

Central Bank balance sheets as policy tools

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Abstract

In the face of the recent financial crisis, central banks have varied the size and structure of their balance sheets. Such actions attempt to exploit additional instruments of central bank policy that go beyond the traditional monetary policy instrument (ie control over the short-term interest rate). The objectives of these measures have varied across countries: offering additional stimulus to the economy in the face of a lower bound on the level of short-term interest rates; supporting market functioning by expanding central bank intermediation; and managing cross-border capital flows in an environment where the domestic financial system lacks the ability to intermediate such large and/or foreign-currency-denominated financial flows. This paper reviews experience with such measures, in particular drawing lessons from the European experience that have potential relevance for Asian central banks.

Keywords: Money, credit, money markets, central bank balance sheets

JEL classification: E5, E4

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1. Introduction²

In meeting the challenges of the financial crisis since 2007, the world's leading central banks have resorted to a variety of exceptional measures, largely revolving around changing the size and composition of their own balance sheets: 'credit easing' in the United States, 'quantitative easing' in the United Kingdom, and 'enhanced credit support' in the euro area. Such measures are credited by some with having saved the world from another Great Depression. They certainly appear to have played an important role in halting the disorderly collapse that threatened to engulf the global financial system after the failure of Lehman in September 2008.

With this narrative in mind, the present paper has two ambitions: first, to better understand the channels through which non-standard central bank measures may have worked, and second, on the basis of this analysis, to draw some conclusions about the appropriate structure of central bank balance sheets in the future. The academic literature offers few guidelines in this respect. We therefore hope that the paper can stimulate further thinking on what promises to be an important topic going forward.

Drawing on experience during previous crisis episodes (notably in Europe during the early 1990s and in Asia during that latter half of that decade), we place recent central bank policies in a broader context. We conclude that the non-standard measures introduced by the Federal Reserve, Bank of England and European Central Bank (ECB) since 2007 may be less exceptional than current conventional wisdom holds. Taking a wider cross-sectional and historical view offers an insight into how non-standard measures may have worked in recent years. And on the basis of this broader analysis, we consider the pros and cons of different central bank balance sheet structures.

2. Transmission channels for non-standard central bank measures

Much of the existing analysis of non-standard central bank policy measures focuses on the importance of *portfolio balance* channels in transmission. This analysis takes as its starting point the view that, owing to the existence of financial frictions in credit markets, assets held in private sector portfolios are not perfect substitutes for one another, even once credit risk and other inherent attributes are allowed for. Where financial markets are not 'efficient' (in Fama's sense), changes in the central bank's portfolio of asset holdings and/or the structure of its liabilities – which, as a mirror image, imply changes in the private sector's balance sheet – can induce changes in the structure of yields and returns in financial markets. In turn, these asset price changes may influence private spending, saving and investment decisions, and thus macroeconomic outcomes.

This analytical framework can be illustrated with reference to quantitative easing: through the portfolio balance mechanism described above, a central bank that purchases long-dated government securities by creating bank reserves (i.e. credits in the accounts of the banking system at the central bank) can hope to flatten the treasury yield curve to a greater extent than implied by the pure expectations theory of the term structure (a corollary of the efficient-market paradigm). Empirical analyses of such policy actions conclude that a sizable impact

² This paper was prepared for the BIS-Bank of Thailand Research Conference on 'Central bank balance sheets in Asia and the Pacific: The policy challenges ahead' held in Chiang Mai, Thailand on 11–13 December 2011. We thank H. Vargas Herrera and B. Soenaryo Mukasan for their very generous discussions of the paper at the conference. Thanks are also due to N. Cassola, A. Filardo, D. Giannone, C. Holthausen, M. Lenza, L. Reichlin and J. Yetman for their comments on the paper and/or contributions to earlier collaborations. Assistance from K. Chung, C. Garcia de Andoain Hidalgo, L. Lam and B. Morley is gratefully acknowledged.

on long-term interest rates can be achieved, as reflected in the growing number of papers that evaluate the impact of central bank balance sheet expansion on the slope and level of the yield curve.³ The emphasis on portfolio balance effects is in tune with a thread of the literature on (unsterilized) central bank foreign exchange interventions that suggests that these balance sheet effects explain the efficacy of such policy actions (eg Dominguez and Frankel, 1993). In this context, purchases of domestic currency assets by a central bank trigger an attempt by the private sector to replace such assets in its portfolio, thereby driving up their price and causing the currency to appreciate.

In previous work on the euro area (Lenza et al, 2010; Giannone et al, 2011a/b; Cassola et al, 2011), we have argued that another channel of transmission for non-standard monetary policy measures may be equally, if not more, important. This alternative view starts from the premise that financial markets can periodically become dysfunctional on account of information problems. The simplest example – but nonetheless arguably the one most relevant to the immediate post-Lehman episode – concerns a situation where an external shock raises questions about the solvency of some potential counterparties in a financial market. Owing to the asymmetric structure of information on the strength of balance sheets, adverse selection can occur in that market, leading to some institutions' being 'red-lined' (ie excluded from the market at any price) in the manner proposed by the credit rationing literature.⁴ Applied to the interbank money market, such considerations have been central to analysis of the financial crisis that followed the failure of Lehman Brothers in September 2008.

On the basis of a structural model of the money market where the existence of information asymmetries between market participants gives rise to adverse selection among banks, Heider et al (2009) offer a compelling explanation of these developments. While their model is inevitably highly stylised, it demonstrates how concerns about the solvency of specific banks can lead to the breakdown of interbank trading. The model distinguishes three regimes: first, a situation of low interest rate spreads and active interbank trading; second, a market exhibiting elevated spreads and adverse selection, with continued but lower trading volumes; and third, a regime where market trading breaks down. What determines the transition from one regime to another in this model is the extent of concerns about counterparty solvency. But when such concerns emerge, the outcome is growing liquidity risk for all banks, not just for those perceived as facing a heightened threat of insolvency as credit risks mount.

When the private market seizes up in this way, the potential spillover to other markets is high because of the central role that the interbank money market plays in refinancing short-term positions in the economy. Central banks therefore have a case for intervention: in doing so, they aim to insulate the rest of the economy and financial system from the impact of the breakdown of liquidity and activity in a specific segment of the financial markets. The simplest way for the central bank to intervene is to expand intermediation across its own balance sheets in that particular dysfunctional segment.

To further use the example of the interbank money market, consider the situation where two banks are unable to complete a Pareto-improving trade with each other owing to mutual – and possibly unjustified – concerns about counterparty solvency. In this case, the central bank can act as an intermediary between the two banks, allowing the underlying transaction to take place, and thereby avoiding the negative externalities that the dysfunctionality in the money market might imply for other market segments. In practice, this means that the central bank will lend to the cash-short bank, and the resulting liquidity injected into the system will

³ See, for example, Kozicki et al (2011), Gagnon et al (2010) and Joyce et al (2010).

⁴ See Stiglitz and Weiss (1981).

ultimately return to the central bank from the cash-rich bank that accumulates a long position in its reserve account at the central bank as a result of interbank payments. Note that this intermediation function of the central bank is not without cost: the central bank absorbs the perceived counterparty risk that prevented the original underlying bank-to-bank transaction. Absorbing such potential counterparty risk can be justified on two grounds: (1) that the central bank has a better assessment of the underlying balance sheet strength of the banks excluded from interbank trading than do their immediate private counterparties; and/or (2) that the central bank internalizes the externalities that do not enter the private banks' calculus about whether to conduct the transaction or not. The latter consideration in particular demonstrates how well-intentioned central banks run the risk of assuming (quasi-) fiscal tasks when they engage in non-standard monetary policy measures of this sort, something we warn against in a subsequent section.⁵

This analysis also has parallels with the literature on central bank exchange rate interventions and policies, in this case where the literature discusses 'sudden stops' in capital flows to emerging markets.⁶ The literature points to the need for central banks to accumulate foreign exchange reserves so as to insure themselves against an unexpected halt in the inflow of capital from abroad. In the remainder of the present paper, we explore this analogy between the non-standard measures introduced in the face of the global financial crisis since 2007, and earlier foreign exchange interventions.

3. Context: Financial crises in developed and emerging markets

In a variety of papers written in the mid-1990s, McKinnon and Pill (1997, 1998) explored the "overborrowing syndrome" – a situation where apparently successful structural reforms in emerging market economies triggered an excessive capital inflow that led first to a boom (in both economic activity and asset prices) followed by a bust (as the unsustainable nature of such financial flows became apparent).

At the heart of their explanation of these phenomena was the "original sin" notion introduced by Hausman and Panizza (2003): emerging market economies lack the institutional infrastructure and associated credibility to deal with such capital flows.

At the macro policy level, the 'fear of floating' (Calvo and Reinhart, 2002) associated with this situation led to the adoption of de facto (and often de jure) exchange rate pegs, given the difficulty faced in running an independent monetary policy and accepting the exchange rate consequences thereof. At the micro level, the inability of domestic financial systems to successfully and efficiently direct the flow of capital from abroad led to a build-up of ultimately unsustainable financial imbalances. In particular, the existence of often implicit retail deposit insurance encouraged excessive risk-taking, and bid asset prices up to their 'Panglossian' levels (since downside risks were socialised) (Krugman, 2000).

This type of analysis was seen to be consistent with a number of the financial crises of the last decade of the previous century, such as the "Tequila Crisis" in Mexico and the Asian financial crisis of 1997–98. Moreover, it led to a number of policy proposals, modest in scope though they were. First, as regards the broader regulatory environment, the analysis emphasized the need for institutional development prior to liberalising the balance of payments capital account, and the need for gradual removal of capital controls so as to permit this development before the economy is exposed to the full force of the global capital

⁵ See Durré and Pill (2010).

⁶ See Calvo and Reinhart (2000).

market. Central to this institutional development were improved regulation and supervision of the banking system (eg preventing currency mismatches on bank balance sheets). Collectively, such measures – which at the time were seen as potentially illiberal and contrary to the prevailing Washington consensus in favour of liberalisation – would now be labelled macroprudential policies.

Second (and partially fulfilling the agenda sketched out in the introduction), the analysis pointed to more specific proposals for central bank balance sheet policies. Notable among these were: (a) preventing reserve requirements from leading to an implicit subsidisation of foreign capital inflows, eg by excluding foreign currency deposits from the definition of the reserve base on which reserve requirements were calculated; (b) the potential use of Chilean-style holding requirements to lengthen the maturity of foreign liabilities in the banking system; and (c) using sterilised intervention to support exchange rate pegs. All three of these initiatives should be viewed as attempts to build a central bank balance sheet structure that is resistant to ‘sudden stops’ or reversals in capital inflows from abroad. This discussion therefore coincides with the goal of the present paper: to explore how central bank balance sheets can help contain financial crises, although, given recent experience, the focus is on domestically generated and propagated crises.

As has been recognized by several authors, the financial crisis of 2007–11 exhibits a number of simple features shared by the emerging-market crises of the 1990s. In particular, institutional weaknesses (including inadequate prudential supervision) led to poor incentives and ultimately to excess credit creation and asset-price boom/bust cycles. Just as in the sudden stops characteristic of emerging-market currency crises, we have seen how certain key financial markets – notably the interbank money market – can seize up, undermining credit creation and threatening broader macroeconomic stability. And just as in the case of responses to past exchange rate crises, this has led in turn to the introduction of central bank balance sheet policies, and poses questions of how the central bank balance sheet should be structured to make for a more robust and resilient situation in the future.

Annex I briefly reviews recent financial crises in order to provide an empirical context for this comparison between recent non-standard measures and previous foreign exchange interventions – two versions of central bank balance sheet policy. In the remainder of the paper, we aim to develop the argument that understanding balance sheet policies and their effects requires a more functional approach – identifying which markets the central bank is forced to support, and how it can do so – rather than simply looking mechanically at indicators such as balance sheet size or composition.

4. Analytical framework

Before turning to the data, it is useful to sketch out elements of an analytical framework. Figure 1 offers a stylised view of a financial market. For illustrative purposes, it takes as its starting point the interbank money market – an object of intense study in the 2007–09 financial crisis.

A traditional analysis of financial intermediation focuses on the flow of resources from private sector savers to private sector borrowers. To simplify, we assume that the flow of savings takes the form of deposits by the domestic private sector in the domestic banking system (A in Figure 1), while borrowing consists of a flow of bank loans to the domestic private sector (B).

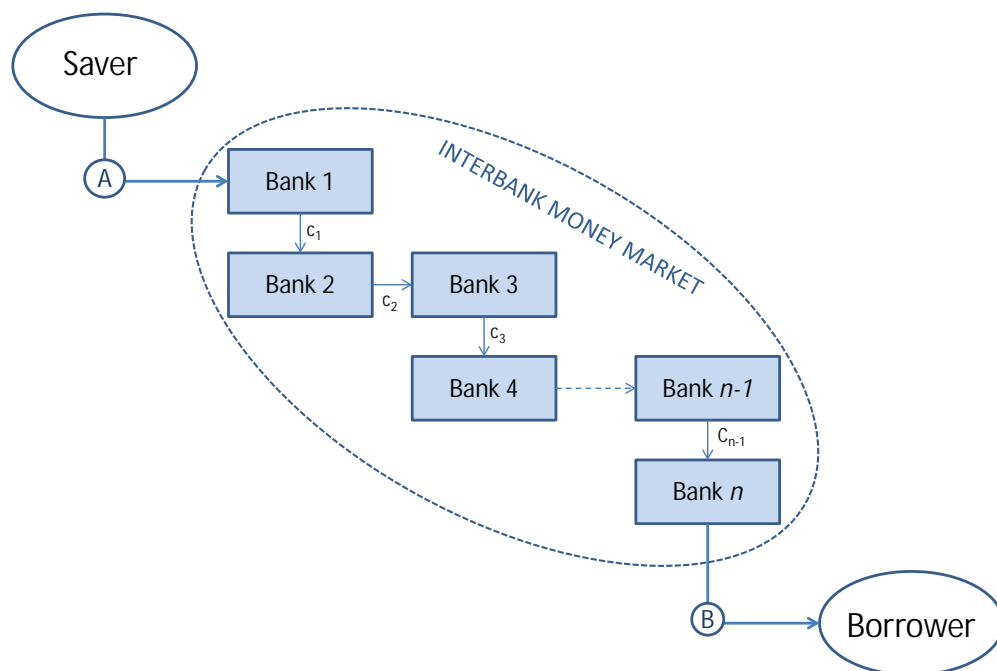
Such an approach excludes all the intervening transactions among banks ($c_1 \dots c_n$).⁷ This is a serious shortcoming in two respects.

First, such transactions are becoming more numerous and important. Using data on US flow of funds, Adrian and Shin (2010a/b) have demonstrated how the build-up of intra-financial-sector leverage prior to the onset of the 2007–08 financial crisis was associated with the emergence of longer ‘intermediation chains’. In other words, the flow of resources from non-bank saver to non-bank borrower passed through an increasing number of banks in the course of being intermediated between private sector saver and borrower. Shin and Shin (2011) make a similar point about the role played by offshore markets in the financing of overborrowing episodes in emerging markets.

Second (and more importantly in the present context), since, as the starting point for our account of the transmission of non-standard policy measures posits, central banks act so as to overcome disruption to these interbank markets, we need to ensure that they are treated and monitored appropriately.

Figure 1

The growing role of wholesale financial markets in financial intermediation



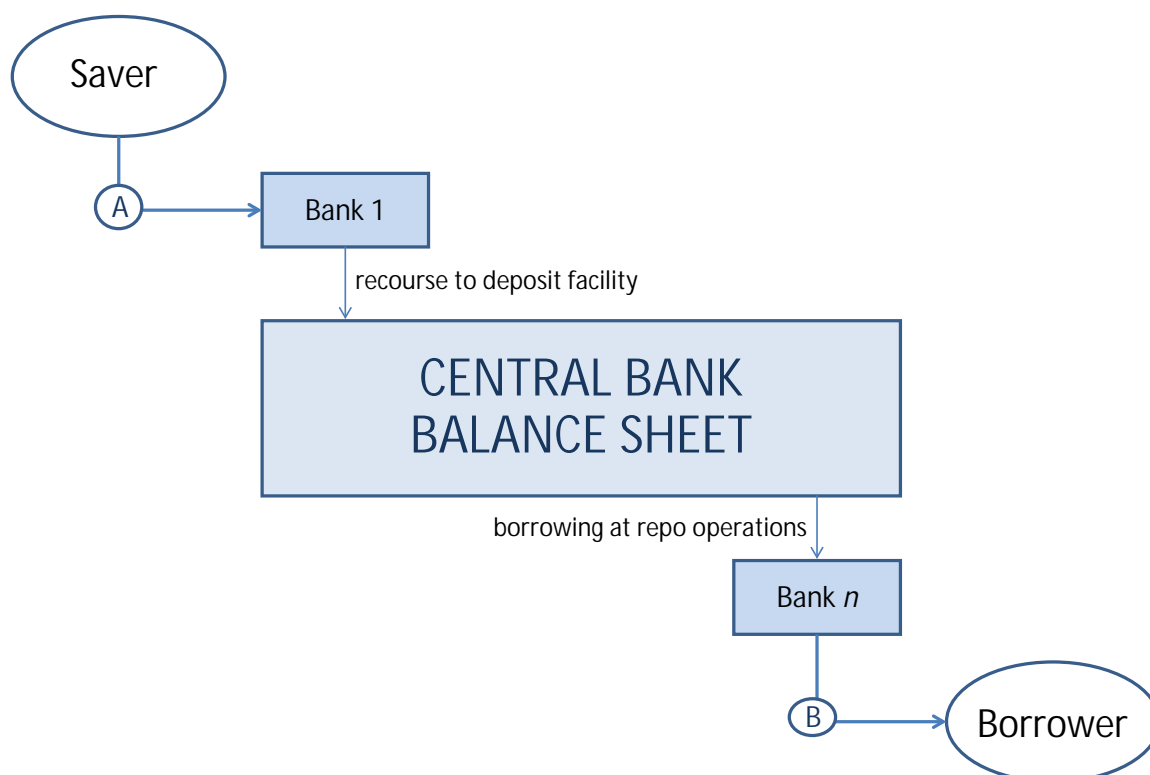
Brunnermeier and Pedersen (2009) and Gorton and Metrick (2011) offer theoretical and empirical accounts, respectively, of how disruptions to wholesale financial markets can induce a wider freezing up of the financial system, with serious adverse consequences for the wider macroeconomy. Our characterisation of the transmission of non-standard policy measures is based on the central bank’s offering its own balance sheet as a vehicle for intermediating those intra-financial sector flows that are disrupted as the financial market seizes up.

⁷ By construction, interbank positions should consolidate to zero: a short-term loan from bank X to bank Y is equivalent to a deposit placed by bank Y at bank X.

In essence, non-standard policy measures represent an attempt to use a central bank's balance sheet, and the tools it has available under its operational framework, for the implementation of monetary policy to act as a de facto central counterparty for wholesale financial transactions. In the case illustrated in Figure 1, the central bank, by so doing, replaces the frozen private interbank market, ensures that the flow of resources from private sector savers to borrowers is maintained, and thereby sustains the necessary flow of credit to the real economy (see Figure 2). By these means, the central bank is able to ensure that disruptions to real economic activity caused by a 'sudden stop' in financial flows are minimised. In the course of intermediating these flows, the central bank's balance sheet will expand, as recourse to its refinancing facilities by those banks making the loans is matched by build-up of reserve holdings by other banks receiving savings deposits.

Figure 2

Central bank intermediation as a de facto central counterparty



To anticipate our subsequent empirical analysis, a number of points can be made even on the basis of this very simple framework. First, success of non-standard measures in this context should be understood as ensuring that the pre-existing flow of resources from and to the real economy is maintained. Rather than stimulating the real economy anew, the purpose of non-standard measures in our framework is to contain disruption. Selecting the relevant counterfactual scenario for the purposes of comparison is therefore key. Second, the stylised representation in Figures 1 and 2 demonstrates that the central bank does not need to substitute for all transactions in wholesale markets. What is crucial is that it maintain the flow of deposits **A** into loans **B**. It does not need to substitute for the (growing number of) intermediate transactions ($c_1 \dots c_n$). Hence while effective interventions in wholesale markets will substitute for private transactions, they need not do so one-for-one.

5. Stylised facts in the various crises

a. Methodology and data

In this section, we discuss the evolution of central bank balance sheets (both their size and composition) during the crisis periods described in Annex I. In the case of a currency crisis (as in Europe in 1992–93 and Asia in 1997–98), we distinguish those countries which devalued from those which did not. As regards the recent financial crisis, countries which experienced very significant market tensions and disruption are compared with others that have faced limited, if any, tensions.

For each of the crises described below, the evolution of the following variables is explored: (i) the size of the central bank balance sheet (% of GDP); (ii) the total amount of loans to government and the domestic private sector by deposit money banks (% of GDP); and (iii) the main components of both the asset and liability sides of the central bank balance sheet (% of total balance sheet size). Deepening the analysis of balance sheet composition under (iii), we look (on the asset side) at (a) foreign assets, (b) claims on the public sector and (c) claims on banks, and (on the liability side) at (d) reserve money, (e) foreign liabilities, (f) government deposits and (g) capital accounts. All the data are quarterly, based on the IMF's International Financial Statistics database. To ensure the robustness of the ratios, we have checked their consistency with national data published by the respective central banks.⁸ For the sake of clarity and parsimony, average and standard deviation are displayed for each category of countries, although some specific information on specific countries is provided when necessary. The full set of charts is provided in Annex III.

b. Main developments in the data

While the market segment affected by crisis varies in the different episodes considered (notably according to whether the focus lay in foreign/offshore markets or in the domestic market), the three crises discussed in detail below share a common feature – the emergence of a liquidity shortage owing to market disruption, which has the potential to affect economic prospects significantly and adversely. As a result, in each episode, the central bank in question has had to substitute for the market by increasing its intermediation role, which in turn affects its balance sheet (both size and composition).

When the crisis episode is rooted in the foreign exchange market, banks have to face huge capital outflows against the backdrop of increased demand for foreign currencies. Banks can thus rapidly become short of (foreign) liquidity, which eventually may endanger their solvency in the medium term.⁹ The central bank has thus provided foreign currency via interventions to stabilize the exchange rate, while simultaneously increasing the provision of liquidity to banks to offset the impact that the withdrawal of foreign capital has on their funding situation. As a result, foreign assets at the central bank fall and its claims on the domestic banking sector increase. The flight to quality triggers capital movements, which reduces reserve money, while the peg defence increases foreign liabilities, and the need for a larger buffer tends to increase the capital accounts. All in all, the size of the central bank balance sheet is expected to decrease slightly or to remain unchanged over time, since the main impact of the intervention is a change in the composition of the asset side of the central bank's balance

⁸ Cross-checking with data provided by national authorities was necessary in some cases in order to disentangle the possible content of important other items for some central banks. Details are provided in Annex II.

⁹ See Shin and Shin (2011) and McKinnon and Pill (1997).

sheet – a substitution of domestic assets in the form of loans to domestic banks for foreign assets.

In the case of a crisis centred on the domestic market, the central bank's increased intermediation role for the purpose of overcoming market distortions materialises through an increase of central bank claims on the banking system (and/or on the public sector), while the foreign components of its balance sheet tend to exhibit opposing effects (the foreign assets experiencing a short-lived increase while the liabilities tend to decrease). Furthermore, the capital accounts remain broadly unchanged or decrease slightly. All in all, the size of the central bank balance sheet tends to increase.

Thus (beyond some country-related specificities), changes in the size and composition of central bank balance sheets reflect the market affected by the crisis, even when the underlying rationale of the measures – namely, increased central bank intermediation to offset disruptions created by a sudden stop in private markets – is the same. At the same time, over a longer horizon (say five to ten years), the evolution of central bank balance sheets may also reflect lessons drawn by policy makers from the crisis itself. For example, the continued accumulation of reserves and/or the expansion of the central bank balance sheet in some Asian countries in the 2000s could be seen as a precautionary building up of financial buffer by the central bank to face a future crisis. These expected developments are in fact confirmed by the developments displayed in the charts of Annex III, which are also summarised in Table 1.

Table 1

Overview of main developments across countries around the crisis year

Crisis period	1993 (ERM) Financial Crisis	1997 (Asian) Financial Crisis	2008 Financial Crisis	
			Advanced economies	Asian economies
Central bank balance sheet size	↓	↓	↑	↔
Banking system size	↔	↓	↔	↔
Foreign assets	↓	↓	↑	↔
Claims on governments	↔	↔	↓ ↑	↔
Claims on banks	↑	↑	↑	↓
Reserve money	↑	↓	↑	↑
Foreign liabilities	↓	↑	↓	↓
Government deposits	↓	↓	↓	↓
Capital accounts	↑	↑	↓	↓

Note: The arrows reflect the tendency observed on average for the corresponding variable directly in the aftermath of the crisis quarter in the sample of countries experiencing tensions in financial markets (ie those that devalued in FOREX crisis episodes or experienced a breakdown of the domestic money market).

In the sections below, we focus on more region-based specificities by systematically two categories of country: (a) countries that devalued during a currency crisis and/or were

significantly adversely affected by financial crisis (Category I); and (b) countries that were somewhat more immune than other countries to the crisis in terms of duration, depth and impact (Category II). To facilitate cross-crisis comparison, we centre the charts in Annex III on the quarter of the crisis year labelled by 'Y', using a 6-year horizon, ie extending 3 years (24 quarters) before and after the crisis.

c. The European ERM Crisis (1992–1993)

During this crisis, the intensification of exchange rate tensions within the ERM peaked in the third quarter of 1992 (=Y on the charts), during which the first devaluations were seen. Central banks in 'more adversely affected' Category I are the Bank of England (UK), Banca d'Italia, Banco de España, Central Bank of Ireland and Banco de Portugal. 'Less adversely affected' Category II includes the Deutsche Bundesbank (Germany), the Banque de France and the National Bank of Belgium. Although both the French and Belgian francs also faced exchange rate tensions within the ERM, they were able to maintain their pegs, albeit with significant assistance from the German authorities and a widening of the exchange rate fluctuation bands in August 1993.

The most striking country-specific developments during this period can be summed up as follows.

With regard to size, central banks with larger balance sheets are not necessarily those that proved immune to the tensions and avoided devaluation. In the third quarter of 1992, balance sheet size amongst the Category I central banks varied between 6% of GDP for the Bank of England and 31% for Banco de Portugal, with the average for the Category II central banks falling in between (at around 11%). As might be expected in a currency crisis, the magnitude of foreign assets was a more relevant determinant of the severity of the crisis. That said, for countries in both categories over the medium term (6-year horizon) the size of the balance sheet was not significantly changed by the crisis: the impact was a transient one.

By contrast, a clear difference appears as regards the evolution of the composition of the balance sheet. On the asset side, central bank foreign assets decreased ahead of the crisis quarter in the devaluing countries (Category I – most importantly in the UK, Italy and Spain), whereas the decrease occurred *with* the crisis in Category II countries (with the noticeable exception of Germany, where foreign assets jumped from 30% of the total balance sheet in 1992-Q2 to almost 50% in 1992-Q3). In both categories, claims on banks increased, with a certain delay for Category II, mostly explained by the fact that tensions vis-à-vis the French franc and Belgian franc occurred in the first half of 1993 (ie shortly before 'Y+1' on the corresponding charts in Annex III).

On the liabilities side, the defence of the peg led to a significant increase of the foreign component in both categories. However, this proved to be a one-time development for central banks in Category I, as they devalued in 1992-Q3 ('Y' in the charts), and a double dip for those in Category II, since the parity of the French and Belgian franc against the German Mark was gradually tested. It is also interesting to note that the enlargement of the confidence interval in the chart, associated with the evolution of foreign liabilities for Category II, is entirely due to the figures for the Banque de France (which jumped from 10% in 1992-Q2 to 26% in 1992-Q3). Finally, in contrast to central banks in Category II, for which they remained broadly unchanged, the size of the capital accounts of central banks in Category I increased gradually in the aftermath of the crisis.

d. The Asian Financial Crisis (1997–1998)

The start of the Asian financial crisis is associated with the devaluation of the Thai baht on July 2, 1997 (thus, Y=1997-Q3 on the relevant charts). According to the definition of country categories, the central banks in Category I are those of Thailand, Korea, Malaysia, Indonesia and the Philippines. Category II includes Hong Kong, Singapore, China and India. Although

these latter countries were also affected by the tensions prevailing in the region at that time, their currencies proved more resilient than those of the Category I countries.

As shown by the charts on the Asian financial crisis, the features characteristic of a currency crisis revealed by our analysis of the ERM episode are broadly replicated here. Some Asian specificities are nonetheless interesting. First, countries that proved more resilient to the crisis included both those with hard currency arrangements (such as a currency board, as in the cases of Hong Kong and Singapore) and those with more flexible currency regimes or where currency convertibility was limited.

Developments in the more adversely affected Category I countries were more volatile and display a number of contrasts with what occurred in the ERM crisis. First, as a share of the overall central bank balance sheet, reserve money significantly decreased for central banks in Category I, whereas foreign liabilities significantly increased with the onset of the crisis. Second, the crisis appears to have had a more persistent effect on the structure of central bank balance sheets: the decrease of foreign assets at the time of the crisis was reversed relatively quickly, but it was followed by a gradual accumulation of foreign assets over time as countries sought 'self-insurance' for a repeat of the 'sudden stop' episode. Furthermore, claims on banks increased significantly during the crisis period, but subsequently decreased to a level below that seen pre-crisis.

e. The 2007–2011 financial crisis

Although the current financial crisis formally started on 9 August 2007, its intensification came with the collapse of Lehman Brothers Ltd on 15 September 2008, which led very quickly to a seizing up of the money market in the euro area (in both the unsecured and secured segments). As a result, the crisis quarter ('Y' on the relevant charts in Annex III) is the third quarter of 2008. Although observers tend to present the ongoing crisis as a 'global financial crisis', it is worth recalling that most of the ongoing tensions are (still) mostly located in the Western advanced economies.

We therefore distinguish three categories of countries for this particular crisis: the central banks of the US, the euro area, the United Kingdom and Japan constitute Category I; those of Australia, New Zealand and Canada form Category II; and those of all the Asian emerging economies covered in the 1997–1998 financial crisis (ie Thailand, Korea, Malaysia, Indonesia, the Philippines, Hong Kong, Singapore, China and India) form a third category. Indeed, as reported by Filardo (2011), despite strong economic and financial fundamentals, countries in the Asia-Pacific region were not immune to the financial crisis in September 2008. However, the tensions were relatively short-lived in this case.

Not surprisingly, changes in central bank balance sheets (of both size and composition) were significantly greater for the countries in Category I than for the Category II countries or, to some extent, for the Asian emerging economies. This cross-country variation reflects differences both in the duration of the crisis (since tensions in the Asia-Pacific region and Canada were relatively limited in time) and in the nature (and magnitude) of the non-standard measures implemented by the relevant central banks. As with foreign exchange intervention in previous crisis episodes, the non-standard measures affected various domestic balance sheet items in the case of Western advanced economies, while foreign asset and liability position were less affected. These observations are broadly in line with the analysis reported in Filardo and Grenville (2012).¹⁰

¹⁰ It is, however, worth noting that the apparent stability of the category averages hides some marked cross-country differences. For example, the evolution of foreign components (assets and liabilities) is more volatile in Korea, Malaysia, the Philippines and, to a certain extent, Thailand around 2008-Q3. Similarly, we observe significant increases in the reserve money component for Hong Kong at this time (jumping from around 4.9%

More specifically, the following observations can be made regarding the central banks in Category I.

First, the evolution of foreign assets as a proportion of the balance sheet total (a decrease at the outset of the crisis, followed by an increase and then a gradual decrease) is mostly due to the figures for the US Federal Reserve and the Bank of England. This item remains broadly stable for the ECB and the Bank of Japan.

Second, the U-shape observed for the claims on the public sector between times 'Y' and 'Y+1' mainly reflects two different types of non-standard measures which affected the amount of public bonds held by the respective central banks: (a) the securities swap programmes initiated by both the US Federal Reserve and the Bank of England around 2008-Q3 following the Lehman failure, and (b) the purchase of government securities from mid-2009 on (through quantitative easing by both the US Federal Reserve and the Bank of England, and through the ECB's securities market programme – SMP – as of May 2010).

Third, the increase of claims on banks reflects the increased provision of liquidity by central banks through their non-standard measures (more pronounced for the US Federal Reserve and the ECB – through credit easing and enhanced credit support respectively – than the average figures).

Finally, the average evolution of foreign liabilities obscures a considerable divergence among the advanced economies in Category I. Indeed, the average decrease in this item mostly reflects the United Kingdom (where, after reaching 60% of the total balance sheet in 2008-Q3, this component dropped to 11% one year later) and Japan (where it decreased from 5% to 3% over the same period). By contrast, foreign liabilities for the US Federal Reserve jumped to around 6% in 2008-Q3¹¹ and remained stable at a level around 5% afterwards. Similarly, this component for the ECB gradually increased during the crisis period to a peak at around 14% of the total balance sheet in 2008-Q4, from a very low pre-crisis level, and it remains at around 6% to date. These developments clearly contrast with those of central banks in Australia, New Zealand and Canada (Category II countries), where foreign liabilities increased significantly as of 2008.¹²

6. Discussion of the empirical analysis

Prima facie, a diverse set of experiences is evident in the use of central bank balance sheet policies in the various episodes discussed in the foregoing section. On one hand, in the face of the Asian crisis of the late 1990s central banks largely responded by changing the composition of the asset side of their balance sheets, substituting domestic assets for foreign assets (via the mechanisms traditionally labelled sterilised foreign exchange intervention). On the other hand, in the period following the failure of Lehman central banks have expanded their balance sheets by accumulating a variety of assets and funding these purchases and/or operations through the creation of central bank reserves. In the latter case, base money creation increases whereas in the former it is kept unchanged. From a traditional monetary policy perspective, this would suggest that the policies involved are quite distinct.

of the total balance sheet in 2007-Q3 to 40.2% in 2009 Q3), which was partly mirrored by a capital account decrease (from 58% to 33.2% over the same period). See Cook and Yetman (2012).

¹¹ This level was already reached in 2007-Q4, when the swap agreement with the ECB was first launched.

¹² The enlargement of the confidence interval on the corresponding chart is essentially explained by the rise of this component for Australia which rocketed from a level of 1.3% to 20.0% between Q3 and Q4 of 2008.

However, in the course of the recent crisis (indeed, before it in the case of the ECB and the Bank of England), central banks have paid interest on reserves through the adoption of a corridor system (Woodford, 2003; Manna et al, 2001). They have argued that this allows them to set the level of interest rates independently of the supply of base money, ie what the ECB has labelled the separation principle. This is consistent with the view that monetary policy – understood as the setting of short-term interest rates – can be pursued in concert with a variety of balance sheet policies. But that leaves open the possibility that these balance sheet policies may be quite different.

We argue that these balance sheet policies are in fact more similar than such an analysis would imply. In particular, we believe that the traditional monetarist focus on a specific component of central bank liabilities – namely the stock of base money – can give a misleading view of how these policies work.

One way of interpreting central bank balance sheet policies is through the lens of the portfolio balance approach. If there are sufficient imperfections in capital markets that changing the composition and/or size of the central bank balance sheet implies sufficiently significant changes in the yield structure to influence macroeconomic behaviour, then both sets of balance sheet policies can be interpreted within a common framework. But notwithstanding the event study evidence offered by some central banks, we find it implausible that this channel is sizable enough to have a large impact, even in the case of the relatively heavy interventions conducted by leading central banks.

More important in our view is the support central bank interventions have offered to market functioning. In particular, when financial markets seize up during the course of generalized loss of confidence and exploding concerns about counterparty risk, expanding central bank intermediation in order to keep markets working plays a crucial role in avoiding financial and macroeconomic collapse.

In the Asian crisis of the 1990s, as capital inflows that were crucial to domestic bank funding dried up (McKinnon and Pill, 1997), central banks stepped in to replace the funding of domestic banks by expanding their domestic monetary policy operations, while simultaneously addressing the capital outflow by running down their foreign currency reserves. In other words, the ‘sudden stop’ in foreign capital inflows – symptomatic of dysfunctionality in cross-border money markets – was met by central bank intermediation of that market, replacing foreign capital flows with reserves and expanding domestic operations. In doing this, the central banks absorbed the foreign currency risk that had previously been held by the domestic banking system, and the credit risk that was previously held by the foreign suppliers of capital. In the face of the macroeconomic and financial crisis at the time, neither party was willing or able to continue to hold such risks and therefore these markets had ceased to work – which is what caused the sudden stop in the first place.

By the same token, after the failure of Lehman in September 2008, banks became unwilling to lend to one another owing to the perceived level of counterparty risk. The interbank money market seized up, especially at term maturities. In essence, there was a ‘sudden stop’ in the money market of a similar nature to that which had previously been seen in emerging FX markets. Similarly, markets for asset-backed securities also dried up as doubts emerged about the quality of the underlying assets, and the threat of risk cascades became better understood. In both cases, central banks expanded their own intermediation in these markets to ensure that the financial sector as a whole did not collapse. For example, the ECB gave banks that were no longer able to access the interbank money market the possibility of funding their assets (including a very broad set of ABS) in potentially unlimited amounts at a fixed low rate, via its monetary policy repo operations. In doing so, the ECB assumed some (indeed, much) of the counterparty credit risk that prevented the direct bank-to-bank transaction from taking place in the first place.

In the Asian case, the main impact of the balance sheet operation was a change in the composition of central bank assets. In the more recent case, the main impact was an

expansion of the central bank balance sheet (including the monetary base). As mentioned earlier, while a traditional monetarist approach would view these two operations as quite different, the above perspective suggests they had many similarities. In short, central bank intermediation substituted for direct private transactions as the market came to a sudden stop. By intermediating in this way, the central banks became ‘market makers of last resort’. Crucially, they also played an important novation function by absorbing onto their own balance sheets much of the credit risk that was impeding the underlying private transactions.

Viewed in this light, successful central bank balance sheet policies rely on a number of features. First, they point to a need for long balance sheets. In this respect, a large and diverse balance sheet makes it easier for a central bank to intermediate quickly in a variety of market segments. For example, the ECB’s relatively high level of remunerated required reserves implied that it had a large buffer upon which to operate as the euro money market seized up in late 2008, while its very long list of eligible collateral allowed it to intermediate and thus maintain a variety of markets, notably in ABS. Similarly, after the experience of the Asian crisis of the 1990s, many central banks in that region had accumulated large holdings of FX reserves as ‘self-insurance’ against a repeat of the experience. This has obviously served them well in the 2008 crisis, where a weakening of capital inflows was met by drawing down FX reserves, intermediating between foreign lenders and domestic borrowers, and absorbing the FX and credit risk. Second, by maintaining confidence, such policies appear to have maintained market confidence. This has certainly insulated Asian emerging markets from the immediate impact of the crisis in the advanced economies. But it has also allowed lending to the real economy to continue in advanced economies.

7. Further considerations in using central bank balance sheets as a policy tool

We have argued that the main channel through which balance sheet policies have influenced macroeconomic outcomes is by supporting market functioning and, albeit to a much lesser extent, via portfolio balance effects. Yet to reach a comprehensive view of their impact, a number of other considerations need to be kept in mind.

Certain balance sheet policies can be used to impose an implicit tax on activities that the central bank deems undesirable owing to the possible negative externalities that they imply for other market segments and/or for real activity. For example, tools such as (unremunerated) reserve requirements can be used to place an implicit tax on financial intermediation (of at least some types). This can be used in the Pigouvian mode to internalise externalities and other spillovers (Gallego et al, 2002). However, the danger exists that these taxes will be evaded by offshore and/or shadow banking activity, simply serving to divert transactions to less well-regulated (and thus potentially more dangerous) venues. Moreover, central banks may adopt balance sheet policies to offer signals to other market participants on the appropriate level of asset prices, setting a focal point for private decision-making. There is a longstanding tradition of this approach in FX interventions, but it can also be applied to asset markets (eg HKMA purchases of equity in 1998 and ECB purchases of covered bonds in 2009–10).

However, it is also extremely important to recognize that actively using the central bank balance sheet as a policy tool comes with potential negative side effects.

First, there is the risk of giving the market confusing signals regarding policy intentions. To the extent that central bank balance sheet management represents a novel policy instrument, communication on the monetary policy stance can become multidimensional and therefore more complex. For example, in mid-2011 the ECB faced scepticism among market participants about the internal consistency of its policies, when it simultaneously raised interest rates while expanding or reintroducing its non-standard measures.

Second (and potentially more important), there is a danger that well-intentioned balance sheet policies to support market functioning (essentially liquidity operations) will end up as quasi-fiscal operations (ie effectively provide solvency support to the banking sector in the form of subsidies to banks financed from central bank capital), as sections of the financial system become dependent on central bank support. In turn, this can hinder the necessary structural reforms and restructuring needed to place the financial system on a sounder footing (Durré and Pill, 2010), as the incentive to do so is blunted by the provision of the support. Thus, ultimately, a risk of introducing rigidities in the conduct of monetary policy is present.

Third, by preparing to respond to financial crises by having longer balance sheets, central banks may make such crises more likely, to the extent that moral hazard infects private financial decisions, as discussed by Giannone et al (2011b).

Finally – and as a result of the preceding arguments – the introduction of balance sheet policies threatens to erode credibility. When a central bank actively manages its balance sheet in parallel with pursuing traditional interest-rate-based monetary policy, it may suggest that other (implicit) objectives are being pursued in parallel with the pursuit of price stability, hence eroding over time the central bank's credibility as regards delivering on the explicit monetary policy objective.

8. Concluding remarks

Reviewing the features of three major financial crises, we conclude that despite the different natures of the market segments facing the crisis, these crises present more similarities than may at first appear, both in terms of market distortions and central bank reactions. In all cases, the central bank has to increase its intermediation role in order to provide a substitute for market mechanisms that provide liquidity.

Our review of the general evolution of balance sheet items across twenty-three central banks suggests that the varying impact on balance sheets among central banks may be related to financial buffers of the balance sheet prevailing or absent before the crisis. Indeed, it might be observed that the central banks that more successfully resist financial tensions (ie those that do not devalue during a foreign exchange crisis or that expand their balance sheets less in domestic market crises) are those with large financial buffers (ie large FX assets and/or relatively large balance sheets). In a foreign exchange crisis, the central bank substitutes for the market by providing foreign currency against the domestic currency, and thus assumes the FX risks that market participants would have tolerated in normal times. Similarly, during a crisis in the domestic money market, by expanding its refinancing operations to ensure continued access to liquidity for market participants who are off the market, the central bank takes on the counterparty risk that other market participants would have borne in normal times. In both cases, the central bank increases its intermediation role, which ultimately increases its balance sheet's risk exposure.

Since the initial consequence of financial crises is a shortage of liquidity, nobody questions the need for central banks to step in and provide a substitute for the market. However, the more prolonged this role, the higher the exposure to risk. Furthermore, one cannot rule out that too long an extraordinary central bank would eventually also entail a risk of quasi-fiscal activity, with prolonged liquidity problems on the part of market participants in fact hiding features of insolvency. This would inevitably introduce rigidities in the conduct of monetary policy, as the reactivation of money markets would not necessarily solve the problems of troubled banking institutions. If this appears to be the case, the real intention behind balance sheet measures could gradually be questioned by economic agents, possibly eroding the credibility of the central bank over time as the economic agents conclude that a hidden policy goal supersedes the official monetary policy objective.

Annex I: Overview of Previous Financial Crises

a. The European exchange rate mechanism (ERM) crisis (1992–1993)

After the collapse of the Bretton Woods system of global fixed exchange rates in 1971–73, the European authorities demonstrated a strong desire to stabilise bilateral exchange rates between their countries so as to support a deepening of economic integration. From 1979, these ambitions took institutional form in the exchange rate mechanism (ERM) of the European Monetary System (EMS). From initial policies aimed at maintaining price competitiveness through periodic devaluations, European countries moved naturally towards disinflation policy by anchoring their own currency to the German Mark from the late 1980s. By renouncing autonomous monetary policy, these countries aimed to import the anti-inflationary credibility of Germany and the Bundesbank.

Tensions in Europe emerged in the early 1990s following a substantial asymmetric shock – German reunification. In this context, anchoring monetary policy by pegging to the German Mark became costly for other European countries, as German monetary policy decisions targeted domestic economic developments and were thus inappropriate for other participants in the ERM.

These tensions initially became manifest in Italy and the UK. After the Danish population rejected the Maastricht Treaty proposals for Economic and Monetary Union (EMU) in the referendum of 2 June 1992, the prospect of a delay in progress towards the introduction of a single currency created exchange rate tensions. Governments' ability to act to contain the tensions was hindered by the already weak state of their economies, which precluded a tightening of monetary policy.¹³ Tensions mounted, leading to a succession of devaluations within and/or exits from the ERM and other exchange-rate pegs. On 16 September 1992 ('Black Wednesday'), sterling and the Italian lira fell out of the ERM, while the Spanish peseta was devalued by 5%. Unsurprisingly, the exit of both the British and Italian currencies from the ERM magnified pressures elsewhere.¹⁴

The crisis peaked on 29 July 1993, when the Banque de France was forced to intervene in favour of the French franc against the Deutsche Mark in massive amounts (the Bundesbank's reserves increased by DM 40 billion). Given their concerns regarding inflation prospects, neither central bank was ready to adjust its own policy interest rates in order to narrow the spread between French and German interest rates. Consequently, European leaders eventually decided at a special meeting on 1 August 1993 to enlarge the fluctuation bands within the ERM with a view to curbing further speculative attacks.

¹³ For instance, when pressures on the Italian lira first appeared (the lira reached its lower limit with respect to the European Currency Unit (ECU) in June 1992), the Bank of Italy hiked interest rates, which in turn increased concerns because of the implied rise in debt service. In early September, the Bank of Italy raised its policy interest rate to 30%, but its international reserves became almost exhausted. Similarly, the Swedish central bank temporarily set its policy rate at 500% on 14 September in order to defend its parity, while selling large amounts of short-term government securities. On 16 September 1992, the Bank of England increased its base lending rate from 10% to 12%, while announcing its intention of raising it by another 300 basis points the following day.

¹⁴ The Bank of France increased its policy interest rates while reaching a low in its international reserves, in the week ending 23 September 1992. The tensions on other currencies persisted, forcing Sweden to abandon the peg to the ECU on 19 November, having lost international reserves equivalent to 10% of Sweden's GDP in the six preceding days. In the same period, Denmark, Spain and Portugal, too, were forced to increase their policy interest rates to defend their currencies. Irrespective of these defence measures, further devaluations were inevitable (about 3% each for the Spanish peseta and the Portuguese escudo on 10 December, and 10% for Irish pound on 30 January 1993).

b. The Asian financial crisis (1997–1998)

Given the interest rate differential with the United States, which was in their favour, Asian emerging countries faced capital inflows which, in presence of the peg, led to appreciation of their currency in real terms. At the same time, buoyant domestic activity and rising inflation prevented them from lowering interest rates to contain the currency appreciation. In contrast, current account deficits that had begun in 1995 actually increased with the anti-inflation policy implemented by most economies in this region, while the sterilisation undertaken by central banks to contain the currency movement proved ineffective due to the substitutability of domestic and US assets reinforced by the peg. The ongoing appreciation of local currencies further increased the current account deficits over time. Kaminsky and Schmukler (1999) associated the initial pressures on the Thai baht with the collapse of the Bangkok Bank of Commerce in July 1996 – an event that forced the Bank of Thailand to inject large amounts of liquidity to support the financial system. Tensions were noticeable from that point on, and were further fed by developments in other Asian emerging economies, as the crisis was stamped as global and successive devaluations became inevitable. With the default of the leading South Korean steel maker, Hanbo Steel Corp, on its loans on 23 January 1997, the region's various currencies experienced increasing pressures, intensified by the prospects of economic slowdown and political instability.

These tensions peaked with the decision by the central bank of Thailand to move to a managed floating for the baht on 2 July while calling on the International Monetary Fund for technical assistance. This decision effectively devalued the baht by about 15%–20%, and it reached a record low of 28.80 to the US dollar. Pressures on Indonesian, Philippine and Malaysian currencies consequently intensified, eventually leading the respective authorities to widen the Indonesian rupiah trading band from 8% to 12% on 8 July, to move to a freer float of the Philippines peso on 11 July, and to abandon defence of the Malaysian ringgit on 14 July. In October,¹⁵ the currency crisis spread to Taiwan, with the devaluation of the Taiwanese dollar creating doubts about the sustainability of the Hong Kong dollar peg. Tension escalated in the region, and in a matter of days the Hang Seng index lost about 30 per cent of its value. Then the failure of Yamaichi Securities Co. Ltd., the fourth largest securities house (November), and the failure of the food trading firm Toshoku Ltd. (December) captured the attention of investors in Japan. Tensions in the region continued to develop in early 1998 (especially with the temporary freeze on debt servicing in Indonesia), before diminishing with better economic news in various countries.

c. The global financial crisis (2007–2011)

Although growing concerns were already perceived in early 2007, notably with the increase in subprime mortgage defaults in the US in February 2007, the “liquidity crisis” in the money market started on 9 August 2007 following the decision of one big euro-area money market player, BNP Paribas, to freeze redemptions for three of its investment funds. Towards the

¹⁵ For that month, the following detailed information also reported on the Executive MBA webpage: “Understanding the World Macroeconomy” of Prof. Paul Wachtel's at the New York Stern University. On 6 October rupiah reached a low of 3,845. On the same day, Russia and London Club signed agreement rescheduling roughly \$33 billion of debts over 25 years with seven years grace, dated from December 1995. On 8 October Indonesia announced it will ask the IMF for financial assistance while on the 17th Taiwan decided to allow its currency to depreciate. Between 20 and 23 October the Hong Kong stock market suffered its heaviest drubbing ever, shedding nearly a quarter of its value in four days on uncertainty over the Hong Kong dollar. The Hang Seng index plunged 23.34% to 10,426.30 by Thursdays close, after 16,601.01 the previous Friday. At that time, the South Korean won also began to slump rapidly in value. On 27 October Asian jitters spilled over onto world stock markets with the Dow plunging 554 points, its largest single-day point loss ever (in a session halted twice after the drops tripped circuit breakers on the New York Stock Exchange).

end of 2007 and early 2008, tensions continued in financial markets on account of further write-downs by financial institutions, downgrading of monoliners and bank rescues in both the US and Europe. Although renewed tensions were already noticeable in the market with the release of the (de facto) nationalisation of GSE Freddie Mac and Fannie Mae on 7 September 2008, the intensification of the 2007–2010 financial crisis around the world really took off with the bankruptcy of the US company Lehman Brothers Ltd on 15 September 2008, after a failed rescue weekend during which major US banks refused to take over the hedge funds without a state guarantee. Since Lehman had counterparties across the globe and often intervened as a third party in credit derivatives contracts, the impact of its collapse on market confidence was incredibly huge. Furthermore, by letting Lehman Brothers Ltd go bust, the US authorities destroyed the ‘too big to fail’ paradigm implicitly assumed by market participants. The immediate tensions that followed this bankruptcy first materialised in the financial difficulties of the international insurance company AIG, which announced a liquidity shortage of USD 40 billion, requiring an emergency intervention of USD 20 billion by the State of New York on the afternoon of 15 September 2008. Thereafter, especially in Europe and the US, money market participants stopped trading and hoarded liquidity to protect their balance sheets and avoid a situation of liquidity shortage. The consequence of these reactions was a breakdown of both the secured and unsecured money market segments on 30 September 2008. Major central banks in the West therefore massively increased their intermediation role by introducing non-standard measures (in the form of unlimited provision of short- to long-term operations/programmes of public and private securities purchases). As discussed in Filardo (2011), this also impacted developments in Asia and the Pacific at that time.

Despite significant improvements in the money market between March and October 2009 thanks to the central bank intervention, the situation remained highly uncertain and fragile. First, credit institutions still appeared uncertain about their access to liquidity in the money market at longer horizons, especially beyond the six-month maturity. Second, the difficulties experienced by some credit institutions in Europe that played an important role in the banks' debt instruments market tended to increase tensions in the euro-area covered bank bond market. For instance, the tensions took the form of increased covered bond spreads against the swap rate, which reached a peak in April/May 2009. Further tensions regarding the public debt instruments of some euro-area countries gradually emerged from November 2009, eventually peaking on 7 May 2010. The roots of the (still ongoing) euro-area sovereign debt crisis began in Greece, where a newly elected government announced a huge revision of the public deficit figure left by the former coalition in late October 2009, calling the sustainability of the country's public finances into question. Consequently, the CDS premium for Greece started to rise in late 2009, along with the spreads between its 10-year public bonds and German bonds. In early 2010, these concerns rapidly affected the bond pricing of other euro-area countries, increasing sovereign CDS premiums and widening spreads against the German Bund. On 7 May 2010, government bond prices registered a record low, and the CDS premium a peak. Several public bond secondary markets dried up thereafter, in turn affecting activity in both the money market and the covered bond market.

Annex II: Data Sources

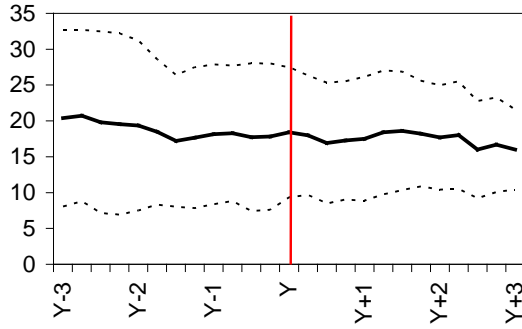
In order to ensure homogeneity across central banks, data from the International Financial Statistics (IFS) of the International Monetary Fund are used. Data on central bank balance sheets from the IFS are from the 'Monetary Authorities' section (IFS section 10), which generally consolidates central bank with the accounts of other institutions that undertake monetary functions (including issuing currency, holding international reserves and conducting IMF account transactions). Major aggregates of the central bank account on the asset side contain items from line 11 to 12g (IFS terminology). For the sake of simplicity in our analysis, we have aggregated some key asset items as follows: (i) claims on public sector are obtained by summing up items 12a, 12b and 12c; (ii) claims on other financial institutions (excluding deposit money banks) are obtained by summing up items 12f and 12g. The liabilities side corresponds to items from line 14 to 17a. In order to balance the asset and liabilities sides of the balance sheet, IFS data usually contain a variable entitled 'Other items', the importance of which varies considerably between central banks. In all cases, further investigation by cross checking information from the IFS data with national data and other sources (eg CEIC and BIS databases) was conducted to disentangle the content of 'Other items'. In this regard, note that the variable 'capital account' of the monetary authorities of Singapore also contains 'provisions and other liabilities' in addition to 'capital and general reserves'. Similar cross-checking applies to the data related to the UK central bank accounts, for which helpful cooperation was provided by the Bank of England.

In the analysis, the loans to (central) government and to the private sector by deposit money banks are also reported (as a percentage of GDP), corresponding respectively to lines 32a and 32d in the IFS database. Finally, the figures used for the gross domestic product (GDP) correspond to data in line 99b and reflect the level of nominal GDP, equal to the sum of final expenditures in national currency.

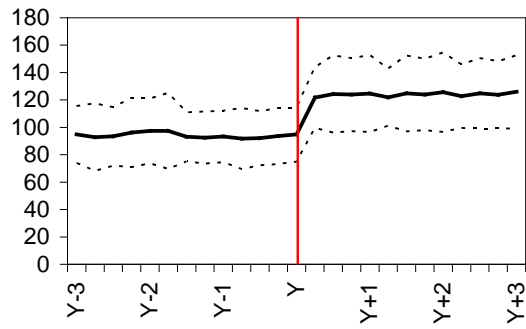
Annex III – Figures

A. The European Exchange Rate Mechanism Crisis (1992–1993)

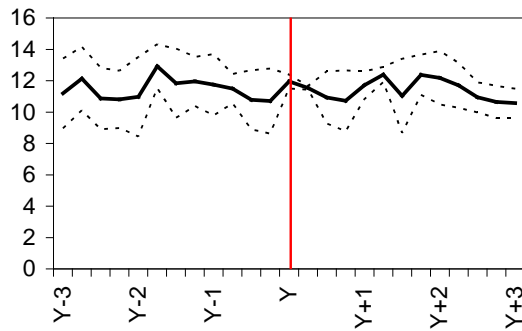
ERM Crisis: Average Size of BS in Category I (% of GDP)



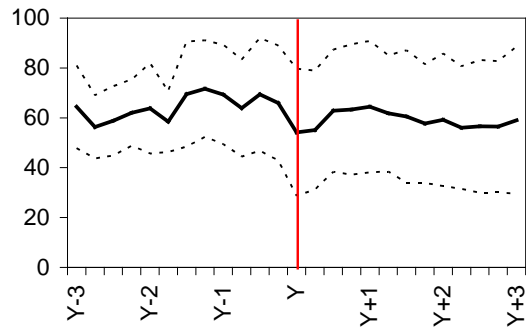
ERM Crisis: Average Size of banking system in Category II (% of GDP)



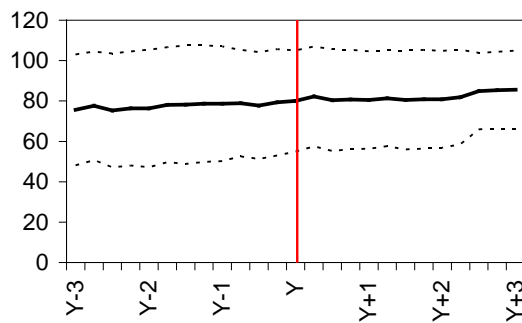
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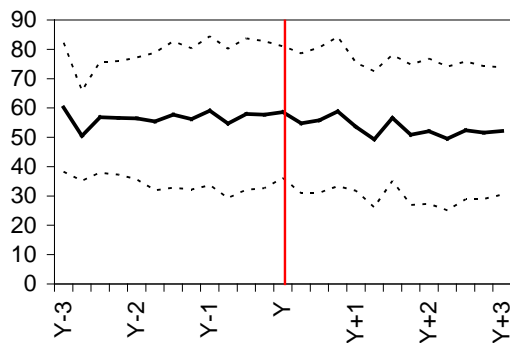
ERM Crisis: Average Size of foreign assets in Category I (% of BS)



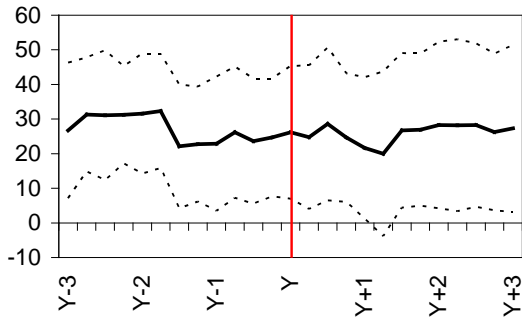
ERM Crisis: Average Size of banking system in Category I (% of GDP)



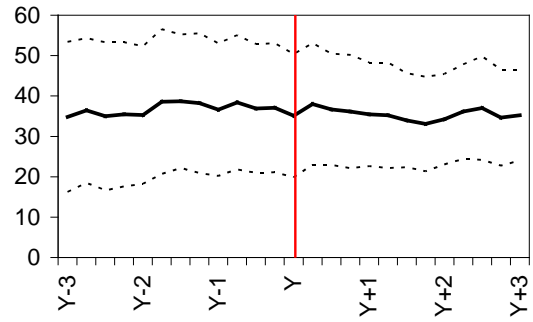
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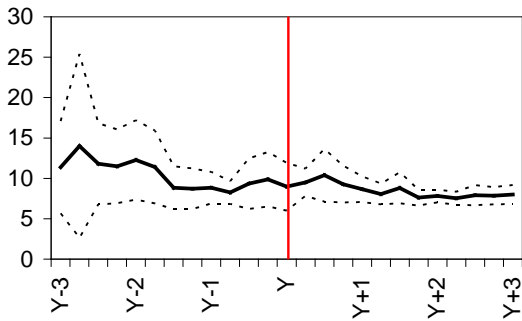
ERM Crisis: Average Size of claims on public sector in Category I (% of BS)



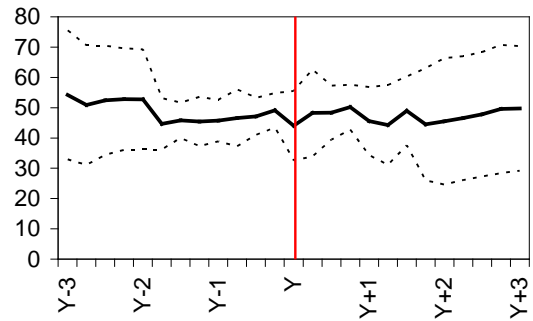
ERM Crisis: Average Size of reserve money in Category I (% of BS)



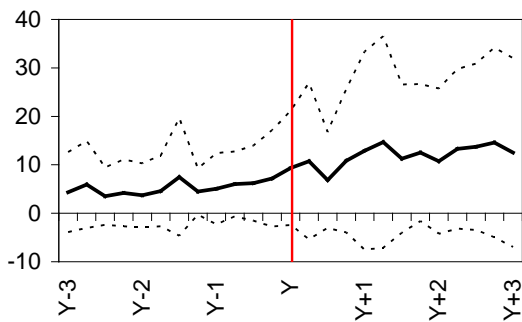
ERM Crisis: Average Size of claims on public sector in Category II (% of BS)



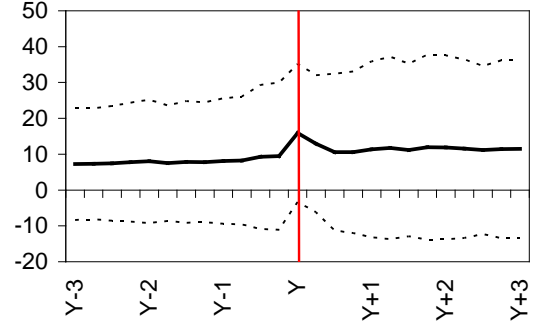
ERM Crisis: Average Size of reserve money in Category II (% of BS)



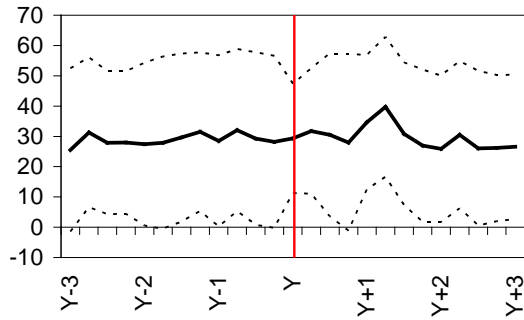
ERM Crisis: Average Size of claims on banks in Category I (% of BS)



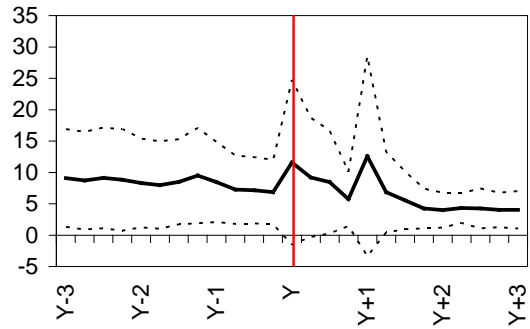
ERM Crisis: Average Size of foreign liabilities in Category I (% of BS)



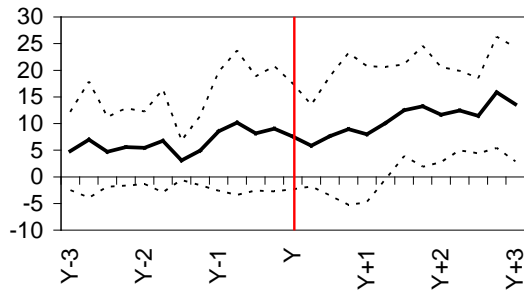
ERM Crisis: Average Size of claims on banks in Category II (% of BS)



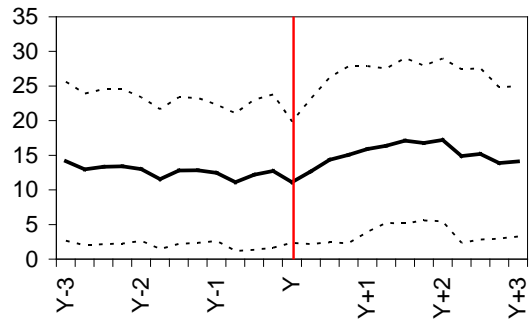
ERM Crisis: Average Size of foreign liabilities in Category II (% of BS)



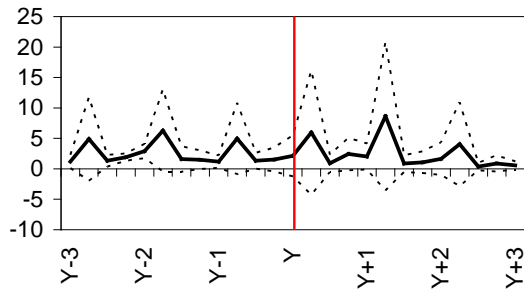
ERM Crisis: Average Size of government deposits in Category I (% of BS)



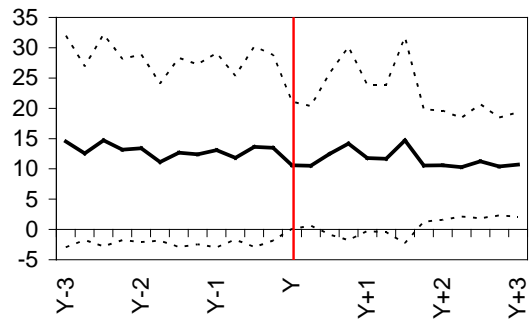
ERM Crisis: Average Size of capital accounts in Category I (% of BS)



ERM Crisis: Average Size of government deposits in Category II (% of BS)

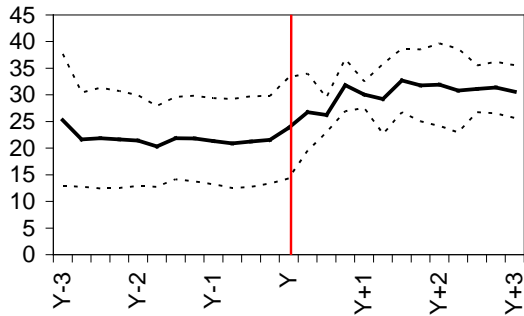


ERM Crisis: Average Size of capital accounts in Category II (% of BS)

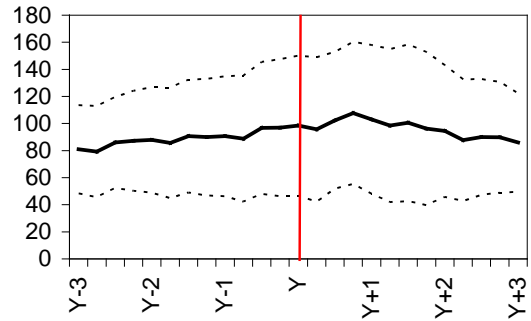


B. The Asian Financial Crisis (1997–1998)

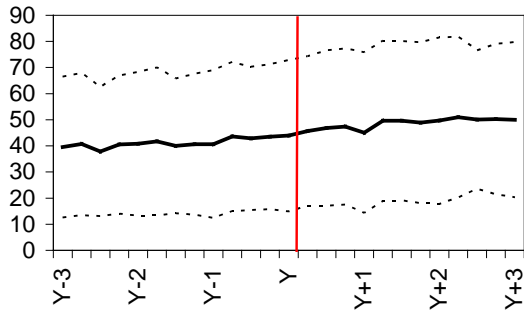
Asian EMEs around 1997: Average Size of BS in Category I (% of GDP)



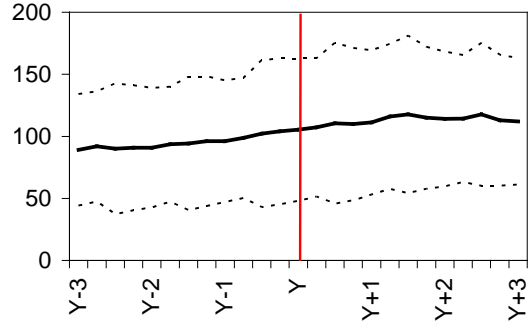
Asian emerging countries around 1997: Average Size of banking system in Category I (% of GDP)



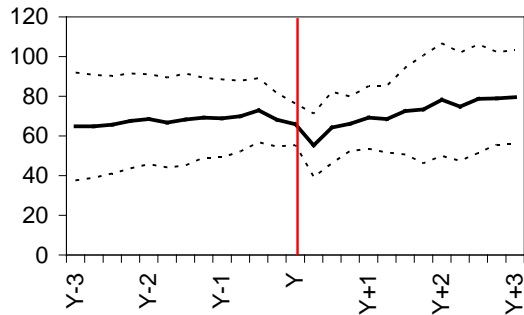
Asian EMEs around 1997: Average Size of BS in Category II (% of GDP)



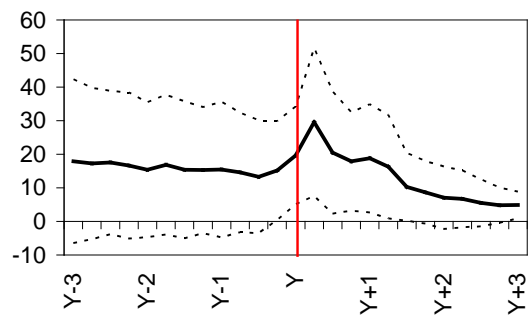
Asian emerging countries around 1997: Average Size of banking system in Category II (% of GDP)



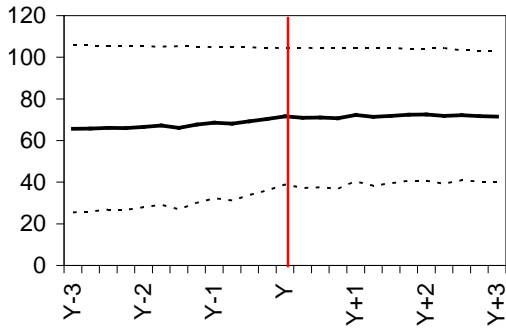
Asian EMEs around 1997: Average Size of foreign assets in Category I (% of BS)



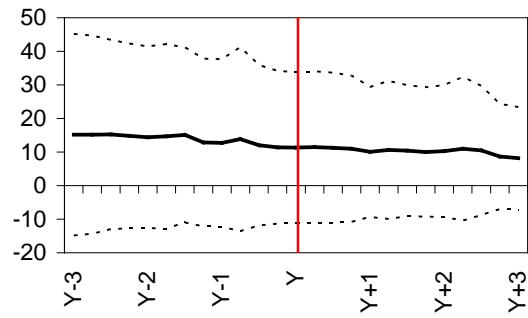
Asian emerging countries around 1997: Average Size of claims on banks in Category I (% of BS)



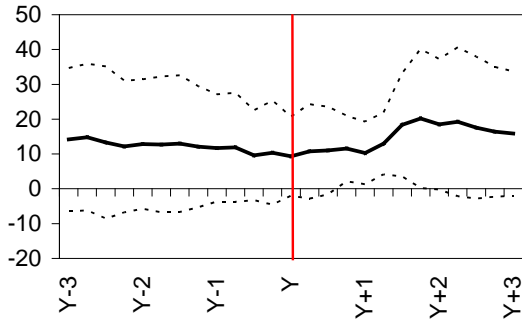
Asian EMEs around 1997: Average Size of foreign assets in Category II (% of BS)



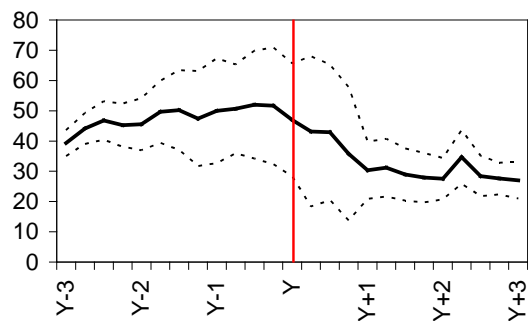
Asian emerging countries around 1997: Average Size of claims on banks in Category II (% of BS)



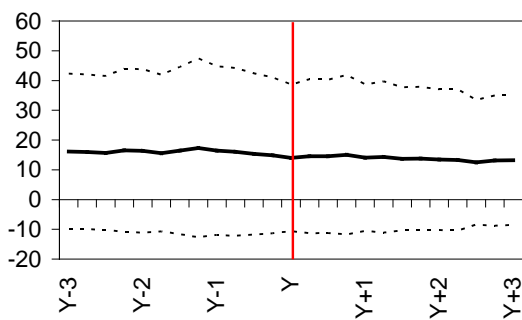
Asian emerging countries around 1997: Average Size of claims on public sector in Category I (% of BS)



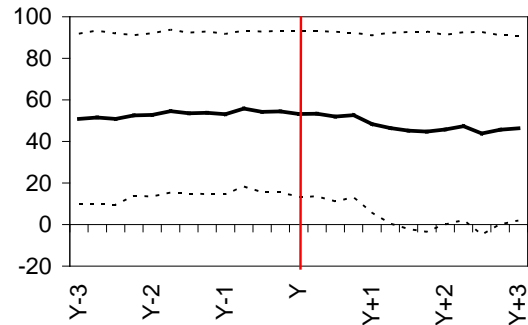
Asian emerging countries around 1997: Average Size of reserve money in Category I (% of BS)



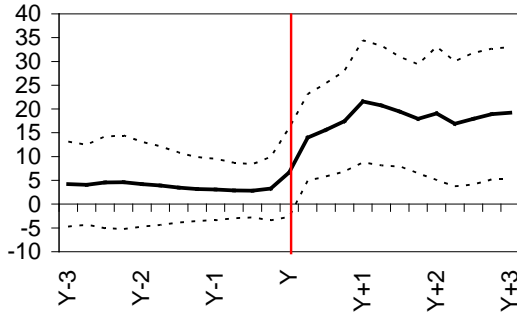
Asian emerging countries around 1997: Average Size of claims on public sector in Category II (% of BS)



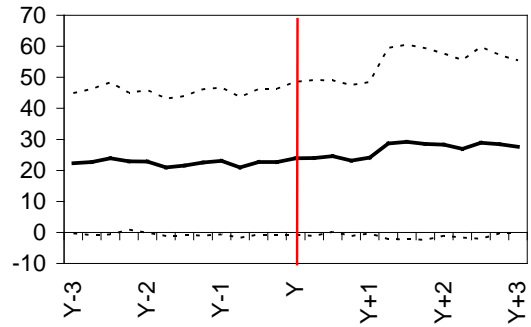
Asian emerging countries around 1997: Average Size of reserve money in Category II (% of BS)



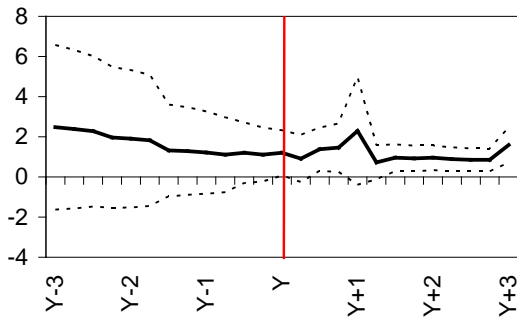
Asian EMEs around 1997: Average Size of foreign liabilities in Category I (% of BS)



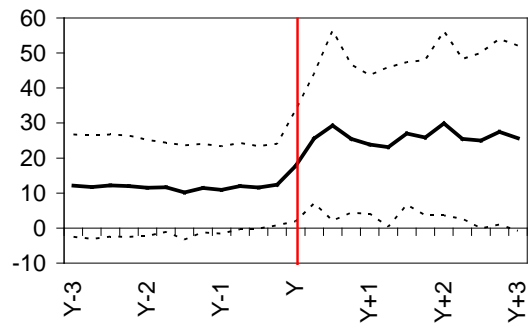
Asian emerging countries around 1997: Average Size of government deposits in Category II (% of BS)



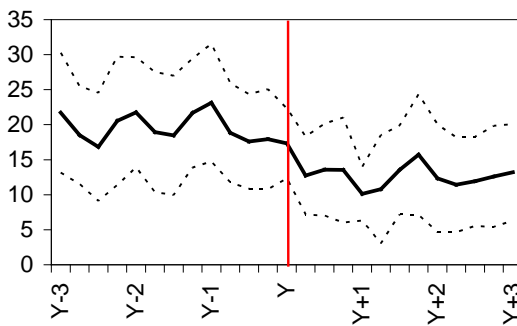
Asian EMEs around 1997: Average Size of foreign liabilities in Category II (% of BS)



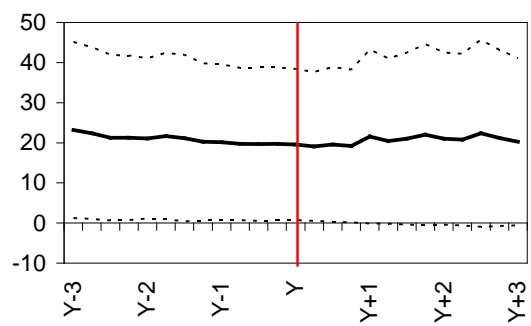
Asian emerging countries around 1997: Average Size of capital accounts in Category I (% of BS)



Asian emerging countries around 1997: Average Size of government deposits in Category I (% of BS)

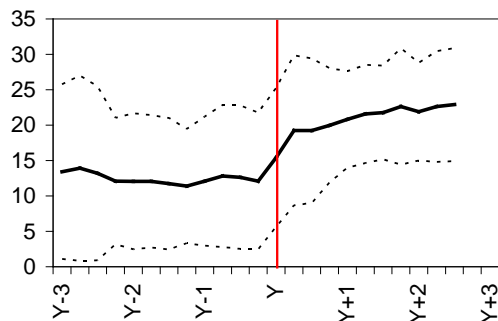


Asian emerging countries around 1997: Average Size of capital accounts in Category II (% of BS)

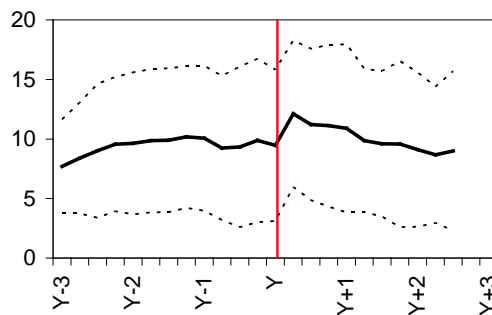


C. The Global Financial Crisis (2007–date)

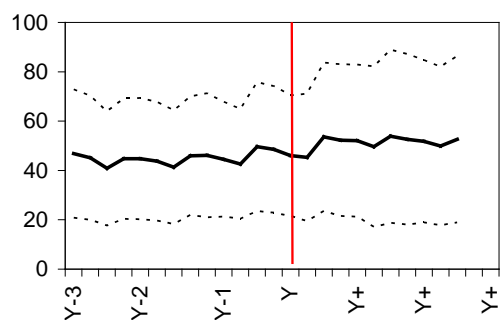
ID economies around 2008: Average Size of BS in Category I (% of GDP)



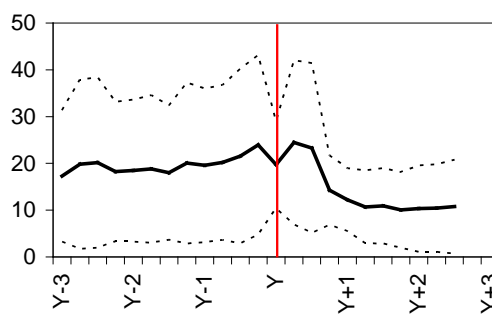
ID economies around 2008: Average Size of BS in Category II (% of GDP)



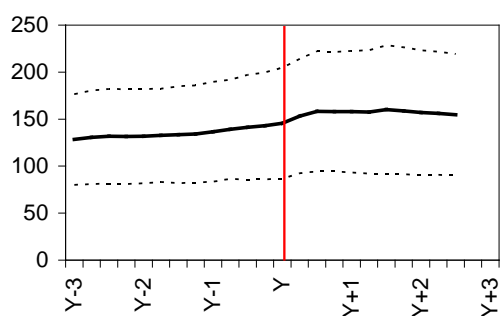
Asian emerging countries around 2008: Average Size of BS (% of GDP)



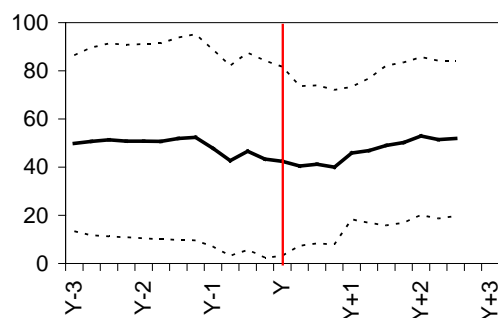
ID economies around 2008: Average Size of foreign assets in Category I (% of BS)



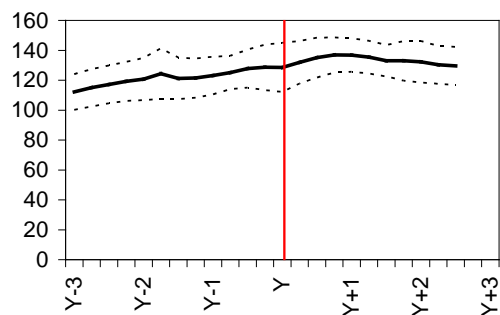
Advanced economies around 2008: Average Size of banking system in Category I (% of GDP)



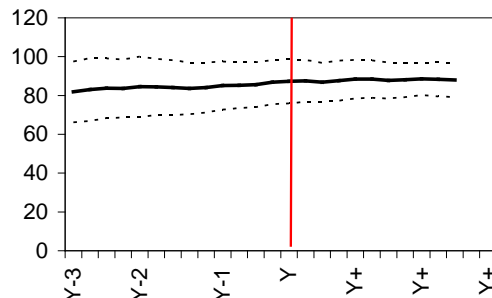
ID around 2008: Average Size of foreign assets in Category II (% of BS)



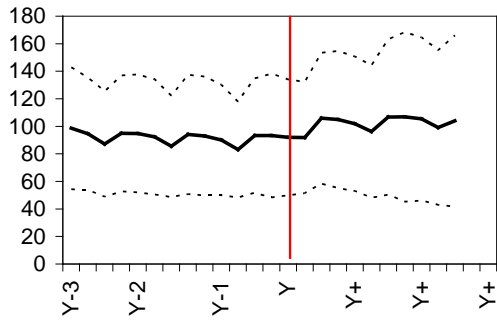
Advanced economies around 2008: Average Size of banking system in Category II (% of GDP)



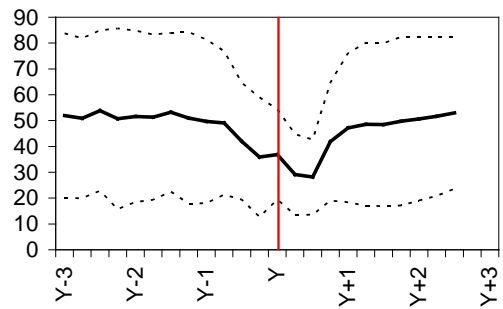
Asian EMEs around 2008: Average Size of foreign assets (% of BS)



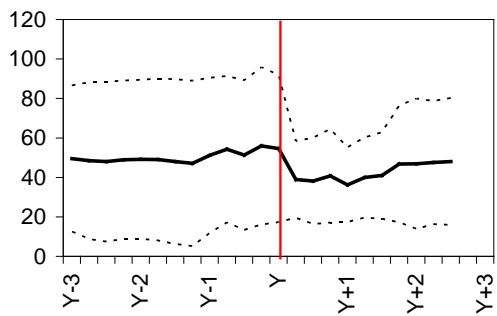
Asian emerging countries around 2008: Average Size of banking system (% of GDP)



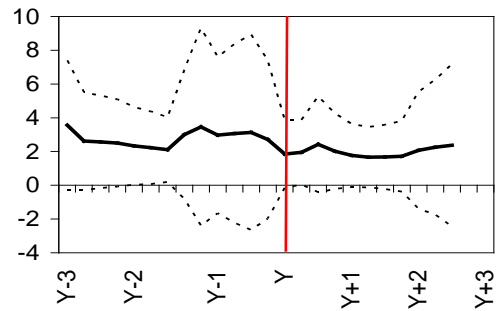
ID economies around 2008: Average Size of claims on public sector in Category I (% of BS)



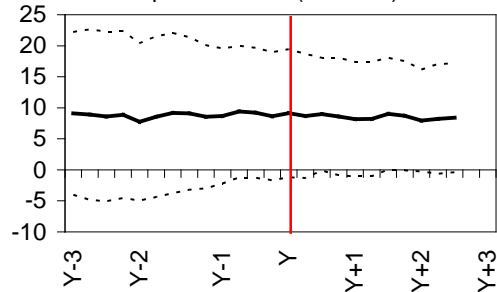
ID economies around 2008: Average Size of claims on public sector in Category II (% of BS)



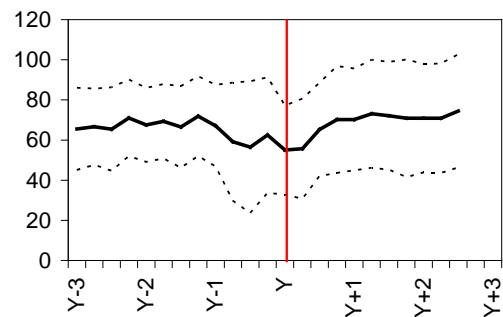
Asian emerging countries around 2008: Average Size of claims on banks (% of BS)



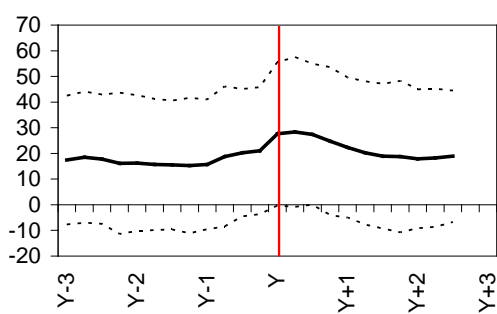
Asian emerging countries around 2008: Average Size of claims on public sector (% of BS)



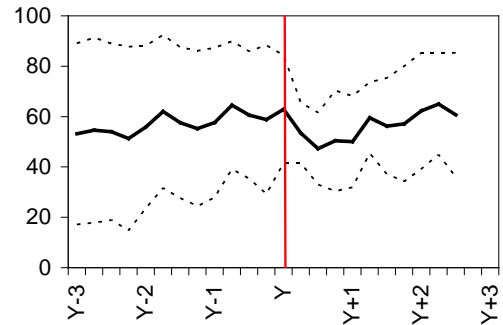
Advanced economies around 2008: Average Size of reserve money in Category I (% of BS)



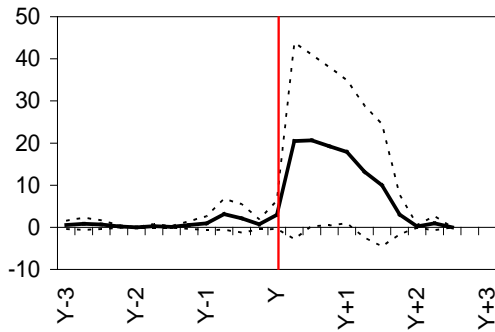
ID economies around 2008: Average Size of claims on banks in Category I (% of BS)



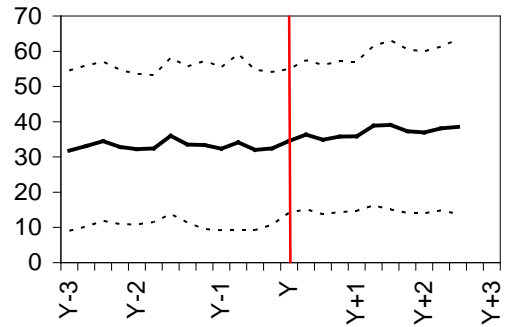
Advanced economies around 2008: Average Size of reserve money in Category II (% of BS)



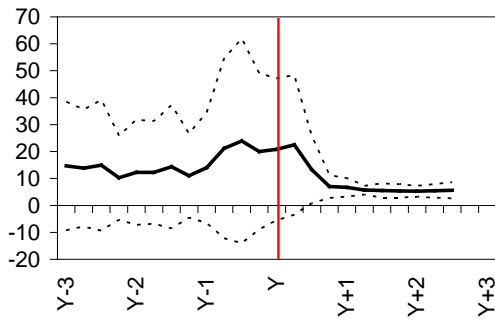
ID economies around 2008: Average Size of claims on banks in Category II (% of BS)



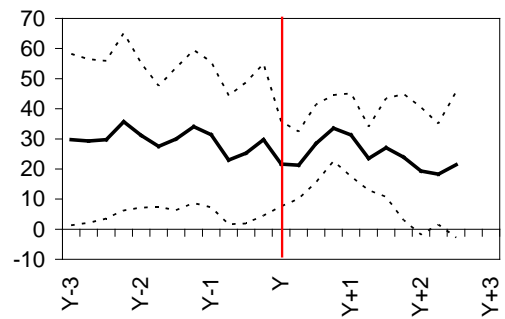
Asian emerging countries around 2008: Average Size of reserve money (% of BS)



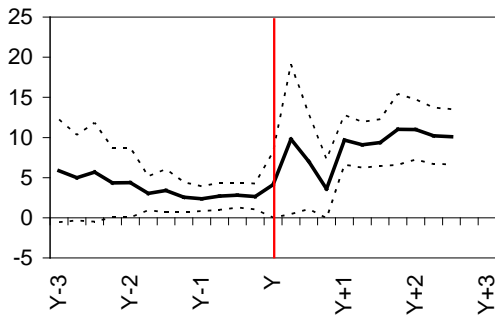
ID economies around 2008: Average Size of foreign liabilities in Category I (% of BS)



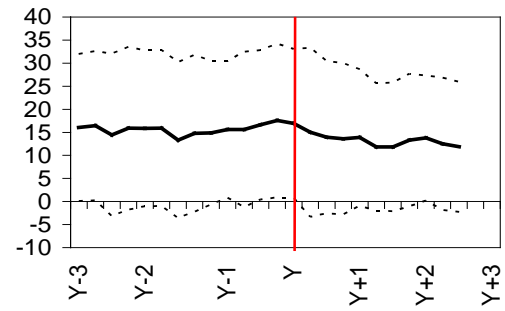
Advanced economies around 2008: Average Size of government deposits in Category II (% of BS)



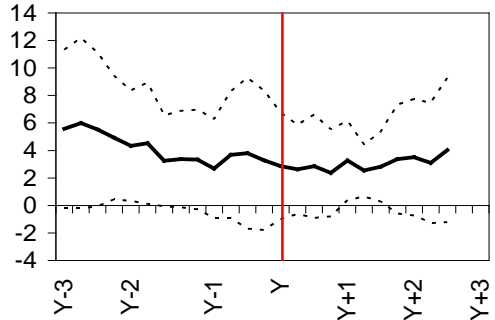
ID economies around 2008: Average Size of foreign liabilities in Category II (% of BS)



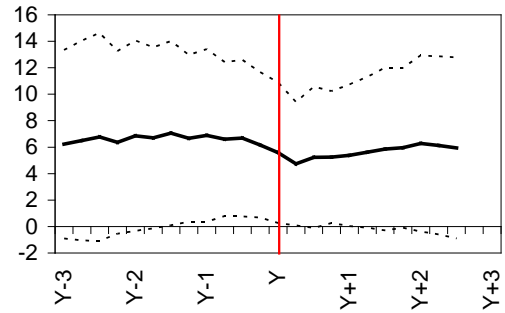
Asian emerging countries around 2008: Average Size of government deposits (% of BS)



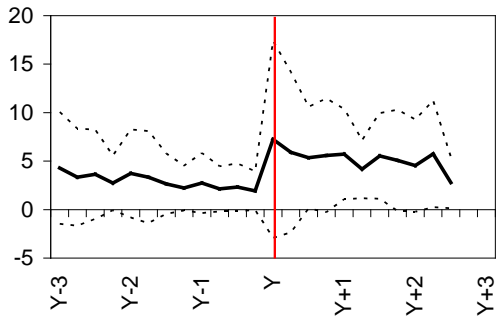
Asian EMEs around 2008: Average Size of foreign liabilities (% of BS)



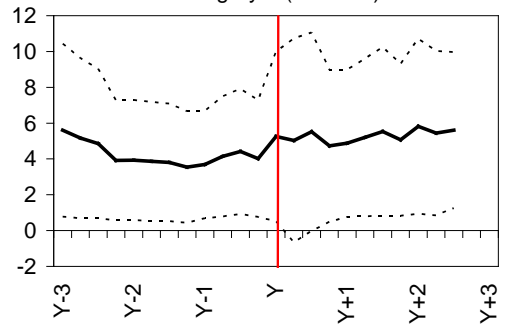
Advanced economies around 2008: Average Size of capital accounts in Category I (% of BS)



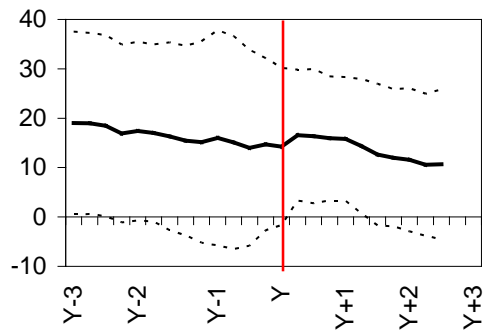
Advanced economies around 2008:
Average Size of government deposits
in Category I (% of BS)



Advanced economies around 2008:
Average Size of capital accounts in
Category II (% of BS)



Asian emerging countries around
2008: Average Size of capital
accounts (% of BS)



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