The Impact of the International Financial Crisis on Asia and the Pacific: Highlighting Monetary Policy Challenges from an Asset Price Bubble Perspective

Andrew Filardo
Bank for International Settlements

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I. Introduction

The international financial crisis of the late 2000s has naturally led to a resurgence of interest in asset price bubble research. For some, the event confirmed the enduring relevance of studying asset price bubbles in our economies. For others, it was a realization that asset price bubbles are of much greater significance than previously thought.

The financial and policy preconditions that foster frothy asset prices from which bubbles emerge have been the focus of considerable attention. While doubtless important, it is not the only aspect that requires greater understanding. We also need to develop a better understanding of the whole life-cycle of asset price bubbles, from their origins, to their expansion and spread, the inevitable collapse, and the aftermath that has to be cleaned up. It is increasingly recognized that researchers must move on from treating bubbles as one-off, exogenous events. The challenge is to develop a more holistic approach, and then build into our policy models endogenous bubble behavior. Such behavior may indeed be rare but nonetheless has its origins in a number of avoidable factors, not least being some combination of financial fragility, flawed policy frameworks, and poor risk management decisions.

This paper contributes to our understanding of asset price bubbles by looking at one aspect of the recent international financial crisis, namely the financial market spillovers from the West to Asia and the Pacific. Where did it come from and how will it end?[1] While there are many different ways to conceptualize the spillovers, this paper will focus on the cross-border spillovers that led to severe underpricing of various types of assets in the region. In other words, experience in Asia and the Pacific involves a typically underrepresented protagonist in most crisis stories, a negative asset price bubble. And, just as with the policy response to the bursting of the dot-com bubble in the United States may have contributed to the housing problems in the 2000s, there are concerns that accommodative monetary policy and strong credit growth today in Asia-Pacific economies may be laying the foundation for a round of positive asset price bubbles.

[1] We borrow these questions from the classic paper on the Japanese banking crisis by Hoshi and Kashyap (2000). While the questions are the same, the answers will be rather different. In the case of Japan, the crisis remained largely contained in the country and had its origin in the deep-seated problems of the Japanese banking system. In the case of the international financial crisis in Asia and the Pacific, the origin, dynamics and geographic scope are much different. Even though Asia-Pacific economies learned the lessons of the Japanese experience, they could not escape the consequences of a different type of asset price bubble. This Asia-Pacific story will be told in this paper.

The paper begins with a brief discussion of a negative asset price bubble and a narrative of the international financial crisis in Asia and the Pacific, highlighting the timeline of the event. Prior to September 2008, the international financial crisis had had a limited impact on Asia-Pacific markets. To be sure there were periods of unusual stress but, by and large, the region was more focused on macroeconomic policy issues throughout much of the year. That all changed in late 2008 as the region, despite its strong economic and financial fundamentals, entered what was to become a sharp V-shaped business cycle. Through the lens of a negative asset price bubble perspective, this paper helps to shed new light on the unusual dynamics as well as the policy tradeoffs faced during the crisis and afterwards. Asia and the Pacific economies are particularly useful "laboratories" to examine these phenomena because of the diverse economic, financial and policy frameworks in place.

The paper also presents a simple model of endogenous asset price bubbles to clarify some of the policy issues. The model assumes there are two regions of the world that are susceptible to domestic asset price bubbles. This type of model emphasizes the highly persistent nature of financial shocks associated with boom-bust dynamics and the potential spillovers across geographic borders. An asset price bubble in one economy can influence the likelihood of an asset price bubble in the other economy. Possibly most important, the actions of the policymaker in one region can affect not only the occurrence of a bubble in its domestic market but also the occurrence of a bubble in the other region. This type of model also elevates the importance of tail risk considerations for policymakers, opening up consideration of more complex monetary policy trade-offs than in conventional macroeconomic models.

The paper then explores the implications, combining both the narrative from the crisis and the implications of the theoretical model to understand better the regional policy trade-offs that occurred during the international financial crisis. In addition to emphasizing the critical importance of having strong economic and financial fundamentals going into a crisis period, it also highlights the value of monetary policymakers adopting state-dependent policy frameworks. During normal times, monetary policy focused on price stability makes sense. During crisis times, the priorities of a central bank may need to be adjusted by putting more weight on financial stability than on short-term inflation stability. This comes down to placing more weight on tail risks when making policy decisions. Practically, this means that short-term deviations

from (implicit and explicit) inflation targets may be appropriate, if not optimal, when coming out of a crisis.

The paper proceeds as follows. Section 2 lays out the basic intuition of a negative asset price bubble. Section 3 reviews the Asia-Pacific experience during the recent international financial crisis, highlighting aspects of this new bubble perspective. Section 4 then presents a simple international monetary policy model with negative asset price bubbles to explore the theoretical channels of spillovers and the policy trade-offs. Section 5 draws on historical narrative and theoretical findings to evaluate the policy implications. Section 6 offers some conclusions.

II. Conceptualizing negative bubbles

An asset price bubble can be thought of as the gap between an asset price's valuation and its theoretical value based on fundamentals. Positive asset price bubbles arise when market prices exceed the fundamental value and, analogously, negative ones when market prices fall below the fundamental value.[2]

While this symmetry is appealing, the dynamics of positive and negative asset price bubbles are likely to be asymmetric. Positive price bubbles, be they in equities, housing, foreign exchange or other widely held assets, are generally thought to inflate gradually over time. The main driver is typically assumed to be overconfidence that manifests itself in elevated risk appetite (technically, less risk aversion) and overly optimistic expectations of future earnings. While the prices are misaligned with longer term fundamentals, the origin of big bubbles often corresponds to periods of history when innovations, real or financial, foster an environment of unbridled optimism about the future. And, they can be egged on when policymakers and other influential institutions and people rally support along the way by arguing that this time it is different. In such a situation, optimism breeds more optimism until significant doubts surface about the sustainability of the upward trend in asset prices. The break in confidence, even something that, in retrospect, might seem relatively minor, signals the beginning of the tumble in asset prices as the bubble bursts.

[2] There is of course a long literature on bubbles from both historical and theoretical perspectives. This paper adopts the notion of irrational asset price bubbles, in contrast to their more mathematically rigorous cousins of the class of rational bubbles. The pragmatic policy perspective is consistent with that of Allen and Gale (1999).

Macroeconomically relevant bubbles are those that, when they collapse, have severe consequences for the real economy.

Negative asset price bubbles, in contrast, would seem to come in a wider variety of types. On the one hand, negative asset price bubbles can develop and burst in an analogous way to positive asset price bubbles, as irrational beliefs permeate an economy; for the negative asset price bubbles it would be irrational pessimism. One can envision this bubble process building over time slowly, as pessimism and risk aversion breed further pessimism and risk aversion. Over time asset prices would underperform historical norms and the overpricing of risk would eventually raise the attractiveness of the assets as an investment. Ultimately, economic and financial fundamentals eventually assert themselves, confidence returns and the negative bubble deflates – it could deflate either with a pop or with a fizzle.

On the other hand, negative asset price bubbles could start more dramatically. In this case, a sudden negative overreaction to current events leads to a significant and immediate underpricing of risk. The wave of pessimism could also initiate deleveraging of the financial system and equally wrenching adjustments to household and corporate balance sheets. In such circumstances, it may be hard to rule out the possibility that the process could be remarkably persistent and unusually nonlinear. If medium-term fundamentals were sound initially, it opens up the possibility that strong policy actions would be effective in stemming the downward spiral and affecting a more rapid recovery than would otherwise be the case.

Modeling these dynamics is not without challenges. The slow, persistent decline in confidence can be modeled as a gradual expansion of a negative asset price bubble. The growth and collapse could be captured by a time-varying Markov process, as has been done for positive asset price bubbles.[3] However, a sharp initial decline in asset prices associated with a collapse in confidence may require additional modeling. One approach is to think of the sharp decline in asset prices as a one-off shock which then ripples through the system. This could set off a more generalized pall of pessimism that then leads to further declines, which can be modeled as a mixture of random shocks and a time-varying Markov process. These options will be explored below.

This more asymmetric version of the negative asset price bubble appears well suited to addressing international financial market spillovers similar to the type seen during the

[3] See Filardo (2006) for example.

international financial crisis in Asia. As described furthering more detail in the next section, Asia had a strong set of economic and financial fundamentals going into the crisis. This, however, was not sufficient to protect Asia from the virulence of the pessimism emanating out of the West. The break in confidence was initially sharp, then it worsened as the financial pessimism morphed into a macroeconomic crisis before experiencing a rapid macro-financial recovery.

III. Asia and the spillovers from the international financial crisis

The notion of a negative asset price bubble is a useful lens through which to analyze the spillovers to Asia during the international financial crisis, the dynamics of the recovery and, possibly most important, the policy trade-offs faced by policymakers in the region. To fully appreciate the relevance of this perspective, it is useful to review the timeline and impacts of the crisis on Asia.

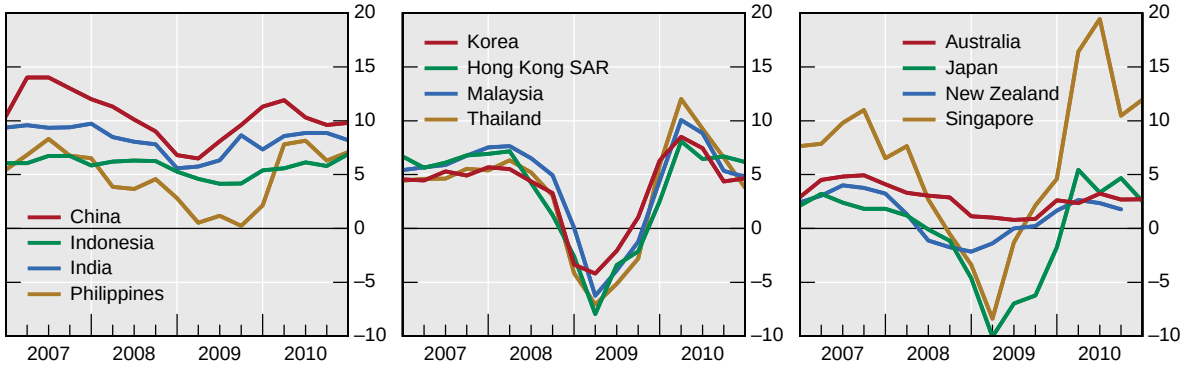
To be sure, economies in the region were affected by the international financial crisis in different ways. Some saw a sharp contraction in output while others experienced a growth cycle recession (Graph 1). At the risk of oversimplifying the complexities of such a large, diverse region, this paper argues that the chronology of the crisis in Asia and the Pacific can be succinctly characterized in 5 phases: i) the initial headwinds blowing from the West, ii) the tsunami, iii) the immediate aftermath , iv) the recovery, and v) the long road to full normalization.[4]

[4] For greater detail, see Filardo et al (2010).

Graph 1

Real GDP growth[1]

In per cent



[1] Annual changes.

Source: national data.

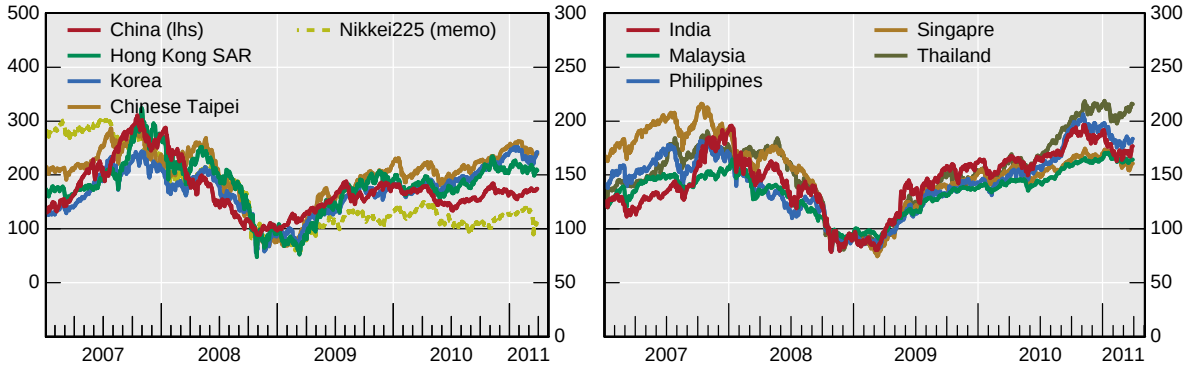
The headwinds (mid-2007-mid-2008)

The initial cracks in the financial system of the West had a relatively limited impact on the economies in Asia during this phase of the international finance crisis. In the run-up to the crisis, it is important to remember that global financial markets were robust and credit growth was strong. The pricing problems that developed early in the crisis were largely limited to certain classes of risky assets, as exemplified by the difficulties at BNP Paribus and later at Bear Stearns. There were also stresses in interbank markets in some advanced economies that led to large, temporary liquidity injections that were needed to restore more orderly financial conditions in some economies. Relative to what was to follow, these rumblings paled in comparison – economically and financially - to the seismic event that occurred in September 2008.

In Asia, the direct spillovers at this time were relatively modest financially and did not significantly alter the macroeconomic trajectories for output and inflation. The Asian exposures to the so-called toxic assets were rather modest. But the region was not immune from the more generalized decline in risk appetites of global investors. Low-grade borrowers in India, Indonesia and the Philippines lost access to markets for a while. And even high-grade borrowers faced much higher financing rates, which was a burden for those economies with large external financing needs. Equity prices came off highs achieved late in 2007 (Graph 2).

Graph 2

Equity prices in Asia[1]



[1] In local currency; December 2008 = 100.

All in all, however, the impact of these financial headwinds on the prospects for economic growth in Asian economies was modest. GDP growth forecasts were still seeing 4-5 percent growth in 2008 and 2009, despite these financial rumblings. Strong Asian growth at the time fed increasingly popular views that the region had become sufficiently resilient to shocks from the rest of the world that it could be characterized as effectively decoupling from the West. One manifestation of this was heavy US dollar borrowing, as expectations of domestic currency appreciation (or at least stability) remained in place in many economies but especially in Korea. While this view would eventually be disproven in the next phase of the crisis, the robust economic activity in 2007 and 2008 contributed to concerns of overheating and price stability. Rising inflation pressures in Asia came from global energy and food prices, which also helped to insulate commodity-producing economies from the financial headwinds from the West.

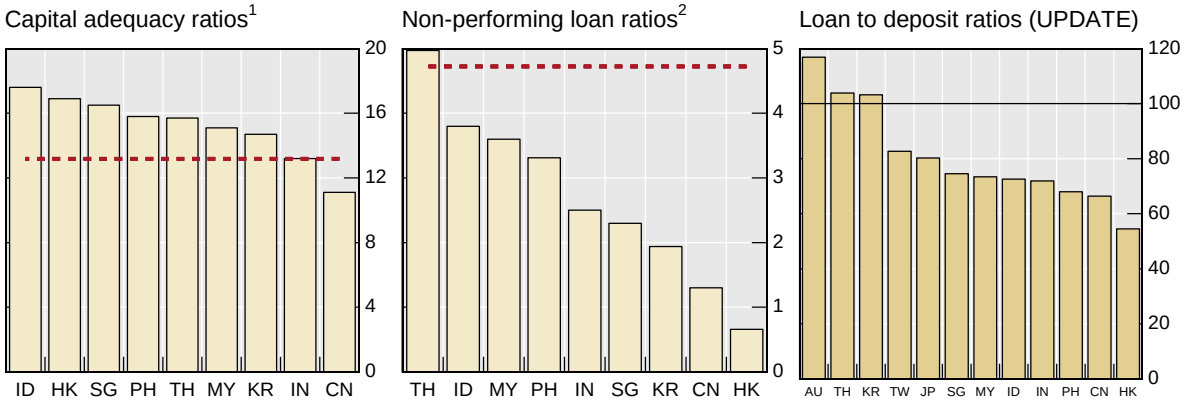
Monetary policy throughout much of the region was being tightened during this phase, especially in India and Indonesia where inflation rates reached double digits. Japan was a stark exception as it kept its policy rate at 0.5%, as its incipient recovery after a very long period of subpar performance seemed particularly vulnerable to the adverse developments in North America and Europe. Malaysia also kept policy rates relatively low as it expressed concerns about the downside tail risks that were brewing on the other side of the Pacific Ocean. New Zealand lowered its policy rates in part because of the slowing of the economy but also the rising term premium on their borrowing.

It is also important to note the performance of banks in the run-up to this phase of the international financial crisis. Asia-Pacific banks weathered this period rather well, continuing to report earnings and experiencing only minor losses. Capital adequacy ratios remained high throughout the period, non-performing loans were low and loan-to-deposit ratios were at a comfortable level as global wholesale funding markets experienced stress (Graph 3). In part, the health and resilience of Asia-Pacific banking systems stemmed from the relatively traditional bank business models. On the liability side, the banks rely heavily on retail deposits; Australia, Korea and New Zealand, though, relied on wholesale funding more extensively than the others. On the asset side, banks generally used the traditional originate and hold approach, and investments in complex financial instruments remained limited.

Graph 3

Soundness of banking sector in emerging Asia

In per cent



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

Numbers refer to the most recent available data, varying between September 2009 and August 2010. The red lines represent the averages of these indicators in the Euro area, Japan, United Kingdom and the United States.

[1] Capital as a percentage of total risk-weighted assets. [2] Definitions may vary across countries.

Sources: Bloomberg; CEIC; IMF; national data.

In part, the Asian banking model reflected the relatively conservative regulatory regime developed in the 2000s, in light of the lessons learned during the Asian Financial Crisis of the late 1990s. During that crisis, the weak banking regulatory systems led to financial system weaknesses that resulted in a dramatic reversal in fortunes. Crises in Asia and elsewhere also served as a backdrop for this approach by both the regulators and the regulated. Naturally, regulators took a relatively conservative approach toward financial stability issues. Maybe more

important, the regulated sector also took a conservative approach towards risk management, generally adopting practices that provided a high degree of resilience during the recent international financial crisis.

Asia and the Pacific also learned important lessons from their 1990s crisis about the value of fiscal discipline and the value of possessing a war chest of foreign reserves, just in case. Fiscal authorities strengthened their policy frameworks in the 2000s, leaving them with considerable fiscal room for maneuver at the time of the international financial crisis. Fiscal surpluses were the rule rather than the exception and government debt was relatively low on an international standard; Japan was a notable exception to this trend.

The region had accumulated massive quantities of foreign reserves throughout the decade. Early on, central banks and finance ministries focused on building buffer stocks motivated primarily by achieving reserve adequacy levels using various metrics (e.g. reserves as a share of GDP, as a share of 3-months of imports and of 1 year of short-term debt). Later in the decade, prolonged exchange rate intervention, which added further to reserves holdings, was largely a by-product of the exchange rate regime. As economies in the region resisted nominal exchange rate pressures, foreign reserves reached unprecedented levels. Some of these reserves and forward FX positions that were built before 2007 helped protect the region from credit rating downgrades as the headwinds from the West picked up. And, some economies used the stock of reserves to help provide dollar liquidity and stabilize their currencies.

The financial tsunami (late 2008)

Despite the strong economic and financial fundamentals in Asia and the Pacific, the region was not immune from the sharp intensification of the international financial crisis after the collapse of Lehman Brothers in September 2008. The arrival of the financial tsunami to the shores of Asia-Pacific was fast and occurred with unprecedented intensity. The initial impact was felt in the financial markets as market confidence and risk appetite collapsed. Asia-Pacific equity indexes fell sharply at the end of 2008, even after prices drifted down from the highs in 2007 through most of the year. Housing prices also faced downward pressures.

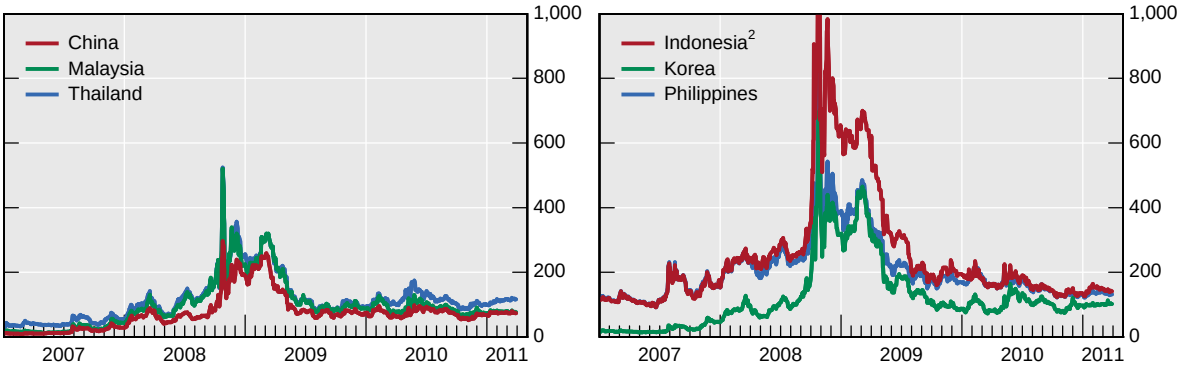
Possibly more revealing was the sharp spike in sovereign CDS spreads in the region (Graph 4). Indonesia, Korea and the Philippines experienced the worst of it. But all were affected to varying

degrees. The iTraxx Asia ex Japan spread jumped from around 150 to 600 briefly, before settling to around 400. The iTraxx Japan did not jump as high initially but then rose to the 500-600 range.

The skyrocketing CDS spreads represented massive reassessments of risks. Research by Kim, Loretan and Remolona (2010) found that most of the increase was due to changes in risk appetite, rather than changes in the underlying expected default rates. This provides solid evidence in Asia and the Pacific that overpricing of risk is an important factor. Moreover, the change in risk appetite had consequences for the real economy. Along with a rapid reversal of commodity prices, there was a multiplication of the downside risks to the economic outlook and genuine concerns about the consequences for financial stability in the region became evident.

Graph 4

Sovereign debt CDS premia[1]

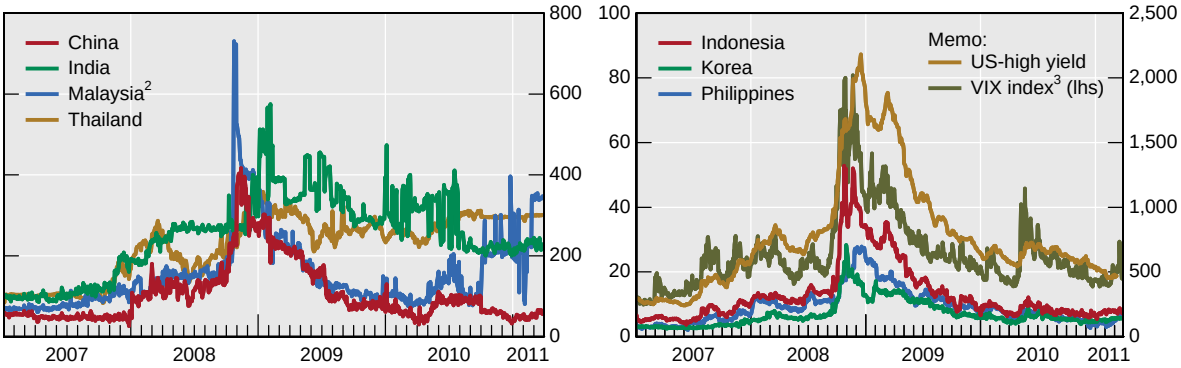


[1] CMA 5-Year Credit Default Swap premia; in basis points. [2] Indonesia's premia exceeded 1000 on December 22, 2008, reaching a peak of 1256.7 on December 23, 2008.

These developments also highlighted the nature of the spillovers of the international financial crisis to Asia and the Pacific. To be sure, part of it could be blamed on deteriorating prospects for economic growth and earnings through trade channels. But, a more substantial part was due to a massive wave of investor pessimism that led to an abrupt swing in the mispricing of risk: from a large underpricing of risk before the crisis to a significant overpricing of risks after the Lehman bankruptcy (Graph 5). In other words, a large negative asset price bubble spilled over to the region.

Graph 5

Bond spreads[1]



[1] Over benchmark US Treasury bonds; in basis points. [2] Malaysia's bond spread exceeded 600 on October 23, 2008, reaching a peak of 730.7 bps on the same day. [3] Implied volatility of US equities.

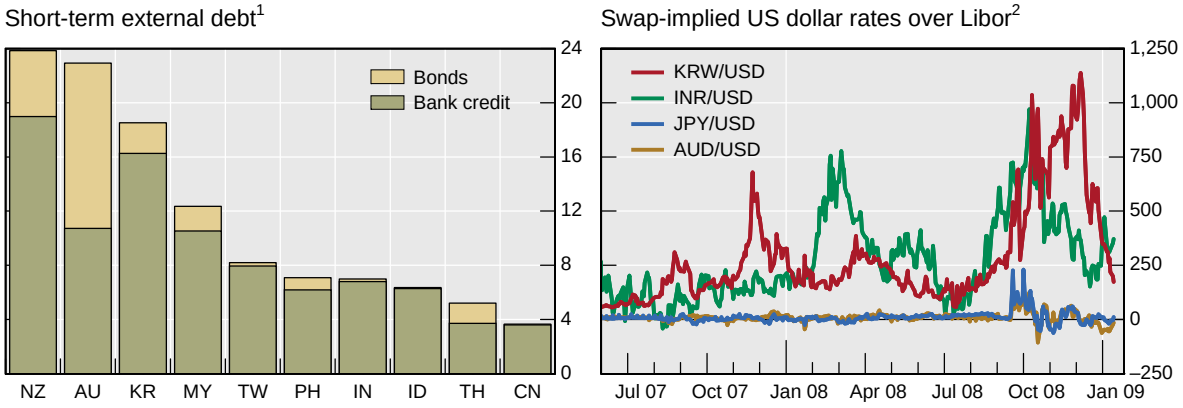
One interesting feature of the international financial crisis was the severe disruption in international, especially US dollar-denominated, money and capital markets. The disruptions raised financing costs faced by borrowers in Asia and Pacific, which intensified the impact of the break in confidence. Huge gross US-dollar denominated exposures in economies such as Korea proved very costly as Asian currencies depreciated. The disruptions happened in three ways: by directly reducing the availability of offshore credit to Asia-Pacific residents; by increasing demand from non-residents to borrow in Asia-Pacific markets; and by leading market-makers to scale back their activities.

With respect to the curtailment of offshore credit, the initial consequences were modest (Graph 6). The small size and covered nature of most Asia-Pacific countries' short-term foreign liabilities limited funding problems. During normal times, Asia-Pacific firms did not have large US dollar borrowing requirements, as many were able to meet their requirements from export revenues and some held foreign currency assets which more or less matched the maturity of their foreign currency liabilities. For example, in Malaysia, Thailand and the Philippines, interbank liabilities were typically matched by short-term foreign currency assets, such as trade finance. In Australia and New Zealand, foreign currency liabilities were systematically swapped into local currency, and local banks shifted funding to local sources when offshore markets no longer offered attractive financing on a swap-covered basis.

However, the freezing-up of short-term markets for US dollars in September and October 2008 had serious repercussions for Asia and the Pacific. The drying up of offshore credit, at the same time exports were collapsing, forced firms needing to refinance dollar-denominated debts and derivative exposures to sell local currency assets and to seek US dollar borrowing from locals. Banks in India and Korea offered exceptionally high interest rates in October 2008 to raise US dollars from local sources. In other Asia-Pacific markets, including Australian dollar and yen markets, demand for US dollars led to some stress, but not severely so. A second way in which the disruptions in US dollar markets caused local financing conditions to tighten was that non-residents sought to tap Asia-Pacific markets and swap the proceeds for US dollars or other foreign currencies, pushing up local yields and credit spreads in the process. Third, international banks responded to the difficulties that they themselves faced in securing financing by scaling back their activities. As a result, Asia-Pacific securities became more expensive to trade. International banks were important dealers not only for foreign currency securities issued by Asia-Pacific borrowers but also for local securities and derivatives. Their retrenchment caused transaction costs to increase and liquidity to drop for a wide range of instruments.

Graph 6

Foreign currency funding pressures



AU = Australia; CN = China; ID = Indonesia; IN = India; KR = Korea; MY = Malaysia; NZ = New Zealand; PH = Philippines; TH = Thailand; TW = Chinese Taipei.

[1] External liabilities with a remaining maturity of one year or less, as a percentage of GDP; at end-September 2008. Bonds refer to foreign currency debt securities outstanding; bank credit refers to consolidated international claims of BIS reporting banks. [2] Spreads between US dollar interbank rates implied by covered interest parity and three-month US dollar Libor, in basis points; implied rates are calculated from forward and spot exchange rates against the US dollar and local onshore interbank rates.

Sources: Bloomberg; Datastream; BIS calculations.

The US dollar squeeze was addressed in part by the ample foreign exchange reserves that Asian economies had amassed in the previous decade. Furthermore, the liquidity assistance in foreign currency provided by the swap facility with the Federal Reserve was a game changer. The actual amount of support was helpful in addressing local banking needs as well as regional needs, more generally, as the US dollars were circulated in the region. In addition, the swap lines provided a signaling effect that was significant in calming market jitters.[5] The knowledge that the Federal Reserve stood ready to provide emergency funds was potentially more important than the massive war chests of international reserves. Australia, Japan and Korea drew on the swap lines while New Zealand and Singapore did not.

Policymakers in the region responded to this changing financial environment with alacrity. Even though the complete set of data would not be available for months, there was no doubt that the sharp intensification of the crisis in the North Atlantic region was a game changer for Asia and the Pacific. The policy response was swift and deliberate.

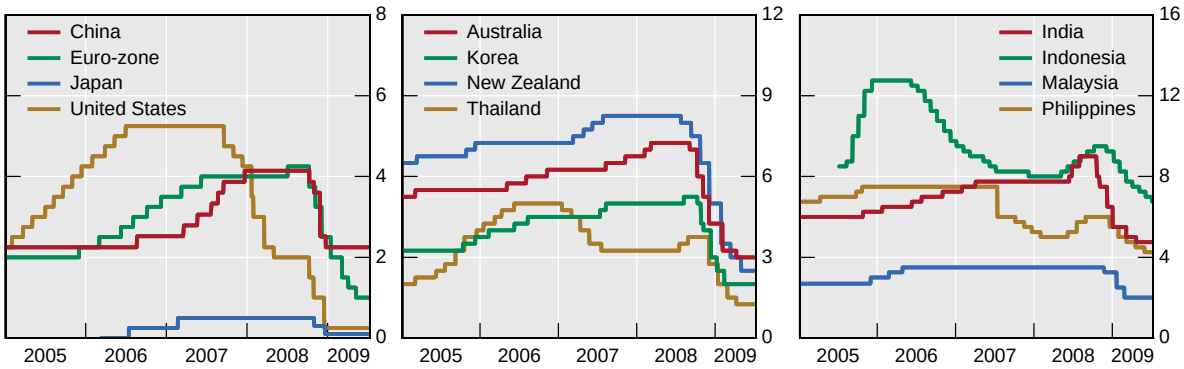
On the policy side, monetary policy interest rates were cut across the board and some were deep. New Zealand started with relatively high policy rates and cut 325 basis points. A number of economies cut their reserve requirements. Massive emergency fiscal stimulus plans were announced. With trade collapsing, in part because of the expected drying up of trade finance, special trade finance programmes were announced. This liquidity squeeze in various markets complicated the monetary transmission mechanism; local currency liquidity supports were provided, including extending maturities of the borrowing and broadening of collateral eligibility for the borrowing.

[5] See Baba and Shim (2011) for a detailed analysis of the Korean case.

Graph 7

Monetary policy rates[1]

In per cent



[1] Policy target rates or their proxies. For China, household saving deposits one-year rate; for the euro area, ECB minimum bid refinancing one-week rate; for Japan, BoJ target rate; for the United States, fed funds rate; for Australia, RBA cash target rate; for Korea, overnight call rate target before 7 March 2008, one-week BOK Base Rate thereafter; for New Zealand official cash daily rate; for Thailand, 14-day repo rate before 17 January 2007, one-day repo thereafter; for India, RBI repo cutoff yield; for Indonesia, BI reference interest rate; for Malaysia, overnight policy rate; for the Philippines, overnight reserve repurchase agreement RRP daily rate.

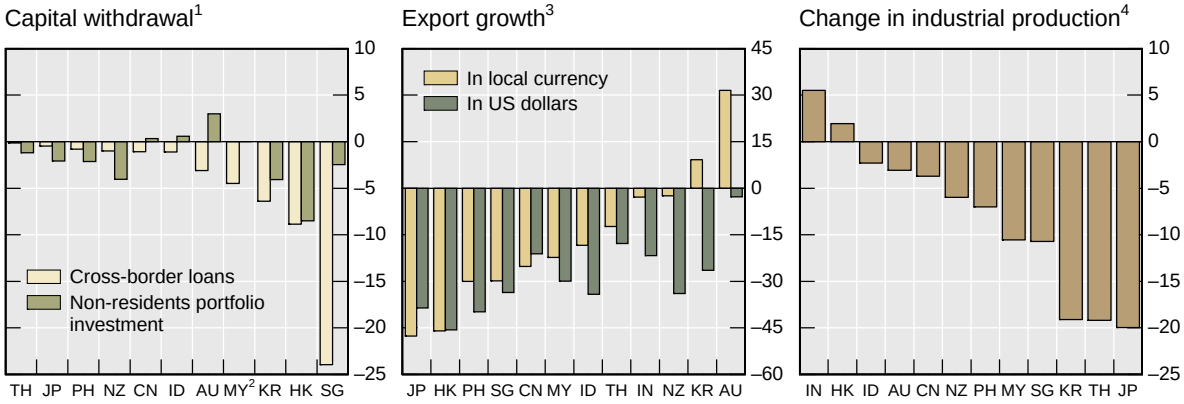
Source: Bloomberg.

The immediate aftermath (late 2008 – early 2009)

By late 2008, it became increasingly evident to policymakers that this financial tsunami had hit the shores of Asia and the Pacific and was quickly morphing into a full-blown macroeconomic meltdown (Graph 8). Exports fell sharply, with the small open economies being severely hit. Industrial production was collapsing as inventories liquidity accelerated the descent. At the time, it was not clear just where the bottom of the cycle would finally end up. As GDP contracted in most of the Asia-Pacific economies, the prospects for growth in 2009 and 2010 were also marked down significantly. Hong Kong, Japan, Singapore and Thailand were the hardest hit economies, with real GDP falling by more that 9%. All this shows just how potent the spillover channels were.

Graph 8

Crisis impact on capital flows, exports and industrial production in Asia



For an explanation of the economy abbreviations, see Graph I.3.

[1] Q4 2008 data for cross-border loans and 2008 annual data for non-resident portfolio investment (gross flow), both as a percentage of 2008 GDP. [2] Data on non-resident portfolio investment not available. [3] January–February 2009 over January–February 2008. [4] December 2008 over June 2008; percentage change.

Sources: IMF; CEIC; Datastream; IMF; national data; BIS.

There were some silver linings in the dark clouds. China, India and Indonesia – the three largest emerging market economies in Asia – were able to grow above 5%. This helped to support economic activity throughout the region owing to the extensive regional supply chains. And, the aggregate demand sustained relatively high commodity prices, which was important for the commodity exporting economies. Moreover, the ability of these three large Asian economies to weather the storm laid the foundation for the eventual global recovery. One lesson from the crisis was that those economies most vulnerable to a shock to external demand suffered heavily. The large economies with substantial domestic demand sectors and limited financial linkages globally weathered the storm relatively better than the small open economies.

The credit crunch in the region compounded the macroeconomic decline. International banks retreated from the region, leaving fewer lenders, at the same time that risk appetite fell. Those economies with less highly-rated financial systems suffered more as risk spreads ballooned, and as a consequence borrowers faced much higher external funding costs. Cross-border capital outflows aggravated the situation for those economies with fairly liquid and open equity markets, such as Korea. The retreat of international banks also precipitated cross-border banking outflows, especially in the financial centers of Hong Kong and Singapore.

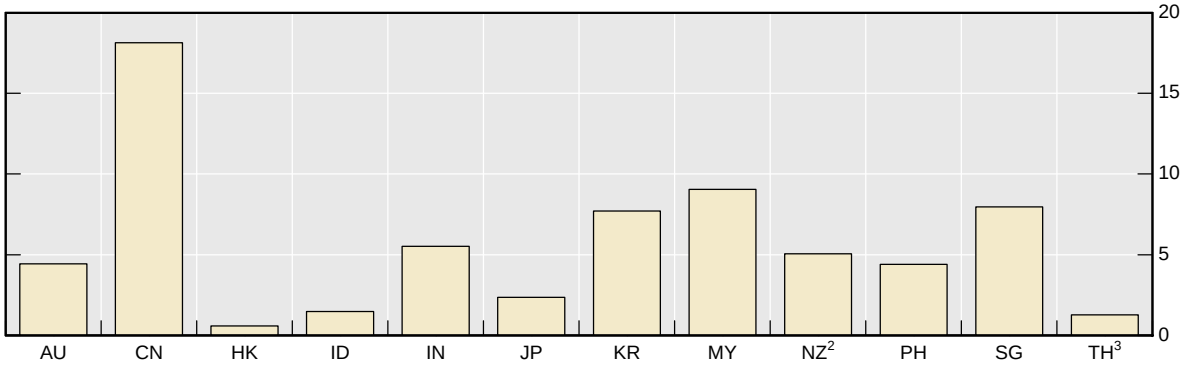
One of the big surprises was the vulnerability of trade finance during the crisis. Trade credit in Asia-Pacific is typically denominated in US dollars and is short-term in nature; hence, it is thought of as being low-risk. However, as dollar liquidity dried up at the height of the crisis, and the FX swap market became dysfunctional, exporters found it difficult to roll over this form of credit. Domestic and regional banks partially filled the gap left by the international banks and new guarantees from governments and international agencies helped too.

In the end, however, the containment of the downside risks can be attributed in large part to the confidence-restoring actions of the governments in the region. In addition to further easing of monetary policy, large supplementary fiscal packages were arranged, in some cases complementing earlier packages (Graph 9). China's multi-year spending initiatives eventually rose to between 10% and 15% of GDP. The median size of the packages in the region was about 5% of GDP.

Graph 9

Announced size of fiscal stimulus relative to 2008 GDP[1]

In per cent



For an explanation of the economy abbreviations, see Graph I.3.

[1] Data up to April 2009; some announced stimulus plans may be spread over multiple years. [2] 2007 GDP number used as a denominator. [3] Not including infrastructure spending plans of THB 1.43 trillion over the 2010-12 period.

Source: IMF; Reuters News; UNESCAP.

A range of unconventional policy actions complemented the conventional macroeconomic tools. They included liquidity assistance in local currency, lending of foreign exchange, expansion of blanket deposit insurance, guarantees of non-deposit liabilities, bank capital injections, short-sale restrictions, relaxation of the mark-to-market rules and the purchase of assets. Explicit and implicit government guarantees also helped to restore the rather fragile confidence during this period. As market fears receded and counterparty risks diminished, market sentiment turned

around and became buoyant by March 2009. As mentioned above, foreign liquidity availability played a critical role in calming markets, especially when they became concerned about adequate US dollar liquidity. The large foreign reserve positions in the region released during the crisis augmented the Fed's bilateral swap arrangements in several key Asian economies . The renewed interest in ensuring foreign reserve adequacy in the future prompted the expansion of intra-regional bilateral swap arrangements and spurred progress toward the $120 billion multilateral reserve pooling arrangement under the Chiang Mai Initiative.

The V-shaped recovery (Spring 2009 and beyond)

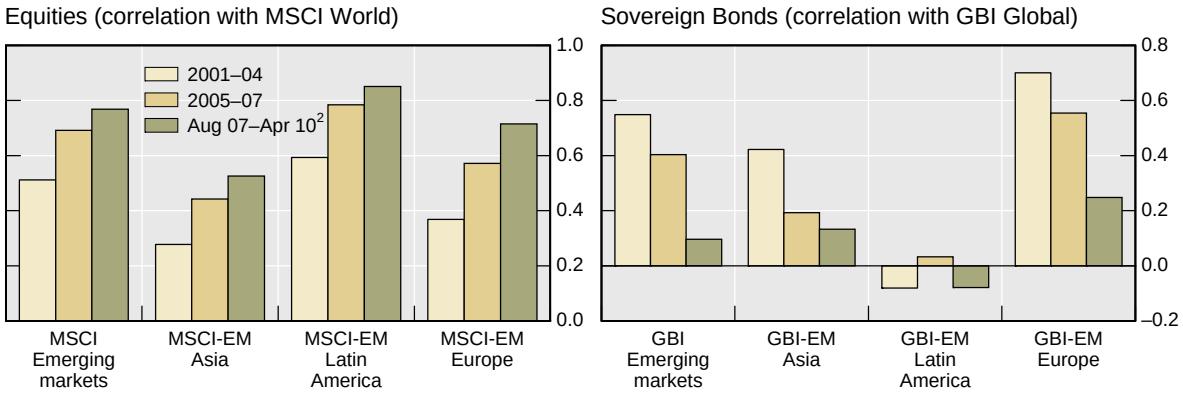
By early Spring 2009, the region showed incipient signs that it was turning the corner. Regional financial markets rallied, reflecting substantially diminished headwinds. Economic activity started to pick up in various parts of the region. While the hardest hit economies experienced a classic V-shaped recovery, this pattern was in no way certain during early 2009. The speed of the recovery was subject to considerable uncertainties about both the durability and breadth of the recovery. One view that received considerable attention at the time was that Asia-Pacific economies could not fully recover until major export destinations in North America and Europe had substantially improved prospects. With little evidence of a sustained turnaround in the major advanced economies, this outcome seemed doubtful, especially because of the lingering financial system stresses and of debt-ladened balance sheets of the banks, the shadow banking system, households and governments. Despite concerns about the major advanced economies, the region did rebound.

By late 2009, however, the success in the region shifted the balance of risks from the downside to the risk of overheating. At the time, accommodative monetary policy remained largely in place as much of the fiscal stimulus continued. Financial markets were on the mends. Another issue that arose during this time for policymakers in the region was that of capital flows. Capital flows returned to Asia and the Pacific, with varying intensities across time and economies. Most broad categories of cross-border flows were picking up. These included foreign direct investment, bond and equity portfolio flows and cross-border bank lending. A number of factors were in play in the region, not least being the prospects for a leading role in the global recovery and the need to tighten monetary policy before the major advanced economies and the other emerging market economies did so. One complicating factor was the flare-up in sovereign debt concerns in Europe

during 2010. This sent a wave of pessimism across the globe, with global risk aversion reversing course for a while. Early on, regional asset prices were impacted in a manner consistent with the higher correlation of global financial markets (Graph 10). By year-end, however, investors appeared to be fairly discriminating, geographically, in their appetite for risk; Asia-Pacific fundamentals were sound and risk spreads reflected this.

Graph 10

Regional correlations in global asset markets[1]



[1] Calculated on daily returns in US dollars. [2] Period of increased global market volatility.

Sources: Datastream; JPMorgan Chase; MSCI Barra.

Against this backdrop, monetary policymakers faced difficult tradeoffs. On the one hand, higher policy rates tended to draw in more capital inflows as international interest rate differentials widened. And, for those resisting currency appreciation, this meant a build-up of one-sided currency bets and carry trade dynamics. On the other hand, low policy rates and the associated prolonged accommodative monetary policy were thought to contribute to asset price bubbles. The evidence during this period supported these concerns. Asia-Pacific equity prices rose rapidly above pre-crisis highs, and property prices in particular jurisdictions saw meteoric rises that raised concerns about bubbles. This was particularly the case in Hong Kong, Singapore and certain cities in China. The reluctance to rely on policy interest rates saw policymakers experimenting with the use of administrative measures such as capital controls and macroprudential tools to rein in capital flow pressures and rapid credit expansion.

Long road to full normalization (2010 to present)

As noted above, the stance of monetary policy in Asia and the Pacific remained accommodative long after the recovery began. Indeed, by some measures of the real policy interest rate, the

stance of monetary policy was extremely loose (Graph 11). One concern is that central banks in the region were keeping policy rates too low for too long. The pickup in inflation and the re-emergence of asset price bubbles all support this conclusion. Going forward, this view would suggest that the inflation fight will be quite difficult. With inflation having picked up, a sharp increase in nominal policy interest rates will be required to raise real policy rates sufficiently to rein in inflationary pressures. If too disruptive, the monetary policy reaction could precipitate a dramatic slowdown and open up another set of daunting policy challenges. This view would argue that, just as in the past, monetary policy that is too pro-cyclical leads to boom-bust dynamics, with respect to goods and services prices as well as asset prices.

In contrast, when looking at the situation through the lens of a negative asset price bubble perspective, the performance of monetary policy in the region takes on a more positive evaluation. This alternative view maintains that the accommodative monetary policy was the appropriate response to the enduring downside risks associated with fragile confidence. Despite nearly two years of recovery, concerns persist that Asia-Pacific economies are susceptible to considerable risks as long as prospects of a sustained recovery in the West remain shaky. Moreover, sovereign risk concerns in Europe and balance sheet adjustments – for governments, corporations and households – in the West, more generally, represent significant tail risks clouding an otherwise fairly bright outlook in Asia and the Pacific (excluding Japan) over the medium term.

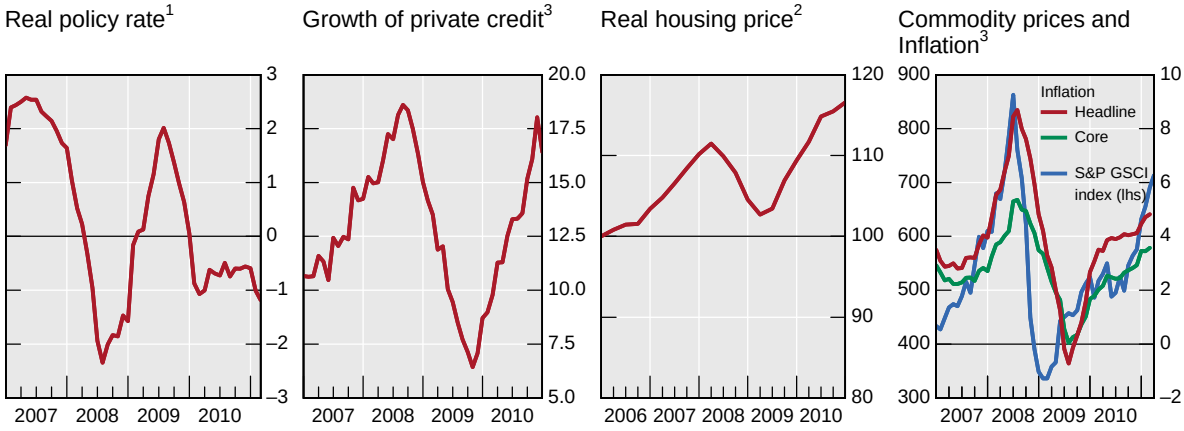
This perspective would argue that monetary authorities in the region have been justified in keeping monetary policy accommodative. The easy policies have helped to boost confidence by providing tailwinds behind the recovery – helping it deepen and broaden – and thereby improving its resilience in case of another negative shock. But such policies are not without their risks. Countering the tail risks from the West with easier monetary policy does suggest that if the tail risks do not materialize, inflation pressures may surge. The increase in inflation, however, is not an indicator of a policy failure but rather a reflection of the risk management approach to monetary policy. If the risks do not materialize ex post, that does not mean that the risk management approach to the range of risks facing monetary authorities has not been optimal ex ante. In other words, it would be incorrect to evaluate the performance of Asia-Pacific central banks by inflation performance alone – as some advocates of inflation targeting might suggest.

Rather, the performance should be assessed on how well the monetary authorities balanced the risks in an ex ante sense.

Full recovery in Asia-Pacific economies and the normalization of the stance of monetary policy is not likely until the global economy is on a more sure footing. In the meanwhile, as the economic and financial tail risks fade, it is important for the policy stance to adjust accordingly. The role of tail risks in policy settings is illustrated in the next section of the paper.

Graph 11

Monetary policy, credit growth housing prices and inflation in Asia



[1] Policy target rates or their proxies corrected by forward- and backward-looking inflation component (equally weighted 12-month backward-looking CPI inflation and 12-month forward-looking consensus expectations); average of China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, Philippines and Thailand. [2] End 2005 = 100; average of China, Hong Kong SAR, Indonesia, Korea, Malaysia, Singapore and Thailand. [3] Annual change; average of China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, Philippines, Singapore and Thailand.

Source: CEIC, IMF IFS, national data.

IV. The model

One striking feature of the recovery in Asia-Pacific has been the persistence of very stimulative monetary policy in the region. Nominal policy interest rates were slashed during the height of the financial crisis. The policy response was not only meant to address the deterioration in the economic and financial prospects but also to address the multiplication of the downside tail risks that arose. More recently, there is a question about whether monetary policy should have been so accommodative for so long. To understand this motivation, we need to focus on the economics of tail risks. From a theoretical point of view, however, conventional linear quadratic monetary policy models generally assign no special importance to tail risks. As a consequence, this class of models is not particularly useful in addressing the dominant policy concerns of the past few

years in Asia and the Pacific.[6] This section adopts a less conventional framework to try to cast a brighter light on the challenges.

This section lays out an international monetary policy model that attempts to capture this unconventional dynamic. At the heart of the model is a negative asset price bubble which, when it develops, can put the economies into a tailspin. At the same time, recognizing this possibility, hypothetical monetary authorities in the regions have incentives not only to smooth inflation and output fluctuations but also to influence the size of the downside tail risks. The details of the model and solution methods are presented in the Appendix for the interested reader.

This international monetary policy model has a relatively simple structure, extended from early modeling efforts by Filardo (2006). The model comprises three key blocks of equations: the macro block, the asset price block and monetary policy block for two countries or regions.

The macro block – a two region setup

The macro block specifies the output and the inflation dynamics for two regions of the world. This includes an IS equation and a PC equation for each economy (one economy is called the US and the other is called A):

Region US

$$(IS_{US}) \quad y_{t,US} = -\gamma_{US}\, r_{t-1,US} + \theta_{US}\, y_{t-1,US} + \varphi_{US}(\pi_{AP,t-1,US} - \pi_{t-1,US}) + \varepsilon_{t,US}$$

$$(PC_{US}) \quad \pi_{t,US} = \pi_{t-1,US} + \alpha_{US}\, y_{t-1,US} + \beta_{US}\, \pi_{B,t-1,US} + \eta_{t,US}$$

Region A

$$(IS_{A}) \quad y_{t,A} = -\gamma_{A} r_{t-1,A} + \theta_{A}\, y_{t-1,A} + \theta_{A,US}\, y_{t-1,US} + \varphi_{A}(\pi_{AP,t-1,A} - \pi_{t-1,A}) + \varepsilon_{t,A}$$

$$(PC_{A}) \quad \pi_{t,A} = \pi_{t-1,A} + \alpha_{A}\, y_{t-1,A} + \beta_{A}\, \pi_{B,t-1,A} + \eta_{t,A}$$

The IS equations describe the evolution of output in the two regions. For region US, output is a function of the lagged policy rate (r), lagged output (y), the lagged real asset price return, ($\pi_{AP,t-1,US} - \pi_{t-1,US}$), and a random error term. For region A, the equation is similar, except that it includes a feedback term from US output to region A. It is assumed that the US is a large

[6] In part, tail risks are particularly relevant in policymaking owing to the weakness of conventional forecasting models in capturing sudden, sharp downward movements in macroeconomic activity. In particular, as Turner and Andersen (1997) note, financial variables are useful in tracking forecast errors (ex post) in bad times but not so helpful in good times.

region and that A is a relatively small region, in the sense that output developments in the US affect A but developments in A do not directly affect US.

The PC equations describe the evolution of goods and services price inflation in the two regions. The structure of this inflation equation is assumed to be symmetric across the two regions. Inflation is a function of past inflation, lagged output, the growth rate of the asset price bubble and a random error term. The growth in the asset price bubble appears in the equations to capture the cross-country experience that consumer price inflation tends to go up less than would be expected during an asset price boom and goes down less than expected in an asset price collapse.

The asset price block

The asset price block describes the evolution of asset price returns in the two regions, $\pi_{AP,US}$ and $\pi_{AP,A}$. Asset price returns in each region are assumed to be composed of a part driven by fundamentals, e.g. $\pi_{F,US}$ for the US, and a part driven by a domestic asset price bubble, e.g. $\pi_{B,US}$ for the US. In general, total asset price returns in each region can be described by the following identity: $\pi_{AP,k} = \pi_{F,k} + \pi_{B,k}$, $for\ k = \{US, A\}$.

The fundamental component of asset prices in each region is modeled in the following way:

$$(F_{US}) \quad \pi_{F,t,US} = \pi_{t-1,US} + \lambda\, y_{t-1,US} + \xi_{t,US} + \Lambda_{t,US}$$
$$(B_{US}) \quad \pi_{B,t,US} = \zeta_t(y_{t-1,US}, r_{t-1,US})$$

$$(F_A) \quad \pi_{F,t,A} = \pi_{t-1,A} + \lambda\, y_{t-1,A} + \xi_{t,A} + \Lambda_{t,A}$$
$$(B_A) \quad \pi_{B,t,A} = \zeta_t(y_{t-1,A}, r_{t-1,A})$$

The F and B equations describe the evolution of the fundamental and bubble components of asset prices, respectively. Fundamental asset price returns are assumed to be determined by domestic inflation and output conditions in each region. On the fundamental side, nominal asset returns vary positively with inflation and output.

The bubbles will follow an endogenous Markovian process, where the transition probabilities are functions of the state of the economy (*y*) and the stance of monetary policy (*r*). For example, a strong macroeconomic position and easy monetary policy raise the probability that a positive asset price bubble will develop; conversely, cyclical weakness and tight monetary policy raise

the probability of a negative asset price bubble. The details about the asset price error terms and the bubble components will be described in more detail below.

More on the asymmetric bubble specification

While positive asset price bubbles are thought to rise gradually over time and then collapse, the evolution of negative asset price bubbles can be more complex. For example, a negative asset price bubble can start with a large, downward collapse. One way to model this is to specify the Λ_t as a Poisson distribution; in other words, $\Lambda_t \sim Pois(\lambda)$, where λ is the expected number of asset price collapses over a period of time.

Alternatively, the negative asset price bubble can build over time in a symmetric manner as with a positive asset price bubble. In this case, the bubble component can be thought of a three-state bubble. This would account for the possibility of a positive asset price bubble, a no-bubble state and a negative bubble state.

$$I_{t,US} = \begin{cases} 1, & +bubble \\ 0, & no\ bubble \\ -1, & -bubble \end{cases}$$

$$I_{t,A} = \begin{cases} 1, & +bubble \\ 0, & no\ bubble \\ -1, & -bubble \end{cases}.$$

This state variables, $I_{t,US}$ and $I_{t,A}$, have time-varying Markovian probabilities governing the transitions:

$$P(I_{t,k} \mid I_{t-1,k}, X_{t-1,k}) = \begin{pmatrix} p_{-1,-1}(X_{t-1,k}) & p_{-1,0}(X_{t-1,k}) & 0 \\ p_{0,-1}(X_{t-1,k}) & p_{0,0}(X_{t-1,k}) & p_{0,1}(X_{t-1,k}) \\ 0 & p_{1,0}(X_{t-1,k}) & p_{1,1}(X_{t-1,k}) \end{pmatrix} \text{ for } k = \{US, A\}.$$

This asymmetric negative bubble specification offers a useful approach to model the asset price dynamics in Asia-Pacific economies in response to the financial crisis in the West. The initial collapse of asset prices in Asia-Pacific economies could be thought of as having worked through two key channels. First, it had implications for the macroeconomy by lowering output. Second, it had implications for the persistence of a negative bubble. By lowering output, the transition probabilities of remaining in a negative asset price bubble increased.

The monetary policy block

Given the structure of the macroeconomy and asset prices, the monetary authority's challenge is fairly standard: to choose a policy rate in order to minimize the weighted average of the variance of output, inflation and the change in interest rates. The monetary authority's loss function is

$$L = L_{US} + L_A \text{ where}$$

$$L_k = \text{var}(y_k) + \mu_{\pi,k}\,\text{var}(\pi_k) + \mu_{r,k}\,\text{var}(r_k - r_{-1,k}) \text{ k=\{US,A\}}$$

In this paper, we will limit the search of the function to the class of linear feedback rules of the form $r_{t,k} = a_{y,k}y_{t,k} + a_{\pi,k}\pi_{t,k} + a_{F,k}\pi_{F,t,k} + a_{B,k}\pi_{B,t,k} + a_{D,k}D_{t,k}$, k={US,A}, where D is the duration of the bubble. These extended Taylor rules include a conventional response to output and inflation. It also includes a response to the fundamental component of asset prices. The more controversial aspect of this monetary policy response is the response to the bubble component. The hypothetical monetary authority can respond to the expansion of the bubbles and to the size of the bubble which is proxied by the length of the bubbles. Succinctly described, the hypothetical monetary authority solves the following optimization problem,

$$\underset{\{a_{y,US}, a_{\pi,US}, a_{F,US}, a_{B,US}, a_{D,US}, a_{y,A}, a_{\pi,A}, a_{F,A}, a_{B,A}, a_{D,A}\}}{\text{argmin}} \; L$$

subject to the law of motion of the economy described in the macro and asset price blocks of the model.

IV. Results

The results from the model highlight some of the theoretical monetary policy tradeoffs that Asia-Pacific central banks faced as the spillovers from the international financial crisis in the West reached their shores. Using the two region model, six simulations are highlighted. These simulations assume that the underlying economic environment is susceptible to both positive and negative bubbles. The hypothetical monetary authorities choose to respond to economic and financial developments using linear Taylor-type rules.

The first set of simulations corresponds to conventional measures of Taylor-type rules that do not take bubbles into account. There are two practical ways to think about these simulations. First, one can think of a monetary authority that has not experienced bubbles and estimates a Taylor

rule in non-bubble periods, and then sticks to this rule when bubbles arrive. Second, the monetary authority thinks of bubbles that it has seen in the past as one-off events and hence does not consider them to be a systemic feature of the monetary policy environment. In a sense, the monetary authority estimates a Taylor rule, abstracting from past periods of bubbles.

The second set of simulations corresponds to an environment in which monetary authorities use extended Taylor-type rules that take bubbles into account. In this case, bubbles are thought to be a regular part of the policy environment, just as inflation and output are. As a consequence, the monetary authority estimates the influence of the bubble environment when choosing its optimal response parameters.[7]

Conventional Taylor rule – responding to output and inflation. In these simulations (models 1 and 4 in Table 1), the monetary authorities in the two regions respond only to output and inflation. Model 4 assumes the existence of bubbles and reflects this dependence in the estimated parameters.

In general, the monetary authorities respond more aggressively to output when there are bubbles. In part, the monetary authorities in a bubble environment understand that bubbles are pro-cyclical and therefore lean against the channel of influence of bubbles on output. And, in part the additional response reflects the channel of influence that the monetary authorities have on the time-varying transition probabilities of the bubble. In the case of negative asset price bubbles and subpar output growth, the monetary authorities would want to ease more aggressively than in the case where their actions did not influence the likelihood of bubbles. One can interpret this bubble dimension of the monetary policy response as an attempt to alter the tail risk probabilities in monetary policy. In other words, monetary authorities try to alter the probabilities of undesirable outcomes.

From a technical point of view, the asymmetry in the inflation responses between the US monetary authority and the A monetary authority reflects the asymmetry in the macroeconomic block; it is assumed that output developments in region US affect economic activity in region A but not vice versa. As the final line in the table shows, taking account of a bubble-prone

[7] Since all the right-hand-side variables of the rule are endogenous, even a conventional specification of a Taylor rule (i.e. responding to inflation and output) will yield different estimated coefficients when bubbles are assumed than when no bubbles are assumed.

environment in estimating the optimal policy response parameters yields a 5% improvement in the loss function.

Table 1

Extended Taylor rule parameters

	Estimated assuming no bubbles and responding to:			Estimated assuming bubbles and responding to:		
	(1) y,π	(2) y,π,π_{AP}	(3) y,π,π_F,π_B,π_D	(4) y,π	(5) y,π,π_{AP}	(6) y,π,π_F,π_B,π_D
$a_{y,US}$	.44	.50	.50	.70	.76	.69
$a_{\pi,US}$	1.48	1.26	1.27	1.32	1.13	.72
$a_{F,US}$		.30	.30		.22	.36
$a_{B,US}$		.30	.30		.22	.12
$a_{D,US}$						.11
$a_{y,A}$	.46	.51	.51	.68	.73	.67
$a_{\pi,A}$	1.55	1.50	1.53	1.71	1.43	1.43
$a_{F,A}$		.31	.31		.21	.08
$a_{B,A}$		.31	.31		.21	.17
$a_{D,A}$						.03
Loss function gain (normalized by L in Model 1)						
Total L	-	7%	5%	5%	16%	17%

Responding to asset prices. In models 2 and 5, the monetary authorities respond not only to output and inflation but also asset price returns. However, monetary authorities are not assumed to be able to distinguish fundamental movements in asset prices from bubble movements. As a consequence, they respond to total asset price variability (i.e. the estimated coefficient on the fundamental and bubble components of asset prices constrained to be equal).

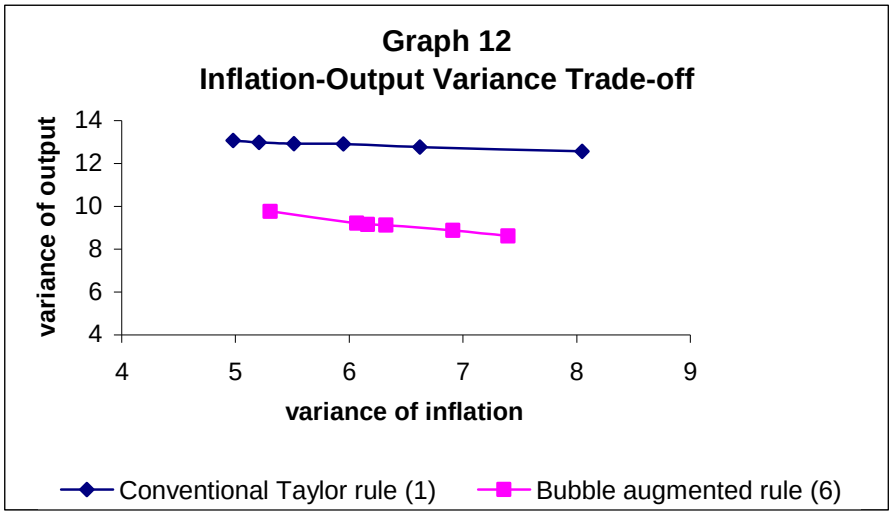
In these models, the monetary authorities respond positively to asset price movements. As asset prices rise, the monetary authorities raise interest rates more than in the more conventional Taylor rule specification. Conversely, as asset prices collapse, the monetary authorities cut

policy rates. The differences in the coefficients between model 2 and model 4 are instructive about the nature of the policy responses. In model 4, the asset price coefficient is less than the coefficient on model 2. This might be read to suggest that the monetary authority responds to asset price developments less in the bubble environment than when it assumes a no-bubble environment. This difference alone could lead to faulty inferences about how to respond to asset prices. At the same time, the coefficient on output rises in model 4. One way to interpret these differences is that responding to the bubble and fundamental asset prices in the same way leads to sub-optimal responses. In model 6, the optimal parameter on the bubble component is less than that on the fundamental component. In the case (model 5) where you cannot distinguish the bubble and the fundamental changes in asset prices, responding to *y* more aggressively than in model 2 captures the incentives associated with responding to the bubble component of asset prices.

The ability of the monetary authority to respond to asset price returns improves the loss function by 7% in the case where the model was estimated without bubbles and 16% in the case where the full model was estimated.

Extended Taylor rule where the central bank can observe bubbles. In this case, the monetary authorities understand that positive and negative bubbles may arise over time and can observe them. As expected, monetary authorities further improve the loss function. The benefit of this extra flexibility to respond to bubbles yields modest gains. Graph 12 shows the results of the optimal monetary policy as the weight on inflation in the monetary authorities' preferences is varied. In this setup, most of the gains arise from a reduction in the variance of output.

These results underscore the basic thesis of this paper. Monetary authorities should lean against tail risks (in this case represented by the likelihood of asset price bubbles) as they arise and should actively try to influence them so as to smooth output and inflation on average over the cycle. As the prospect for asset price bubbles arise, monetary authorities should ease monetary policy and maintain that easy stance until the tail risks recede.



These gains may be exaggerated. In practice, monetary authorities have very limited ability to observe small, emerging bubbles that will eventually develop into large, macroeconomically significant bubbles. In the model, they are able to respond early and with confidence as bubbles develop. Less problematic is the call for monetary authorities to respond to large asset price bubbles. Yes, they are also difficult to identify with a high level of confidence but they are somewhat easier to identify especially when they are correlated with prolonged credit expansion. Overall, these simulations have to be interpreted with care.

V. Policy implications

The experience of Asia and the Pacific during the international financial crisis offers various lessons about the dynamics of asset price bubbles and their policy challenges. Before exploring the monetary policy challenges in some detail, it is important to briefly highlight some fiscal, foreign exchange reserve and general financial stability implications.

On the fiscal side, strong medium-term fiscal frameworks gave policymakers the ability to respond aggressively to crises. Instead of the fiscal situation raising the specter of fiscal dominance, skyrocketing sovereign risks and propelling the crisis forward, sound fiscal policies acted as an effective shock absorber. Now that the crisis is over and the acute need for stimulative fiscal packages has waned, the region can focus on restoring, and in some cases strengthening, the fiscal position of their economies. Indeed, for some central banks worried about economic overheating and rising inflation pressures, somewhat restrictive fiscal policy

offers the benefits of slowing the growth of aggregate demand and of having less of enticement effect on foreign capital flows than boosting policy interest rates.

On the foreign reserves side, the experience of the past 15 years has illustrated rather dramatically the importance of having an adequate war chest of reserves. Large reserve holdings are not without their costs, however. Carry costs of reserves can be very expensive, especially in low credit-rated jurisdictions. The accumulation of reserves may also lead to financial stability concerns for a few reasons. If the reserve accumulation is sterilized by using reserve requirements, this policy tool acts as a tax on the regulated banking system and therefore may distort its growth, and drive financial services into the unregulated shadow banking system. If the issuance of central bank bills is used, prolonged reserve accumulations leave the banking system in emerging markets saddled with lazy assets that may increase the procyclicality of the financial system as banks search for yield. And, as we have seen in Latin America, as economies eschew foreign exchange rate smoothing via managing foreign exchange reserves, the private sector develops hedging devices that spur on financial deepening. Indeed, resisting exchange rate appreciation for too long and keeping the exchange rate too stable encourages borrowing in foreign currency by the private sector has in the past been an important source of economic and financial instability.

The international financial crisis also underscores the broader perspective that the global financial system needs to be strengthened and made more resilient. Efforts at the G20, the Financial Stability Board, the Basel Committee on Bank Supervision and the Committee on the Global Financial System, just to name a few key players, have been critical to achieving this aim. It is now important that the new principles and guidelines are implemented as part of a new framework for financial stability, not only in the economies that were most directly affected by the crisis but by all, as there are considerable benefits from the new thinking.

Monetary policy implications

The spillovers of the international financial crisis to Asia and the Pacific have naturally presented daunting policy challenges for the central banks in the region. And, there were valuable lessons that were learned. For example, the conventional wisdom prior to the crisis emphasized the importance of price stability as the primary objective of monetary policy. In the post-crisis

period, there is a greater appreciation of the role that central banks also can play in helping to secure financial stability.

With respect to the bursting of asset price bubbles, we learned that monetary authorities are likely to respond in an asymmetric way. A hallmark of the pre-crisis conventional view of monetary policy was that central banks should act gradually on the way up the policy rate cycle, as well as on the way down. But the crisis revealed that a bursting bubble generates considerable downside risks to output, inflation and the normal operation of the financial system. As a consequence, central bankers may need to respond aggressively, not gradually; by slashing policy rates, not by measured reductions over time; by communicating clearly the relevance of tail risks in the policy decisions, not by dwelling on the mean of the forecasts for inflation and output. In other words, the monetary policy strategy needs to be pro-active and state-contingent.

In the case of negative bubbles, monetary authorities have to be wary of the fragility of private sector confidence. When financial markets and investors are jittery about the future, prices of assets can become volatile and stay depressed. Overpricing of risk can raise the cost of borrowing and the ensuing volatility in these costs can adversely affect the monetary transmission mechanism. As history has shown, monetary policy actions may be needed not only to counter the financial headwinds but also to restore confidence. And, even in the case where there is little evidence of a negative bubble, the mere possibility of a negative bubble may call for aggressive action from central banks in the form of a more accommodative stance of monetary policy than would otherwise be the case.

This bubble perspective suggests that monetary policy frameworks may need to formally incorporate state contingent features. During normal periods, monetary authorities would generally adopt one strategy that relies more heavily on the role of stable market expectations. During periods of stress, monetary authorities may need to adopt more pro-active policies.

In addition, there is a need for more research into the types of policy tools that would be most effective during periods of stress. During normal times, policy interest rates and flexible exchange rate regimes provide an effective environment in which monetary authorities operate. During periods of stress, however, there may be roles for quantitative tools of monetary policy. In emerging market economies this might include greater reliance on reserve requirements, liquidity facilities and the asset composition of central bank balance sheets. The international

financial crisis and its aftermath underscore the importance of having a better understanding of the relationship between interest rate policy tools and the wide range of quantitative tools available to monetary authorities.

Finally, as this paper has emphasized, these policy concerns arise in economies subject to domestically-driven bubbles and also in economies subject to spillovers from other economies. Clearly, strengthening fundamentals – monetary, fiscal and financial system – are all important. Developing strategies to address spillovers are also important – just in case. And, market confidence that an economy has a robust policy framework in place to counter periods of stress may by itself help insulate economies from the spillovers from ever reaching the shores. Such considerations may be rather important today as the long fight against the tail risks associated with a negative asset price bubble appears to be laying the foundation for frothy asset markets in Asia and the Pacific.

VI. Conclusions

This paper argues for a more systematic exploration of the nexus of asset price bubbles and monetary policy. In contrast to the past literature, this paper focuses on the potential spillovers of a negative asset price bubble from one economy or set of economies to others. One key lesson from the crisis is that no matter how strong an economy's fundamentals are, and no matter how resilient it is to domestic economic and financial shocks, economic and financial globalization have opened up potent international transmission channels.

These policy challenges are difficult to model. The attempt to do so in this paper has yielded some encouraging results. The unconventional negative spillovers in the model are modeled by a negative asset price bubble, i.e. macroeconomically significant asset prices that significantly undershoot values implied by medium-term fundamentals. This is modeled as a negative asset price bubble that represents a change in asset prices of greater persistence and non-linearity than standard error processes in optimal monetary policy models. Despite this added complexity, the model can be solved and the policy implications analyzed.

The results highlight the role of tail risks in calibrating the monetary policy trade-offs facing central banks. These tail risks, of course, may not materialize and raise questions ex post about the policy responses in the aftermath of a financial crisis. However, it is important to evaluate central bank performance in this environment by the ex ante conditions. For flexible inflation-

targeting central banks, this distinction may be particularly important at this policy juncture. The optimal monetary policy in this model suggests that central banks tradeoff the costs of higher inflation with the costs of prematurely withdrawing stimulus bolstering the normal operation of their financial markets.

In economies where this tail risk is significant, a short-term overshoot of inflation should be seen as part and parcel of an optimal monetary policy response, and not as a policy mistake. In other words, narrow inflation targeting is not optimal in the current policy setting. Moreover, the more elaborate trade-offs implied by the model could create communication complications for those central banks with flexible inflation-targeting regimes that have, in the past, convinced the public that medium-term inflation deviations from target, not accompanied by observable supply or demand shocks, were seen as a yardstick for a central bank's performance.

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Appendix

The calibration of the model is as follows:

Macroeconomic block

$\gamma_{US} = 0.2, \theta_{US} = 0.6$ and $\varphi_{US} = 0.4;$

$\gamma_A = 0.2, \theta_A = 0.6,\ \ \theta_A^{US} = 0.3$ and $\varphi_A = 0.4.$

$\alpha_{US} = 0.15$ and $\beta_{US} = -0.04; \alpha_A = 0.15$ and $\beta_A = -0.04$

The two error terms, $\varepsilon_{t,US} \sim N(0, \sigma^2_{\varepsilon,US}); \varepsilon_{t,A} \sim N(0, \sigma^2_{\varepsilon,A})$ and

$\eta_{t,US} \sim N(0, \sigma^2_{\eta,US}); \eta_{t,A} \sim N(0, \sigma^2_{\eta,A})$, are assumed to be random variables with i.i.d. normal distributions with known variances $\sigma^2_{\varepsilon,US} = 1.1$ and $\sigma^2_{\eta,US} = 0.5; \sigma^2_{\varepsilon,A} = 1.1$ and $\sigma^2_{\eta,A} = 0.5$.

Asset price block

Fundamental component

The parameter on lagged output, λ_{US} and λ_A, is assumed to be 0.2 each and the error terms $\upsilon_{t,US} \sim N(0, \sigma^2_{\upsilon,US})$ *and* $\upsilon_{t,A} \sim N(0, \sigma^2_{\upsilon,A})$ are assumed to be random variables with an i.i.d. standard normal distribution with known variances $\sigma^2_{\upsilon,US} = 1.0$ and $\sigma^2_{\upsilon,A} = 1.0$.

Bubble component

These state variables tracking the bubbles in each region, $I_{t,US}$ and $I_{t,A}$, have time-varying Markov probabilities governing the transitions:

$$P(I_{t,k} \mid I_{t-1,k}, X_{t-1,k}) = \begin{pmatrix} p_{-1,-1}(X_{t-1,k}) & p_{-1,0}(X_{t-1,k}) & 0 \\ p_{0,-1}(X_{t-1,k}) & p_{0,0}(X_{t-1,k}) & p_{0,1}(X_{t-1,k}) \\ 0 & p_{1,0}(X_{t-1,k}) & p_{1,1}(X_{t-1,k}) \end{pmatrix} \text{ for } k = \{US, A\}.$$

The corresponding multinomial probability distribution for $\zeta_{t,k}$ for k={US,A} is

$$\pi_{B,t,k} = \zeta_{t,k} = \begin{cases} \theta_{p,k} & \text{with probability } p_{1,1}(\tilde{X}_{t-1,k}),\ \text{given } s_{t-1,k} = 1 \\ -\theta_{p,k}\tau_{t-1,k} & \text{with probability } 1 - p_{1,1}(\tilde{X}_{t-1,k}),\ \text{given } s_{t-1,k} = 1 \\ \theta_{p,k} & \text{with probability } p_{0,1}(\tilde{X}_{t-1,k}),\ \text{given } s_{t-1,k} = 0 \\ 0 & \text{with probability } p_{0,0}(\tilde{X}_{t-1,k}),\ \text{given } s_{t-1,k} = 0 \\ \theta_{n,k} & \text{with probability } p_{0,-1}(\tilde{X}_{t-1,k}),\ \text{given } s_{t-1,k} = 0 \\ \theta_{n,k} & \text{with probability } p_{-1,-1}(\tilde{X}_{t-1,k}),\ \text{given } s_{t-1,k} = -1 \\ -\theta_{n}\tau_{t-1,k} & \text{with probability } 1 - p_{-1,-1}(\tilde{X}_{t-1,k}),\ \text{given } s_{t-1,k} = -1 \end{cases}$$

where $\theta_{p,k}$ and $\theta_{n,k}$ represent the rate at which the bubble grows in the positive and negative bubble states, $\tau_{t-1,k}$ tracks the duration of the bubble phase and $\tilde{X}_{t-1,k} = (y_{t-1,k}, r_{t-1,k})$. The bubble is parameterized so that $(\theta_{p,k} = 0.9,\ \theta_{n,k} = 0.9)$

The general specification of the time-varying transition probabilities is

$$P_{i,j,k} = G\left(\frac{\exp(\mu_{0,I_{t-1,k}} + \mu_{I_{t-1,k}} \tilde{X}_{t-1,k})}{1 + \exp(\mu_{0,I_{t-1},k} + \mu_{I_{t-1},k} \tilde{X}_{t-1,k})} \right) \text{ for k={US,A},}$$

with the following parameterization:

$$P_{0,0,k} = 0.96 - 1.92 \times \left| \frac{\exp(0.5 y_{t-1,k})}{1 + \exp(0.5 y_{t-1,k})} - 0.5 \right|,\ P_{0,1,k} = (1 - P_{0,0,k}) \times \frac{\exp(y_{t-1,k})}{1 + \exp(y_{t-1,k})},$$

$$P_{0,-1,k} = 1 - P_{0,0,k} - P_{0,1,k} \qquad \text{for k={US,A}.}$$

The transition probabilities for the positive-bubble and negative-bubble states are

Version 1: $P_{1,1,US} = P_{-1,-1,US} = \exp(2.5) / (1 + \exp(2.5))$ and

$P_{1,1,A} = P_{-1,-1,A} = \exp(2.5) / (1 + \exp(2.5))$

Version 2:

$$P_{1,1,US} = \frac{\exp(2.5 + 1.1 y_{t-1,US} - 0.4 r_{t-1,US} - 0.1 \tau_{t-1,US})}{1 + \exp(2.5 + 1.1 y_{t-1,US} - 0.4 r_{t-1,US} - 0.1 \tau_{t-1,US})},\ P_{1,0,US} = 1 - P_{1,1,US}$$

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$$P_{-1,-1,US} = \frac{\exp(2.5 - 1.1y_{t-1,US} + 0.4r_{t-1,US} - 0.1\tau_{t-1,US})}{1 + \exp(2.5 - 1.1y_{t-1,US} + 0.4r_{t-1,US} - 0.1\tau_{t-1,US})}, P_{-1,0,US} = 1 - P_{-1,-1,US}.$$

$$P_{1,1,A} = \frac{\exp(2.5 + 1.1y_{t-1,A} - 0.4r_{t-1,A} - 0.1\tau_{t-1,A})}{1 + \exp(2.5 + 1.1y_{t-1,A} - 0.4r_{t-1,A} - 0.1\tau_{t-1,A})}, \; P_{1,0,A} = 1 - P_{1,1,A}$$

$$P_{-1,-1,A} = \frac{\exp(2.5 - 1.1y_{t-1,A} + 0.4r_{t-1,A} - 0.1\tau_{t-1,A})}{1 + \exp(2.5 - 1.1y_{t-1,A} + 0.4r_{t-1,A} - 0.1\tau_{t-1,A})}, P_{-1,0,A} = 1 - P_{-1,-1,A}$$

Version 3:

$$P_{1,1,US} = \frac{\exp(2.5 + 1.1y_{t-1,US} - 0.4r_{t-1,US} - 0.1\tau_{t-1,US} + 0.1\tau_{t-1,A})}{1 + \exp(2.5 + 1.1y_{t-1,US} - 0.4r_{t-1,US} - 0.1\tau_{t-1,US} + 0.1\tau_{t-1,A})}, \; P_{1,0,US} = 1 - P_{1,1,US}$$

$$P_{-1,-1,US} = \frac{\exp(2.5 - 1.1y_{t-1,US} + 0.4r_{t-1,US} - 0.1\tau_{t-1,US} + 0.1\tau_{t-1,A})}{1 + \exp(2.5 - 1.1y_{t-1,US} + 0.4r_{t-1,US} - 0.1\tau_{t-1,US} + 0.1\tau_{t-1,A})}, P_{-1,0,US} = 1 - P_{-1,-1,US}.$$

$$P_{1,1,A} = \frac{\exp(2.5 + 1.1y_{t-1,A} - 0.4r_{t-1,A} - 0.1\tau_{t-1,A} + 0.1\tau_{t-1,US})}{1 + \exp(2.5 + 1.1y_{t-1,A} - 0.4r_{t-1,A} - 0.1\tau_{t-1,A} + 0.1\tau_{t-1US})}, \; P_{1,0,A} = 1 - P_{1,1,A}$$

$$P_{-1,-1,A} = \frac{\exp(2.5 - 1.1y_{t-1,A} + 0.4r_{t-1,A} - 0.1\tau_{t-1,A} + 0.1\tau_{t-1,US})}{1 + \exp(2.5 - 1.1y_{t-1,A} + 0.4r_{t-1,A} - 0.1\tau_{t-1US})}, P_{-1,0,A} = 1 - P_{-1,-1,A}.$$

Monetary Policy

The parameters of the loss function $(\mu_{\pi,k}, \mu_{r,k})$ for k={US,A} are listed in the tables.

Solution Methods

The model is solved by simulating the shock processes and minimizing the monetary authorities loss function. Details are given in Filardo (2006).