Key facts on central bank balance sheets in Asia and the Pacific

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1. Introduction

Central bank balance sheets in emerging Asia have been expanding rapidly over the past decade. Most of the increase is accounted for by the unprecedented rise in foreign reserve assets. Some of this expansion reflects efforts to bolster buffer stocks of reserves in the aftermath of the Asian Financial Crisis in the late 1990s. Increasingly over the past decade, however, the reserve accumulation has been the by-product of monetary policy frameworks focused on resisting exchange rate appreciation. The funding of this asset accumulation across the region has been diverse, including extensive use of required and excess reserves, and the issuance of central bank paper.

This paper briefly lays out the key facts and policy issues associated with the expansion of central bank balance sheets in Asia and the Pacific, drawing extensively on the research done in the BIS Asian Office over the past year. Section 2 highlights the salient trends in both central bank assets and liabilities, and the various central bank policy challenges. Section 3 discusses some of the risks that the expansion of central bank balance sheets may pose for the region. Section 4 notes the implications of expanding central bank balance sheets for debt management, briefly revisiting the traditional debate about the potential conflict between central banks and debt managers. Finally, section 5 highlights the initial progress being made to introduce central bank balance sheets into conventional monetary policy models.

2. Expanding central bank balance sheets

The expansion of central bank balance sheets in Asia and the Pacific has been unprecedented (Graph 1). While China has been the single largest contributor to this regional trend, the trend has been widely present across emerging market economies in Asia.

Of course, part of the expansion is consistent with the fundamental role of central banks in accommodating secular increases in currency demand fuelled by rapid economic growth. But the massive expansion goes well beyond currency demand. It is also important to note that the size of central bank balance sheets in Asia today as a percentage of GDP is far greater than in the advanced economies (Annex, Table A1).

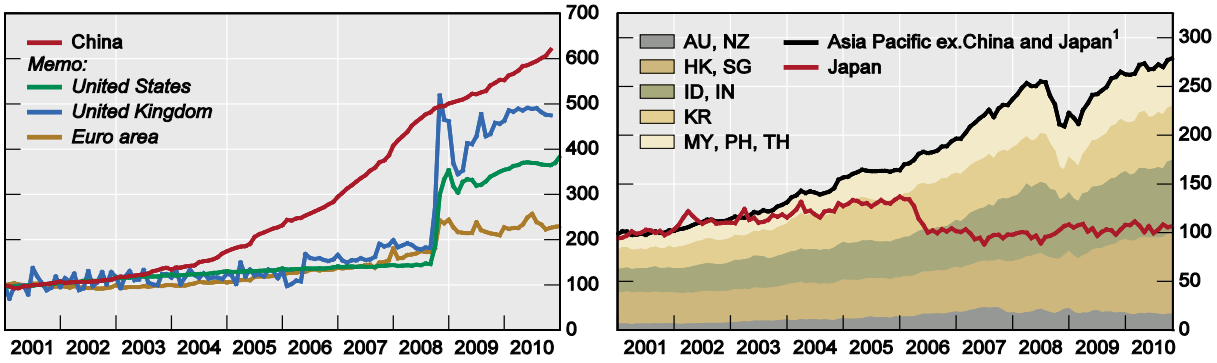
There is a temptation to conclude that the mere fact that central bank balance sheets are unprecedentedly large translates into clear and present policy dangers. But it is important to note that the underlying policy frameworks, rather than the outcome in terms of balance sheets per se, are the source of policy risks. So one might ask, when thinking about policy risks, what the role of central bank balance sheets is. In other words, how should we view central bank balance sheets?

First, central bank balance sheets are a means to policy ends. They represent the available financial resources with which central banks pursue their policy objectives. In this sense, the special nature of central bank balance sheets gives central banks the unique ability within the broader government sector to take on such policy mandates as lender of last resort status and price stability. And since the beginning of the International Financial Crisis, there has

been greater awareness of the potential role that central banks have in using their balance sheets in crisis resolution (eg through large-scale asset purchase programmes).

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: IMF, International Financial Statistics; national data.

Second, the size and structure of central bank balance sheets can provide useful information about policy risks – especially when assessing the unintentional consequences of policies. The sheer size of a central bank's balance sheet can signal potential imbalances in the macroeconomy and financial system, regardless of the particular policies driving the burgeoning balance sheets. The imbalances arise because the financial sector's balance sheets are the natural counterparts to that of the central bank. In other words, the size and structure of a central bank balance sheet can provide a valuable bird's eye view of growing risks across the financial system; in contrast, focusing narrowly on the marginal impact of central bank actions on a policy-by-policy basis may be misleading. Traditionally, inflation risks have been thought to be correlated with central bank balance sheet size. Now we need to add financial stability risks to this perspective. And just as central bank balance sheets may alert us to risks in the economy as they are arising, they also provide a key input for designing exit strategies from current policies.

Central bank assets and liabilities: the facts

The assets and liabilities of a central bank differ from those of private sector banks. A simplified central bank balance sheet is shown 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 accumulated profits and losses as well as transfers of resources from the government.

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

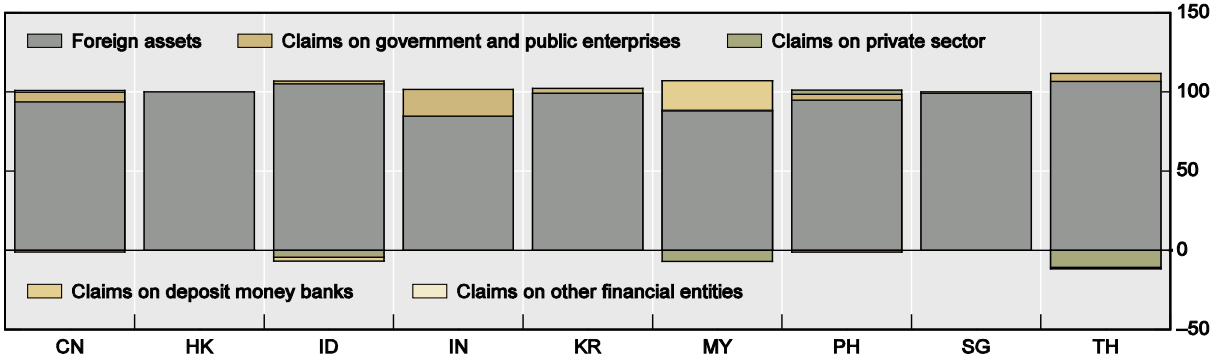
Assets

In emerging Asia, the remarkable increase in central bank assets has been dominated by growth in net foreign assets (Graph 2), with most of the accumulation of foreign assets being in US-dollar-denominated bonds.

Graph 2

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;

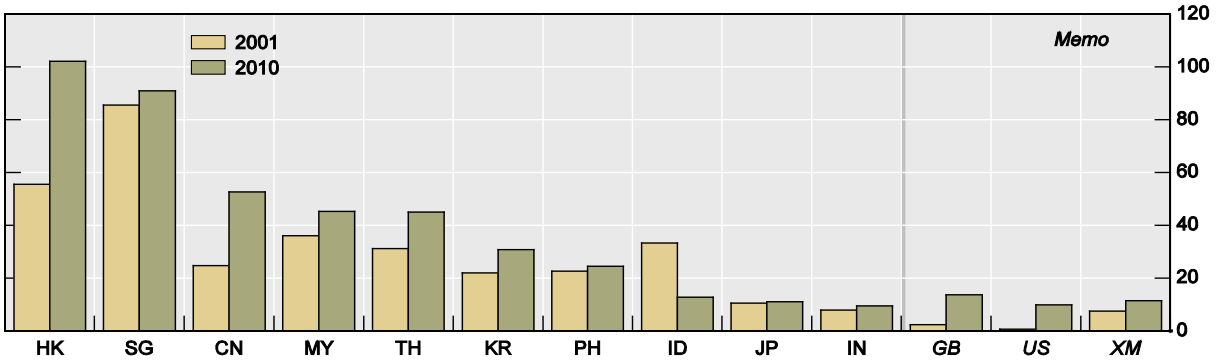
Source: IMF, International Financial Statistics.

After a decade or more of these policies, many economies are sitting on large foreign exchange reserve holdings. Singapore and Hong Kong SAR, for example, have reserves of around 100% of GDP; China, Malaysia and Thailand have reserves equal to around half of GDP. To put these figures in perspective, the ratios are far in excess of the pre-crisis ratios in the advanced economies, and exceed the advanced economy ratios even now, after the substantial expansion of their balance sheets during the crisis (Annex, Table A1).

Graph 3

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.

Some policymakers point out to their critics that the rapid accumulation of foreign exchange reserves has not always been one-sided (Graph 4). Some central banks experienced a sharp transitory reduction during the international financial crisis. 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. Thus, even though the growth in foreign assets has been large and mainly one-sided over the past decade, there is some openness to running down assets when there are depreciation pressures. An open question is whether the accumulation/decumulation process will be more symmetric going forward.

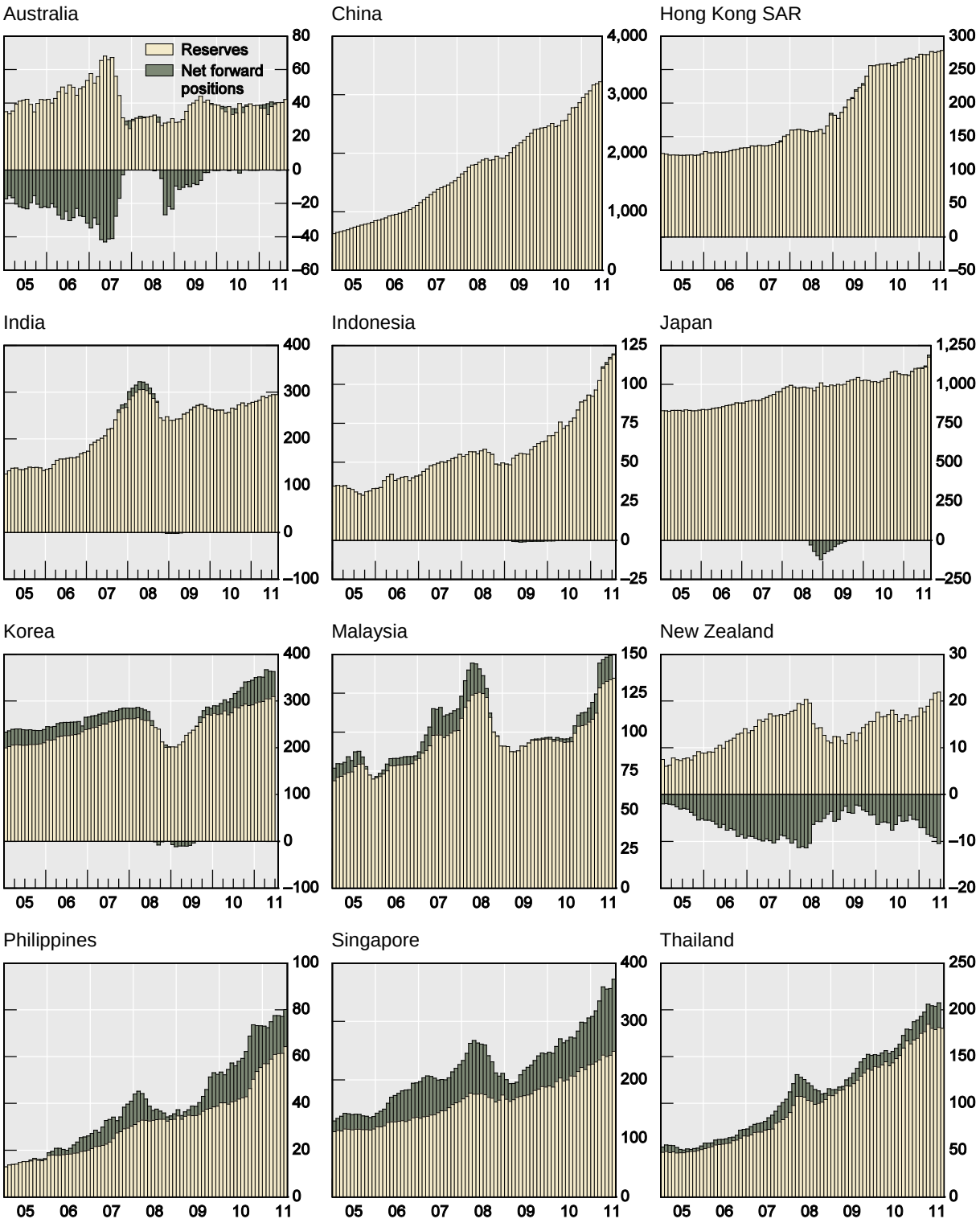
The policy factors driving the expansion in the region have changed over time. Early in the post-Asian crisis period, Asia-Pacific policymakers took to heart the importance of having a sufficient war-chest of reserves that could be used in the event of a run on the currency. Reserve adequacy also helped 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, thus influencing the cost of local currency borrowing.

By the second half of the 2000s, however, Asia as a whole was seen as having ample reserves, based on conventional import and external debt metrics (Annex, Table A2). With adequate reserves, the further accumulation of reserves was primarily motivated by the policy aim of resisting exchange rate appreciation. Again, economic history in the region weighed on the minds of policymakers. One of the central lessons of the Asian Financial Crisis in the late 1990s was that fixed exchange rates are hard to defend in the face of large volatile foreign capital flows and substantial changes in sentiment. But authorities did not accept the argument that those countries which could not credibly peg indefinitely should float freely. Instead, with the notable exception of Hong Kong SAR's currency board, many policy makers sought out the middle ground of a managed float. While there were times of heavy intervention to resist sharp depreciations, notably in Korea and Indonesia during the recent international financial crisis, the more typical mode has been 'leaning against the wind' in the face of appreciation pressure, which helps to account for the trend of foreign reserves accumulation.

Graph 4

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

In billions of US dollars



[1] Official reserves excluding gold, in billions of US dollars. Includes SDRs and reserve positions in the IMF. [2] Long positions in forwards, and futures in foreign currencies vis-à-vis the domestic currency, minus short positions.

Sources: IMF, International Financial Statistics; IMF, International Reserves and Foreign Currency Liquidity; national data.

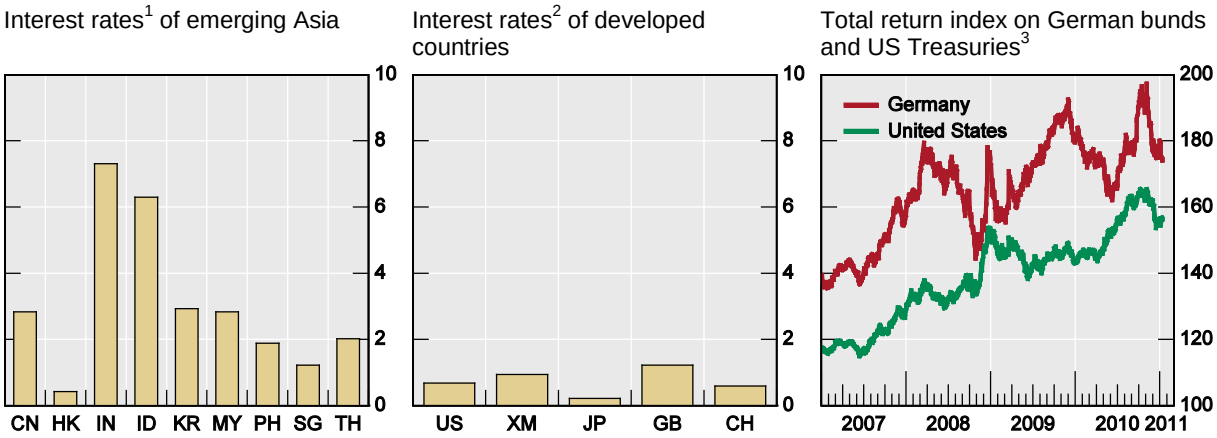
Finally, the return on the foreign currency assets on central bank balance sheets has been low (Graph 5). These foreign assets, dominated by US and euro fixed-income instruments, have relatively low yields in a global sense. In recent years the decline in yields in the US has led to paper gains on a mark-to-market basis. Going forward, however, if the securities are held to maturity, the paper gains will be offset by lower future returns.

In addition, the domestic currency return on such foreign-currency-denominated assets is influenced by swings in the exchange rate. Appreciation of domestic currencies lowers the effective return and can even result in losses. Questions remain about the policy importance of such losses when the reserves are being held primarily to protect against sudden stops and rapid currency depreciations in the future.

Graph 5

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.

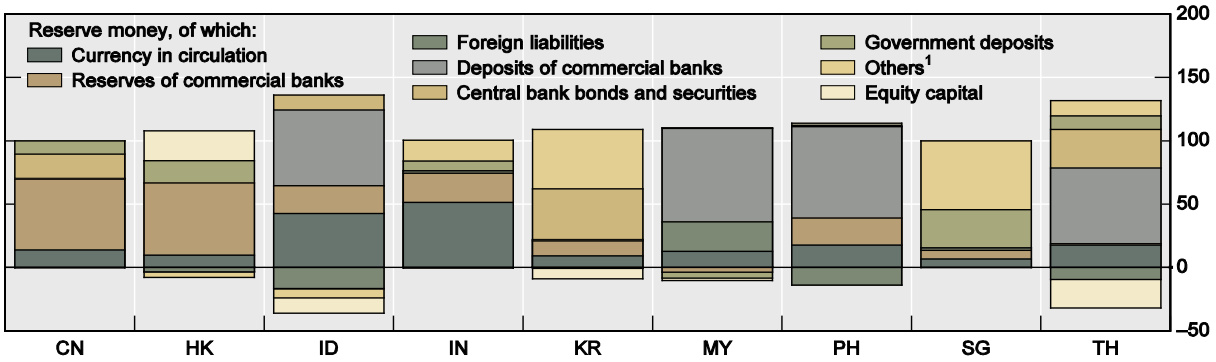
Liabilities

The liability side of a central bank's balance sheet provides insight into the selection of central bank policy instruments that have been used to finance the purchase of the foreign reserve assets (Graph 6, and Annex, Table A3). The impact of the liability-side expansion of Asian central bank balance sheets has been more diverse across the region than the impact of the asset side. Though it is difficult to generalise, the choice of liabilities across economies reflects two factors: historical reliance on particular policy tools in each jurisdiction, and the relative cost of each tool in the policymaker's toolbox.

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, International Financial Statistics.

First, let us briefly review the diverse trends. 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 is partly due to the growth in commercial bank deposits with central banks as financial systems deepen. 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 and the use of deposit facilities at central banks also show up significantly. Changes in government deposits are an additional important explanatory variable 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.

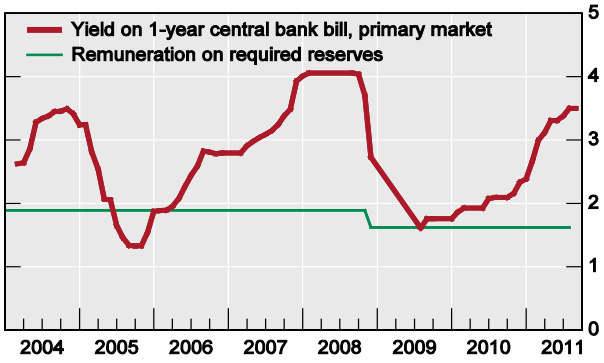
Second, the diverse trends reflect the historical use of particular tools in a given jurisdiction and the relative costs of the various tools in the toolkit. For example, two instruments that are used heavily in Asia are required reserve ratios and issuance of sterilisation securities. These tools have different costs and benefits that determine their attractiveness. Compared with central bank securities, required reserve ratios tend to remove liquidity from the banking system on a more permanent basis and are typically low-cost tools for the central bank because either little or no interest is paid. However, the below-market interest rate acts as a tax on domestic banks. One concern is that this increases incentives to borrow in the unregulated shadow banking system. A related concern is that high-quality borrowers are the most likely to find alternatives to banks as sources of funding, precipitating a decline in the credit quality of banks' loan portfolios. In the case of China, as the interest costs of sterilisation bonds have risen, the reliance on low-yielding reserve requirements has increased, as Ma, Yan and Liu (2011) discuss (Graph 7).

Another option for central banks in Asia is to sell off their domestic bond holdings in open market operations. However, the limited size of domestic bond markets provides a disincentive to sterilise the large accumulation of foreign reserve assets. Paying interest on excess reserves is also a possibility. However, the interest costs could be quite high owing to the large amounts of liquidity to be drained, and fine-tuning operations using excess reserves are more difficult than those based on issuing central bank bills.

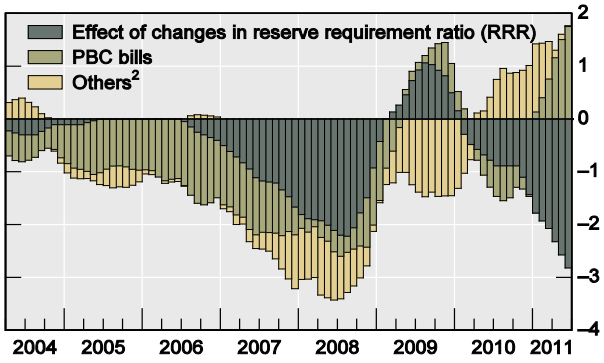
Graph 7

Sterilisation tools and costs in China

PBC bills yield and remuneration on required reserves (in per cent)



Liquidity withdrawal (–) or injection (+), by sterilisation tool[1]



[1] Components of net domestic assets; year-on-year change of three-month moving average; in trillions of RMB; positive (negative) indicates injection (withdrawal) of liquidity. [2] Net domestic assets other than effect of changes in RRR and PBC bond issue.

Source: Ma, Yan and Liu (2011).

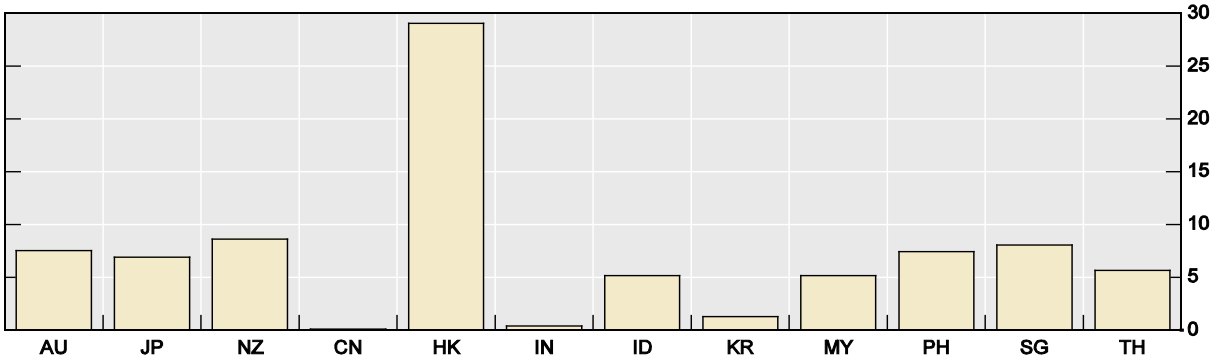
Equity capital

Central bank equity issues have taken on increased importance in recent years. In part, central banks have faced balance sheet losses owing to appreciating currencies and because of taking on quasi-fiscal costs. These losses have eaten into central banks' equity capital buffers, raising questions about how best to replenish capital (Graph 8). The greater emphasis on private sector capital adequacy naturally raises the question of what capital standards central banks should be subject to. While much of this discussion goes beyond the scope of our conference, these central bank financing issues may take on increasing importance in future.

Graph 8

Central bank equity, 2010

As a percentage of total assets



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

Sources: IMF, International Financial Statistics; national data.

A critical policy issue is whether a central bank retains its ability to act if it has negative equity. Both in theory and in practice, the answer is yes. Central banks are very different institutions to private sector banks, primarily because central banks cannot be illiquid, given

their ability to print money. This does not mean that negative equity positions over the long term do not create problems. Issues of credibility and loss of central bank independence cannot be ruled out. These possibilities suggest that there is a premium on central bank governance designs that put funding rules in place to ensure that a central bank has a sound recapitalisation plan and other indemnities from the general government to prevent the perception that short-term, opportunistic pressures might influence central bank policy decisions.

3. Macroeconomic and financial stability risks

The expansion of central bank balance sheets in the region raises concerns about three types of risks: inflation risks, financial stability risks, and credibility and independence risks. We briefly highlight each of these in turn.

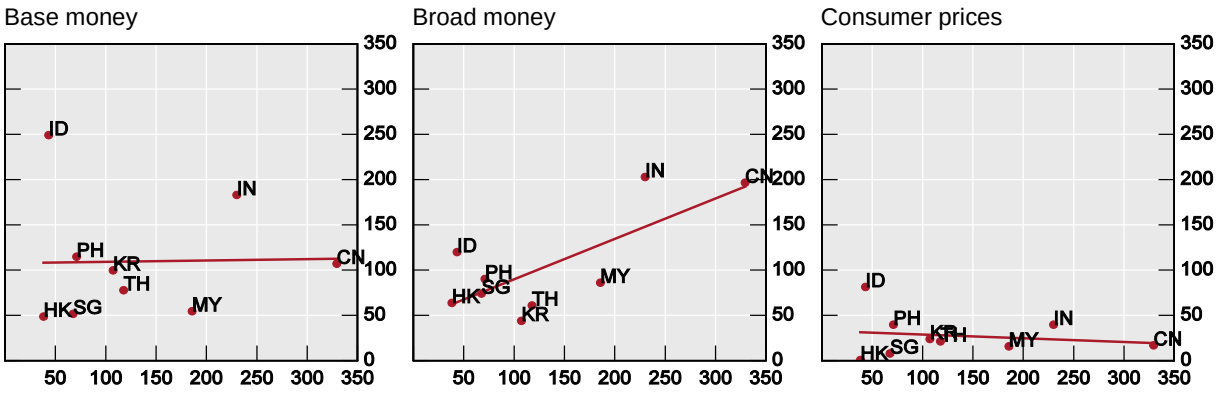
Inflation risks. Traditionally, the rapid expansion of central bank balance sheets has gone hand-in-hand with the growth of the monetary aggregates. This additional liquidity in the economy served as stimulus that eventually pushed inflation rates higher.

In emerging-market economies, central banks could reduce the chances of such an outcome if they sterilised foreign exchange purchases by draining reserves from the financial system. In this way, Asian central banks have been able to control inflation despite the massive accumulation of foreign reserve assets. Graph 9 shows that there has so far been little correlation between base money growth, broad money growth and consumer prices. It is also important not to overlook the fact that central banks in some Asian economies have built strong price stability credibility over the past two decades, despite some backsliding recently in some jurisdictions. This credibility has also helped to keep inflation rates well-anchored even in cases where broad money and credit growth did accompany foreign exchange intervention trends. For these reasons, a significant deterioration in inflation performance is not likely a consequence of the growth in central bank balance sheets.

Graph 9

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 percentage change in central bank total assets; the vertical axis represents the percentage change in the variables shown in the panel title.

Source: Filardo and Grenville (2012).

Financial stability risks. Despite the relatively benign assessment of the inflation risks associated with the trends in central bank balance sheets, the financial stability risks are a greater concern for several reasons (Graph 10).

In the short run, an acceleration in the rate of foreign reserve accumulation would be likely to crowd out domestic investment in the region. In the case that downside risks in Europe and the United States materialise, appreciation pressures on Asian exchange rates may thus lead to less near-term investment.

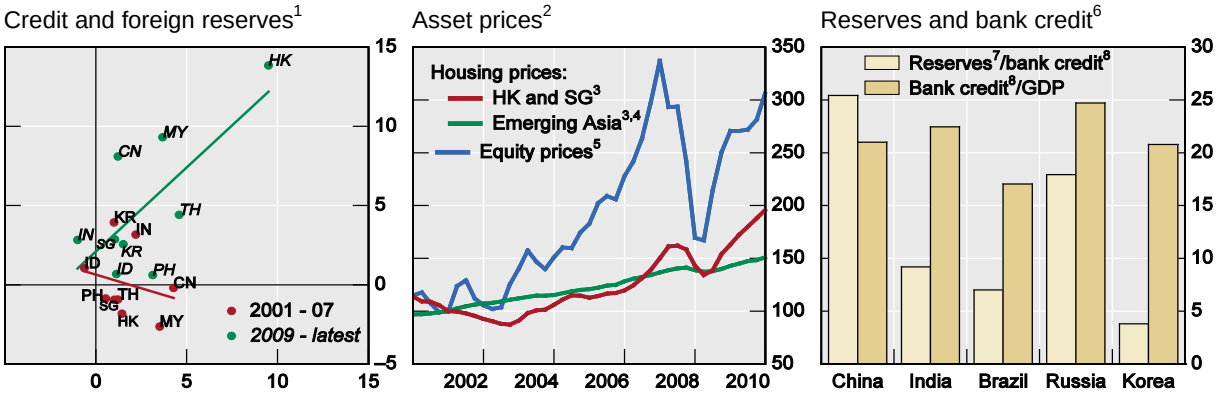
Indeed, Cook and Yetman (2012) estimate the potential impact for each 1% increase in the level of reserves to be a decline of approximately 1% in the growth of the quantity of loans relative to assets for the banks. This impact reflects the bank-dependent lending channel in emerging Asia. Emerging Asia is characterised by the following three traits: 1) bank intermediation is crucial to capital formation; 2) banking activity is limited by bank capital; and 3) central bank asset accumulation influences the size and structure of bank balance sheets. Empirical evidence from balance sheet data for 55 banks in Indonesia, South Korea, Malaysia, the Philippines and Thailand indicates that banks finance the accumulation of reserves through a combination of measures: holding reserves at the central bank and/or purchasing sterilisation bills. This in turn reduces resources for loans in the short run.

Of course, this may not be the end of the story. Over time, the massive accumulation of foreign reserve assets at the central bank will generally result in an increase in "lazy assets" on the books of private sector banks. The liabilities of the central bank are claims of the private sector banks. The accumulation of these generally low-yielding assets on the banks' balance sheets provides growing incentives to expand credit at some (possibly future) point in time.

When global risk aversion is high, as it has been in Asia for some time now, banks may be content sitting on these lazy assets. The concern is that when the global recovery begins to gain traction and global risk aversion falls, these banks will attempt to sell or leverage these highly liquid securities on their balance sheets in the form of loans. This behaviour is consistent with correlations between credit and foreign reserves in the past. Of course, this risk-taking channel can be offset by monetary policy actions (and macro-prudential tools). However, if the surge in lending is sufficiently strong and the monetary authorities get behind the curve, the credit expansion has the potential to be a "credit boom gone bad", with well-known negative consequences for economic and financial instability.

Graph 10

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; the points show 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 to latest available data. [7] Foreign exchange reserves minus currency in circulation. [8] Bank credit to the private sector.

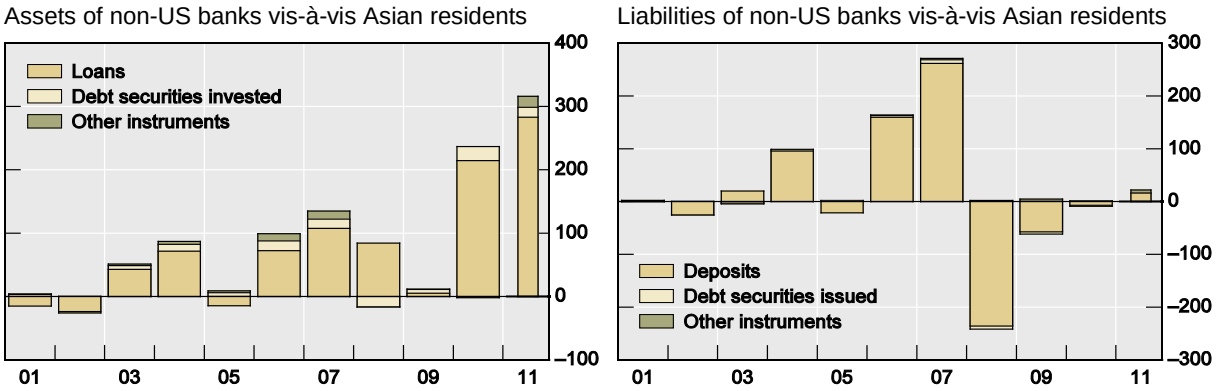
Source: Filardo and Grenville (2012).

Finally, the expansion of central bank balance sheets, particularly in the West, appears to be contributing to financial stability concerns today. Graph 11 illustrates the sharp pickup in offshore dollar lending in Asia over the past couple years. Admittedly, some of the recent anecdotal evidence suggests that some of this credit growth has eased as European banks have withdrawn from Asian markets.

Graph 11

USD flows outside US[1, 2]

(in billions of USD)



[1] 2011 figure based on annualised Q1 data. [2] Estimated-exchange-rate-adjusted changes of total positions of BIS reporting banks outside the US vis-à-vis all sectors in emerging Asia-Pacific.

Source: BIS locational banking statistics.

The expansion of central bank balance sheets in the West, as part of their response to the international financial crisis, was initially thought of as a big push factor behind capital flows to the region. Such aggressive capital flows were seen as a risk to sustainable growth in the region. But low policy interest rates in Asia and high global risk aversion appear to have prevented such destabilising carry trades. Chen, Filardo, He and Zhu (2012) find evidence that the central banks that adopted large-scale asset purchase programmes were successful in lowering the yield curve in their economies, but that these programmes also had spillover effects on Asia. Asian yield curves shifted downward contemporaneously with those in the West.

The lower interest rates in the region have helped to pump up credit and asset prices in a number of economies. In addition, the low interest rates in the United States and the dollar-based Asian economies have created a new channel of credit growth in Asia – the offshore dollar market. In this market, non-US banks are willing to lend US dollars at low rates of interest to Asian residents. Without an increase in their US dollar deposits on the books of these offshore banks, they may be taking on a currency mismatch if the loans are funded by selling local-currency assets. If funded by FX swaps, the currency mismatch may be less worrisome, but this type of funding does entail counterparty risks – which, in today's global financial world, cannot easily be dismissed. To assess these risks, more complete data on offshore bank balance sheets is needed. The only point here is that the unintended consequences of the massive accumulation of foreign reserve assets in Asia are beginning to be seen in regional credit developments. These need to be tracked closely.

Sustained, large balance sheet losses and credibility and independence risks. The average running cost ('quasi-fiscal costs' represented by the differential between domestic and foreign interest rates, Graph 5) 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

most economies in emerging Asia (Filardo and Grenville, 2012; Cook and Yetman, 2012). For most economies in emerging Asia, investing in USD loses around 2 percent per year, calculated in terms of the domestic currency of these economies. 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.

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

A major concern is that the public reporting of the weakened state of the central bank's balance sheet may diminish the central bank's reputation. And if the central bank has to go cap-in-hand to the Ministry of Finance and Parliament to approve capital replenishment, the reputational damage may be accompanied by a weakening of independence.

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 (Filardo and Grenville, 2012). 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 more vigorous economic activity resumes. Thus, the differential will widen from the abnormally narrow levels seen over much of the past decade. A large inflow will be attracted by this wider interest differential, accelerating the accumulation. In addition, there is the prospect of further upgrades 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, the phenomenon will make reserve holding more costly in terms of capital losses.

4. Central bank balance sheets and debt management

In the past few decades, advanced economy central banks became less active as market makers for government debt, and new agencies were set up to take over sovereign debt management (Turner, 2011). Moreover, debt managers were generally given relatively narrow mandates in order to minimise the expected cost of funding for the government over the medium to long term while ensuring prudent risk management practices.

Emerging market economies saw less drift in such mandates. Where financial systems were less fully developed, central banks retained a bigger role in promoting deep and liquid financial markets, especially for government bonds. At the same time, some central banks, such as the Reserve Bank of India, retained some functions related to sovereign debt management.

However, many central banks have had to increase their issuance of central bank bills as part of sterilisation operations, as central bank balance sheets have expanded. Mehrotra (2012) notes that the outstanding stock of central bank paper now amounts to over 10% of GDP in some Asian economies. And the average maturity of central bank paper is still relatively short, but has risen during 2010-11. This could help to lock up excess liquidity for longer periods of time, which is especially relevant in an environment of strong capital inflows.

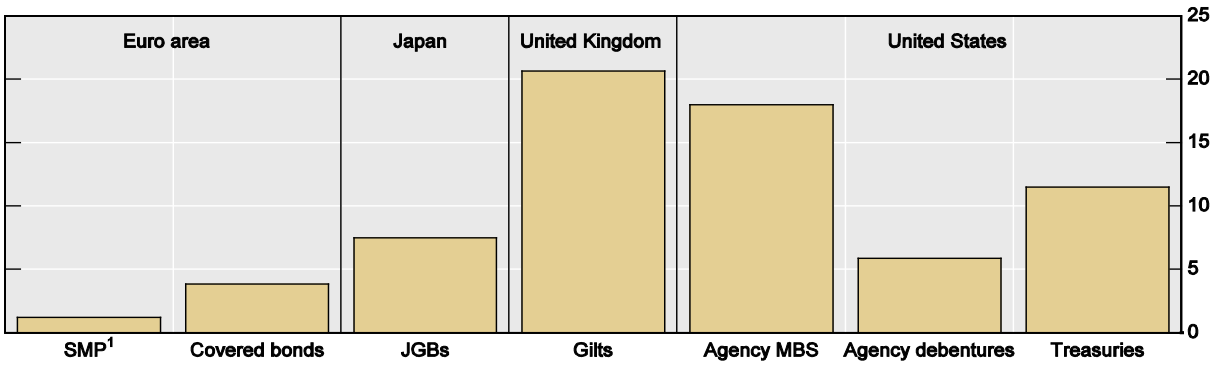
These trends have created an elevated possibility of conflict between debt managers and central banks. As major advanced economy central banks implemented large-scale asset

purchase programmes to take duration out of the markets, for example, longer-term interest rates came down. Graph 12 shows that these central banks now hold substantial quantities – 10% to 20% – of domestic government debt outstanding. This action was meant to stimulate the economy (at the zero lower bound of nominal interest rates) by lowering the cost of long-term borrowing. It also meant that long-term borrowing by the government looked increasingly attractive. If debt managers, in their efforts to minimise financing costs, were to issue more long-term debt, this would work at cross-purposes to the goals of the central bank.

Graph 12

Central bank outright holdings of selected debt securities

Per cent of total market; as at end-December 2010



[1] Securities Markets Programme holdings include private and public debt securities.

Sources: Bloomberg; Datastream; European Covered Bond Council; SIFMA; UK Debt Management Office; US Treasury; central banks.

While sovereign debt management choices do not appear to have constrained central banks' ability to ease monetary conditions significantly in the advanced economies so far (see CGFS, 2011), the possibility cannot be ruled out for the future. This would be especially true if concerns about the cost of short-term debt financing continue to intensify at the same time as new large-scale asset purchase programmes are contemplated. And for emerging markets this would be true as long as there was a need to finance the large and growing stock of foreign reserve assets.

Such possibilities raise the issue of enhancing coordination between debt managers and central banks. To manage the potential tensions arising from sovereign debt management, it is essential that debt managers and central banks understand each other's motives for their respective actions. Moreover, it is important that markets also share this understanding. Helpful steps in this regard include stable and predictable issuance, with issuance calendars announced well in advance of auctions and central banks spreading their purchases over a range of maturities to avoid squeezes in particular market segments. For emerging markets, central banks may also need the authority to lengthen the maturity of their central bank bill issuance and to provide incentives for domestic and international investors to hold longer maturities, as Bank Indonesia has been doing in recent years.

5. Modelling challenges

In recent years, there has been renewed interest in modelling the role of central bank balance sheets in macroeconomics generally, and for monetary policy deliberations in particular. Previously, central bank balance sheets were treated mainly as a sideshow of little real consequence. The crisis in the West and the build-up of foreign exchange official

reserves in Asia have underscored the importance of bridging the gap between theory and practice.

The canonical model used in most policy analysis can be reduced, in essence, to three central relationships: (1) a Phillips curve that relates inflation to inflation expectations and output, (2) an IS curve that relates output to real interest rates, and (3) and a Taylor rule that describes monetary policy as a function of deviations between macroeconomic variables – typically inflation and output – and their targets.

$$\pi_t = f(\pi^e_{t-1}, y_{t-1}) \quad (1)$$

$$y_t = g(i_{t-1} - \pi^e_{t-1}) \quad (2)$$

$$i_t = h(\pi_{t-1} - \pi^*, y_{t-1} - y^*_{t-1}) \quad (3)$$

The model may be complicated in many realistic ways without fundamentally changing its essence. For example, for an open economy we might add exchange rates to all of the equations: to the Phillips curve (to allow for pass-through from exchange rates to inflation); to the IS curve (to capture the relationship between external demand and exchange rates); and perhaps even to the Taylor rule (to allow for a policy response to exchange rate movements). But fundamentally, we would still have a model with a three-equation reduced form.

Where do central bank balance sheets fit into this model? The short answer is that they do not. Within most of the benchmark macroeconomic models used in recent decades, there is no role for central bank balance sheets, or even for the information that they contain.

From a pragmatic point of view, ignoring central bank balance sheets may have been a reasonable simplification until recently, at least for most advanced economies. Before the international financial crisis, monetary policy was centred on a paradigm in which policymakers set short-term interest rates and offered signals about the likely future path of policy rates. The size and composition of central bank balance sheets tended to be passive and merely reflected the underlying demand for different central bank liabilities. Central bank balance sheets also tended to be limited in size, and their composition stable.

For emerging economies, failing to take explicit account of the role of central bank balance sheets in policy analysis in the past may have been less benign. In the lead-up to the Asian financial crisis, for example, many national currencies in emerging Asia were overvalued, leading to a decline in foreign currency assets on central bank balance sheets, as foreign exchange intervention was used to support the value of these currencies. The expectation of currency depreciation due to the loss of foreign currency assets precipitated currency crises in a number of economies. The situation faced by many emerging Asian economies today is the mirror image of this, with the rapid accumulation of foreign currency assets bloating central bank balance sheets as a result of action to resist exchange rate appreciation.

Recent events in advanced economies pose a further challenge to the canonical model. Central bank balance sheets have been growing rapidly, driven primarily by purchases of domestic currency assets. The composition of the balance sheets has also changed, in part reflecting extraordinary policy actions intended to stimulate the economy and offset the recessionary effects of deleveraging within the private sector.

Analysing the effects of such policies, along with the macroeconomic risks and policy challenges that large balance sheets might pose, requires new analytical frameworks that depart from the canonical model in ways that provide a meaningful role for central bank balance sheets.

The key to generating a role for central bank balance sheets in models is ensuring that changes in their balance sheets are not automatically offset by the decisions of other actors in the economy. Underlying the irrelevance of balance sheets is the idea that the balance sheets of taxpayers, governments and central banks are intertwined, since taxpayers are

residual claimants on public sector wealth – or, equivalently, residual payers of public sector liabilities. An influential paper by Wallace (1981) demonstrated that changes in the official sector's balance sheet will not affect the risk-return profile of households or change equilibrium financial-asset prices when markets are complete. Effectively, optimal decision-making by residual-claimant taxpayers/investors will result in changes in private sector balance sheets that exactly offset the effects of changes in the official sector.

There are a number of plausible ways to proceed to overturn the Wallace (1981) result: removing perfect substitutability between different types of assets; assuming that actors in the private sector face leverage constraints; and modelling possible links between monetary policy and fiscal policy. We briefly discuss each in turn.

For central bank balance sheet irrelevance to hold, different types of assets must be perfectly substitutable at the margin. Eggertsson and Woodford (2003) have shown that if private agents have a liquidity preference for central bank monetary liabilities, for example, then the size and composition of central bank balance sheets will have equilibrium effects. They argue that such a liquidity preference is likely to be especially relevant when interest rates are constrained by the zero lower bound.

The Eggertsson and Woodford result may be viewed as a special case of portfolio balance theory (see Branson and Henderson, 1985, for a literature review). Portfolio balance theory focuses on the imperfect substitutability of domestic and foreign bonds in the portfolios of private investors due to frictions in financial markets. As a result, financial markets are not efficient, and investors will prefer some assets over others – hence these models are sometimes referred to as "preferred habitat" models. Changes in the asset and/or liability composition of the central bank balance sheet will then imply changes in the balance sheet of the private sector that may influence private sector decisions to spend, save and invest. In this framework, even sterilised foreign exchange interventions by the central bank may have important real effects on the economy.

An alternative means to ensure that central bank balance sheets play an important role is to assume that other economic actors face leverage constraints, as in Bernanke, Gertler and Gilchrist (1999), and as in Woodford (2011). A key condition for the irrelevance of central bank asset purchases is that investors be unconstrained in the purchase of individual assets; otherwise their limited ability to purchase assets may prevent them from fully offsetting changes to the balance sheet of the central bank.

A number of papers provide examples of how targeted central bank lending in the presence of leverage constraints on asset purchases by private investors may have important real effects. For example, Curdia and Woodford (2011) construct a model with heterogeneous consumers, in which borrowers may have less than full access to the pool of private savings. In their model, the level of direct central bank lending to credit-constrained private sector borrowers can improve societal welfare. Ashcraft, Gârleanu and Pedersen (2011) construct a model in which only a fraction of bank assets are pledgeable as collateral. Central bank lending, which demands lower collateral "haircuts", can relax credit conditions efficiently by lending at lower margins. And Reis (2009) describes a model in which financial intermediation is plagued by pledgeability concerns which, together with information costs, may reduce the funding for profitable investment projects when central bank balance sheets expand.

Chadha, Corrado and Meaning (2012), in this conference, also develop a model along these lines, in which there are two effective leverage constraints: households face a leverage constraint based on the level of their collateral, and banks face a leverage constraint due to required reserve ratios. They show that these constraints ensure an important role for asset purchases by the central bank as a policy tool for improving economic welfare.

The above examples of models with leverage constraints all apply to the purchase of domestic currency assets by the central bank. Applying leverage constraints in an open economy context, Cook and Yetman (2012) consider the effects of a central bank's

accumulating foreign exchange reserves that are financed, or equivalently sterilised, via the sale of central bank paper to the banking system. If banks do not face leverage constraints, foreign exchange intervention may be accomplished without changing real allocations of private sector agents, as per Wallace (1981). But in the presence of binding leverage constraints on banks, the acquisition of foreign currency assets crowds out investment – to the detriment of long-run growth, and with an exacerbation of current account imbalances.

A final route to ensuring a role for central bank balance sheets is to model the interrelationship between inflation and fiscal policy. Durré and Pill (2010) provide an example of such a model. It builds on the fiscal theory of the price level (Woodford, 1995), wherein the path for prices may be ultimately determined by fiscal policy. Underlying this is the assumption that if governments fail to respect their intertemporal budget constraints, but by assumption cannot default, fiscal considerations will drive price development in equilibrium. Durré and Pill (2010) show that credit policies, which are quasi-fiscal in nature, may therefore be used by a central bank to support price stability objectives.

There is no consensus on the best way to incorporate central bank balance sheets into policy analysis, but current efforts suggest the likely shape of analytical frameworks to come. And different approaches to ensuring a role for central bank balance sheets are likely to be more appropriate in different circumstances.

For example, portfolio balance approaches may be most appropriate for assessing the role of policies whose objective is to adjust the balance sheet of the financial system so as to stimulate some sectors, as with "Operation Twist." Based on historical estimates, it may be possible to assess the likely degree of substitutability of different assets, and therefore the degree of stimulus to the macroeconomy from a given change in the central bank's balance sheet.

Models incorporating binding leverage constraints may find the greatest currency in circumstances in which the private sector is deleveraging – for example during crises, and when the counterparty to transactions that change the size or composition of the central bank's balance sheet is domestic banks that face regulatory barriers to increasing the size of their own balance sheets. In the former case, such models may allow for a careful analysis of the degree to which expansion of the central bank's balance sheet will offset the contraction of private sector balance sheets, and in the latter case they may provide a way of assessing for the wider economy the trade-offs posed by central bank balance sheet expansion.

Finally, models incorporating explicit links between fiscal and monetary policy may be especially helpful for assessing balance sheet expansions in economies facing fiscal distress that have independent currencies and may in principle use expansion of the monetary base to prevent fiscal default, although there remains some work to be done on the relevance of this class of models (for example, see the discussion in Buiter, 2002).

In sum, most economists agree that central bank balance sheets may, in principle, play a significant role in the economy and reveal important information about monetary policy. However, standard macroeconomic models leave little role for central bank balance sheets – a conceptual simplification consistent with the assumption of complete markets. In recent times, macroeconomic events have demonstrated the inadequacy of this assumption for several reasons. First, during crisis periods the degree of market completeness inevitably declines. Second, central bank balance sheets have seen dramatic changes in both their size and composition compared with historical norms. And third, recent changes in central bank balance sheets appear to have had important macroeconomic effects.

We have briefly outlined a number of ways to incorporate a role for central bank balance sheets in standard models used in central banks for policy analysis. But the development of these models remains nascent. In the discussions during the remainder of this conference, we will hear more about the kind of dynamics that these models need to incorporate.

Table A1

Central bank total assets

	In billions of USD		As a percentage of quantity indicated							
			GDP		Currency in circulation		M2[1]		Bank credit[2]	
	01	**11**[3]	**01**	**11**[3]	**01**	**11**[3]	**01**	**11**[3]	**01**	**11**[3]
Australia	32	81	8	5	217	152	12	5	10	4
China	514	4425	39	62	271	621	27	36	35	49
Hong Kong SAR	126	315	75	129	966	1063	33	40	50	65
India	85	394	18	22	178	192	31	27	62	43
Indonesia	61	161	38	19	690	352	75	53	211	72
Japan	892	1847	24	29	160	162	12	12	21	28
Korea	131	417	26	35	922	1177	37	48	33	37
Malaysia	39	165	42	59	590	836	31	43	33	52
New Zealand	5	25	9	16	492	867	11	16	8	11
Philippines	22	79	31	36	464	631	50	61	78	124
Singapore	70	245	82	92	1091	1256	72	68	70	85
Thailand	47	207	41	58	426	580	35	48	42	58
Memo:										
Euro area	*718*	*2994*	*11*	*24*	*285*	*227*	*17*	*23*	*11*	*15*
United Kingdom	*72*	*391*	*5*	*16*	*192*	*523*	*4*	*9*	*4*	*8*
United States	*663*	*2857*	*6*	*19*	*108*	*288*	*9*	*21*	*12*	*32*

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

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

Table A2

Foreign reserve adequacy[1]

Outstanding year-end reserves position

	In billions of USD				As a percentage of:									
					GDP	Imports	Short-term external debt[2]				Broad money			
	1997	2009	2010	2011	2010	2010	1997	2009	2010	2011	1997	2009	2010	2011
Australia	16	33	33	33	3	17	23	16	13	11	5	3	2	2
China	140	2,399	2,847	3,262	48	214	394	1,594	986	841	13	27	26	27
Hong Kong SAR	91	245	258	270	115	59	53	251	167	147	25	29	28	27
India	24	259	268	286	17	74	305	304	201	192	12	23	19	19
Indonesia	16	60	90	117	13	71	45	198	213	209	22	27	33	38
Japan	208	997	1,036	1,135	19	162		200	176	173	5	12	11	11
Korea	20	265	287	296	28	68	30	174	191	182	6	20	20	19
Malaysia	20	93	102	132	43	65	133	545	394	342	19	31	29	34
New Zealand	4	14	15	20	11	52	45	61	89	91	22	25	27	31
Pakistan	1	10	13	15	8	42	56	428	558	609	4	16	18	21
Philippines	7	37	54	66	28	88	55	292	353	377	22	43	53	66
Singapore	72	188	226	249	101	73	40	164	148	142	73	69	72	69
Thailand	26	134	166	178	52	92	66	1,026	1,034	915	22	42	42	41
Memo items:[3]														
Asia[4]	*645*	*4,733*	*5,394*	*6,060*	*37*	*83*	*104*	*404*	*348*	*325*	*19*	*28*	*29*	*31*
Latin America[5]	*154*	*468*	*547*	*639*	*13*	*81*	*112*	*305*	*253*	*234*	*70*	*46*	*42*	*42*
Central Europe[6]	*39*	*164*	*180*	*203*	*25*	*47*	*274*	*224*	*232*	*222*	*37*	*36*	*40*	*41*
Other[7]	*36*	*521*	*558*	*612*	*17*	*88*	*56*	*335*	*332*	*328*	*22*	*38*	*33*	*33*

[1] For the outstanding year-end position, regional aggregates are the sum of the economies listed; for percentages, simple averages. For 2011, 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] Sum (reserves in USD billions) or simple average (other indicators) of the economies listed. [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; BIS, *Consolidated banking statistics*; BIS, *Securities statistics*; national data.

Table A3

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 0.05 are 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, *International Financial Statistics*.

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