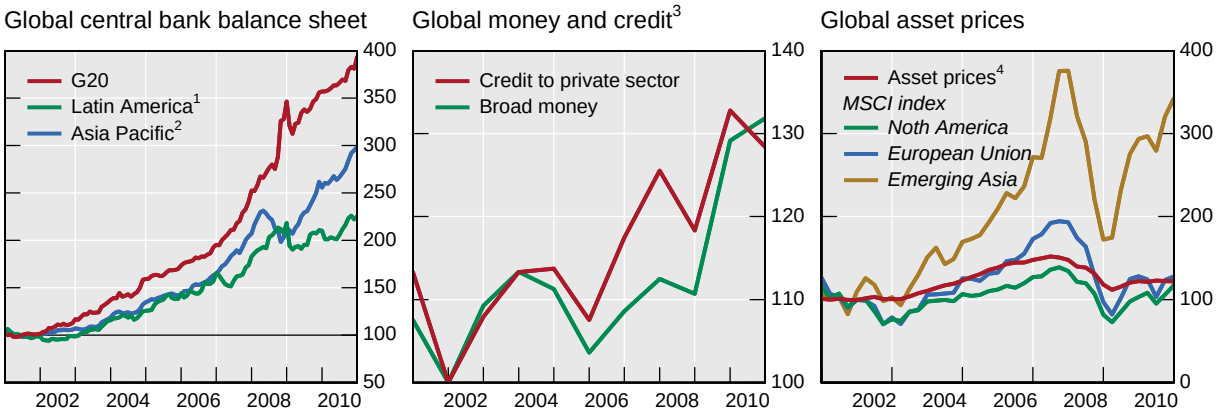
Sources: Consensus Economics©; IMF *IFS*; IMF *WEO*; national data.

In addition, we have not addressed the potentially important implications of a simultaneous surge in central bank balance sheets globally, as was highlighted in Graph 1. While it appears that Asian central banks have been able to sterilise the impact of foreign exchange interventions on domestic inflation, one has to wonder whether the accommodative monetary policy in Asia and that in the West may be contributing to a surfeit of global liquidity that is finding its way into asset prices and, in 2011, into a surge in commodity prices and in generalised inflation in some economies (Graph 16). The trends in central bank balance sheets also may play a significant role in driving the prices in international financial markets. What might be the implications of a significant shift in the trend of foreign asset accumulation going forward? Such issues deserve further exploration.

Graph 16

Global dimensions

2001 = 100



[1] Chile, Columbia, Peru and Venezuela. [2] Hong Kong SAR, Malaysia, New Zealand, Philippines, Singapore and Thailand. [3] As a percentage of GDP; aggregate of G20 and economies listed at footnotes 1 and 2. [4] An index represents equity price, residential property price and commercial property price; weighted average of Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, United Kingdom and United States based on 2005 GDP and PPP exchange rates.

Sources: IMF *IFS*; IMF *WEO*; national data.

Annex

Table A1

Foreign reserve adequacy[1]

Outstanding year-end reserves position

	In billions of US dollars			As a percentage of quantity indicated							
				GDP	3-month Imports	Short-term external debt[2]			Broad money		
	96	08	10[3]	10[3]	10[3]	96	08	10[3]	96	08	10[3]
Australia	14	29	42	3	89	21	15	15	4	4	3
China	105	1946	2761	49	852	376	1868	1147	11	28	26
Hong Kong SAR	63	178	261	116	283	36	189	226	19	22	28
India	20	247	269	19	351	260	338	235	11	27	20
Indonesia	18	49	86	13	310	51	174	201	15	30	33
Japan	207	1003	1042	19	665	...	264	199	4	12	11
Korea	33	200	287	29	278	45	172	171	6	19	19
Malaysia	26	91	102	47	288	226	402	457	20	35	29
New Zealand	6	11	15	12	222	61	55	93	25	26	31
Pakistan	1	7	13	8	169	19	343	617	2	12	20
Philippines	10	33	53	28	378	121	406	364	26	43	52
Singapore	77	174	218	101	293	44	150	184	73	75	69
Thailand	37	108	162	52	387	80	998	1169	18	38	42
Memo:											
Asia[4]	*617*	*4076*	*5310*	*38*	*351*	*...*	*413*	*391*	*18*	*29*	*30*
Latin America[5]	*142*	*440*	*545*	*13*	*345*	*145*	*362*	*270*	*77*	*53*	*...*
Central Europe[6]	*40*	*133*	*180*	*25*	*193*	*383*	*171*	*258*	*39*	*33*	*38*
Other[7]	*29*	*513*	*564*	*17*	*390*	*59*	*272*	*379*	*19*	*42*	*36*

[1] For the outstanding year-end position, regional aggregates are the sum of the economies listed; for percentages, simple averages. For 2009, latest available data. [2] Consolidated cross-border claims to all BIS reporting banks on countries outside the reporting area with a maturity up to one year plus international debt securities outstanding with a maturity of up to one year. [3] Latest available data. [4] Economies shown above. [5] Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela [6] The Czech Republic, Hungary and Poland. [7] Russia, South Africa and Turkey.

Sources: IMF; Datastream; national data.

Table A2

Central bank total assets

	In billions of USD		As a percentage of quantity indicated							
			GDP		Currency held by the public		M2[1]		Bank credit[2]	
	01	10[3]	01	10[3]	01	10[3]	01	10[3]	01	10[3]
Australia	32	73	8	6	217	165	12	6	10	5
China	516	3680	39	63	272	591	27	35	35	48
Hong Kong SAR	105	259	63	114	811	943	27	35	42	63
Indonesia	60	97	38	15	817	457	74	43	209	66
India	86	340	18	21	180	179	31	27	63	43
Japan	892	1510	24	27	181	174	12	12	21	25
Korea	123	326	25	34	867	1168	35	45	31	33
Malaysia	39	106	42	52	679	949	31	37	33	52
New Zealand	6	23	12	16	675	895	14	18	11	11
Philippines	20	56	28	30	524	718	45	54	79	169
Singapore	79	227	93	98	1232	1343	81	74	79	97
Thailand	46	142	39	48	477	678	34	42	41	51
Memo:										
Euro area	*718*	*2490*	*12*	*21*	*285*	*230*	*17*	*23*	*11*	*15*
United Kingdom	*71*	*388*	*5*	*17*	*190*	*562*	*4*	*9*	*4*	*8*
United States	*680*	*2377*	*7*	*17*	*111*	*263*	*9*	*21*	*13*	*30*

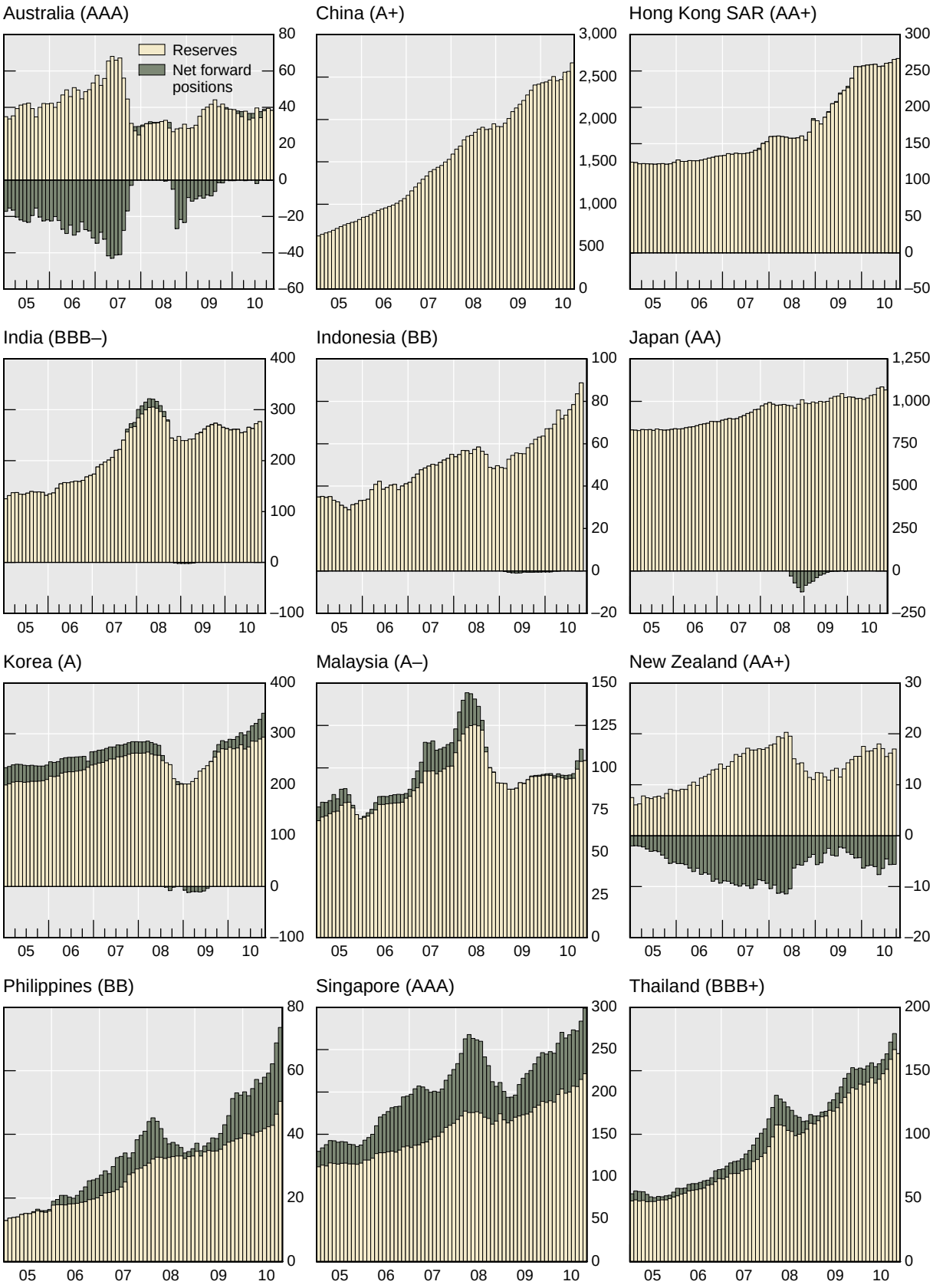
[1] Money plus quasi money. [2] Bank credit to private sector. [3] Latest available data.

Sources: IMF; national data.

Graph A1

Foreign exchange reserves[1] and net forward positions[2]

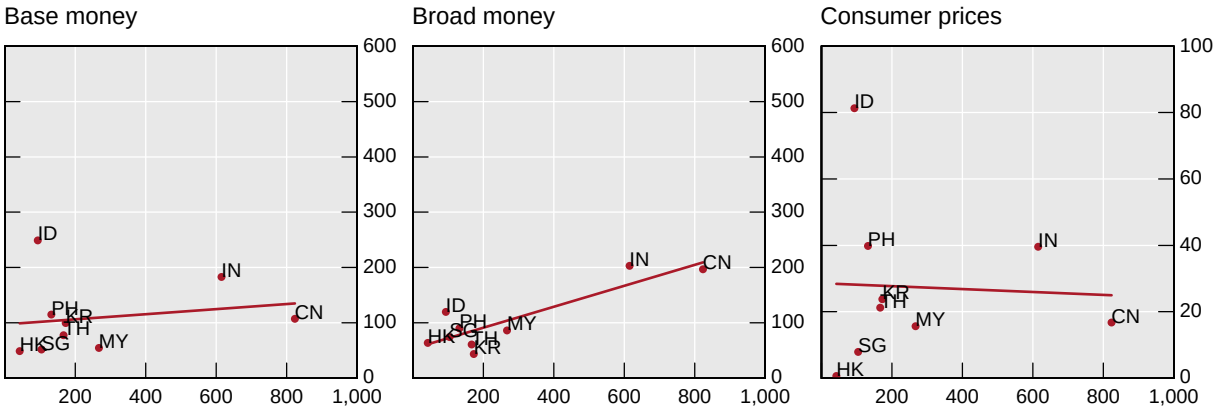
In billions of US dollars



Graph A2

Growth of foreign exchange reserves relative to the growth of money and consumer prices[1]

2001 – 07; in per cent



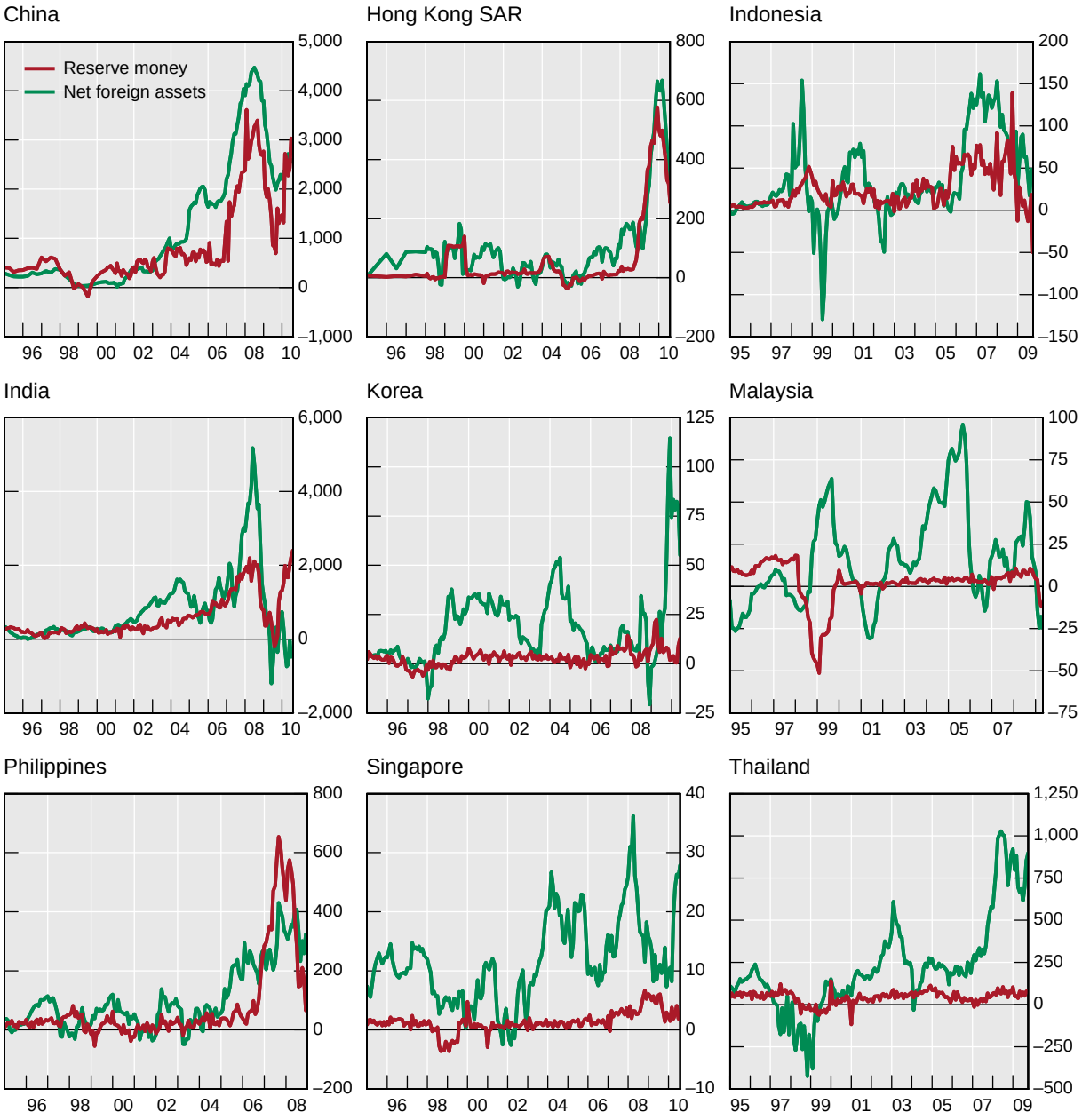
[1] The horizontal axis show change in foreign exchange reserves; the vertical axis represents the change in the variables shown at the panel title.

Sources: Datastream; IMF *IFS*; national data.

Graph A3

Reserve money and net foreign assets, by economy

Annual changes, in billions of local currency[1]



1 For Indonesia and Korea, trillions of local currency.

Sources: IMF IFS.

References

Adrian, T, and H Shin (2009): Financial intermediaries and monetary economics, *Federal Reserve Bank of New York Staff Report*, No 398.

Aizenman, J (2010): The impossible trinity (aka the policy trilemma), *Encyclopedia of Financial Globalization*.

Aizenman, J, and R Glick (2008): Sterilization, monetary policy, and global financial integration, *mimeo*.

Aizenman, J, M Chinn and H Ito (2008): Assessing the emerging global financial architecture: measuring the trilemma's configurations over time, *NBER Working Paper,* No 14533, December.

Amato, J, A Filardo, G Galati, G von Peter and F Zhu (2005): Research on exchange rates and monetary policy: an overview, *BIS Working Papers*, No 178, June.

BIS (2009): Capital flows and emerging market economies, Report submitted by a Working Group established by the Committee on the Global Financial System, *CGFS Papers*, No 33.

BIS (2010): *80th Annual Report*, Basel, June.

Borio, C, and P Disyatat (2009): Unconventional monetary policies: an appraisal, *BIS Working Papers,* No 292.

Borio, C, J Ebbesen, G Galati and A Heath (2008a): Foreign exchange reserve management: elements of a framework, *BIS Papers,* No 38.

Borio, C, G Galati and A Heath (2008b): Foreign exchange reserve management: trends and challenges, *BIS Papers*, No 40.

Borio, C, and H Zhu (2008): Capital regulation, risk-taking and monetary policy: a missing link in the transmission mechanism?, *BIS Working Papers*, No 268.

Calvo, G (1991): The perils of sterilization, *IMF Staff Papers, Vol 38*, No 4, pp 921 – 926.

Chai-Anant, C, and C Ho (2008): Understanding Asian equity flows, market returns and exchange rates, *BIS Working Papers*, No 245.

Chung, K (2009): Household debt, the savings rate and monetary policy: the Korean experience, *BIS Papers*, No 46.

Cline, W R, and J Williamson (2010): Estimates of fundamental equilibrium exchange rates, *Peterson Institute of International Economics Policy Brief*, No 10-15.

Danthine, J-P (2011): Market developments, Swiss monetary policy and foreign exchange reserve management, Introductory Remarks at the half-yearly media news conference, http://www.bis.org/review/r110628c.pdf?frames=0, June.

Disyatat, P (2010): The bank lending channel revisited, BIS Working Papers, No 297.

Dornbusch, R (1976): Expectations and exchange rate dynamics, *Journal of Political Economy*, December.

Endut, N, and T G Hu (2009): Household debt in Malaysia, *BIS Papers*, No 46.

Engel, C (1996): The forward discount anomaly and the risk premium: a survey of recent evidence, *Journal of Empirical Finance, Vol 32*, pp 305–319.

Fischer, S (2001): Exchange Rate Regimes: is the bipolar view correct?, *Journal of Economic Perspectives, Spring.*

Genberg, H, R McCauley, Y C Park and A Persaud (2005): Offical reserves and currency management in Asia: myth, reality and the future, *Geneva Reports on the World Economy 7*.

Glick, R, and M Hutchison (2008): Navigating the trilemma: capital flows and monetary policy in China, *Federal Reserve Bank of San Francisco Working Papers*.

Hauner, D (2005): A fiscal price tag for international reserves, *IMF Working Papers* 05/81.

Hauner, D (2006): A fiscal price tag for international reserves, *International Finance 9:2,* pp 169–195.

He, D, F Leung and P Ng (2009): A framework for monitoring capital flow in Hong Kong, *HKIMR Working Paper* 16/2009.

Ho, C, and R McCauley (2007): Resisting appreciation and accumulating reserves in Asia: examining the domestic financial consequences, *BIS papers*.

Hutchinson, M, R Sengupta and N Singh (2010): India's trilemma: financial liberalisation, exchange rates and monetary policy", unpublished manuscript, August.

Ma, G, X Yan and X Liu (2011): China's reserve requirements: practices, effects and implications, unpublished BIS working paper, August.

McCauley, R (2007): Assessing the benefits and costs of official international reserves, in Bakker, A (ed) *Central bank reserve management*.

McCauley, R, and G Ma (2008): Resisting financial globalisation in Asia, *Bank of Thailand International Symposium 2008*.

Mohanty, M, and P Turner (2006): Foreign exchange reserve accumulation in emerging markets: what are the domestic implications?, *BIS Quarterly Review,* September.

Montoro, C, and R Moreno (2011): The use of reserve requirements as a policy instrument in Latin America, *BIS Quarterly Review*, March.

Moser-Boehm, P (2005): Governance aspects of foreign exchange interventions, foreign exchange market intervention in emerging markets: motives, techniques and implications, *BIS Papers*, No 24.

Ouyang, A, R Rajan and T Willett (2007): Managing the monetary consequences of reserve accumulation in emerging Asia, *HKIMR Working Paper*, No *20/2007*.

Reinhart, C, and K Rogoff (2009): *This time is different: eight centuries of financial folly*, Princeton University Press.

Rodrik, D (2008): The real exchange rate and economic growth.

Stella, P (1997): Do central banks need capital? *IMF Working Papers*, No *97/83*.

Subhanij, T (2009): Household sector and monetary policy implications: Thailand's recent experience, *BIS Papers,* No 46.

Turner, P (2011): Fiscal dominance and the long-term interest rate, *LSE Financial Markets Group Special Paper Series* no 199, May.

Williamson, J (2000): *Exchange rate regimes for emerging markets: reviving the intermediate option*, Institute for International Economics (Washington).