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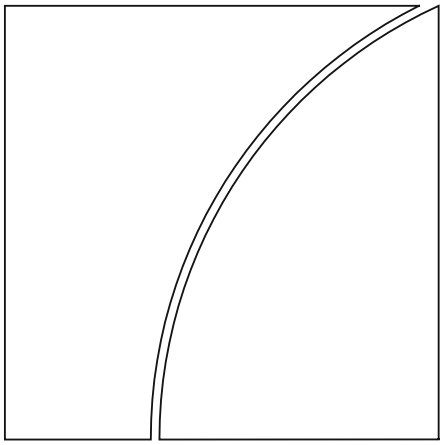

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Cross-border Financial Linkages: Challenges for Monetary Policy and Financial Stability

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Introduction

Frank Packer[1] and Chang Shu[2]

Ever more extensive global financial linkages are changing in ways that have significant implications for policy. Governor Wheeler of the Reserve Bank of New Zealand notes in his welcome address to the conference (reprinted in this volume) that Asia-Pacific countries have experienced a particularly rapid growth in financial flows since the crisis. He emphasises that opening the capital account is one of the most powerful reforms a government can undertake, as greater cross-border financial linkages offer major efficiency gains in resource allocation. But he also warns that cross-border flows present challenges for monetary policy and financial stability. The monetary policy challenge is that considerable uncertainty exists about the exchange rate channel in monetary policy transmission and that unjustified appreciation in the real effective exchange rate – driven perhaps by global financial market conditions – can cause a misallocation of resources that can inhibit the country's long-term economic potential. Wheeler also cautions that cross-border financial linkages can have important implications for financial stability. These can arise when the herding behaviour of large investors causes international financing flows to amplify financial shocks. He explains how macroprudential policy and effective liquidity rules can reduce such systemic risks.

The BIS has long documented the extent and complexity of global financial linkages in its international banking and securities statistics, focusing an increased amount of research on these areas in recent years. Borio (2014) notes that cross-border financial linkages can exacerbate the international monetary and financial system's tendency to amplify the build-up of financial imbalances. External credit is inclined to lead and outgrow domestic credit during credit booms that greatly increase the likelihood of subsequent financial crisis (Borio et al (2011)). At the same time, the increased share of international bank and bond credit denominated in US dollars reflects the key role of that currency in developing Asia. This can serve to directly transmit monetary policy and leverage cycles from the United States to financial conditions elsewhere (McCauley et al (2015)).

Further, the channels of influence are also evolving. For example, it is now increasingly evident that, post-financial crisis, shift from international bank to global bond market financing constitutes a new phase, or "the second phase" of global liquidity (Bruno and Shin (2015)). This has fuelled a strong expansion in domestic bank credit in many Asian countries (Shin and Turner (2015)). The shifting balance between onshore and offshore bond issuance should also be taken into account when tracking corporate exposures (Mizen et al (2012)). Both borrowers and lenders from the emerging markets are playing a greater role in global bond markets, linking long-term interest rates more closely together (Turner (2015)).

[1] Regional Adviser, Representative Office for Asia and the Pacific, Bank for International Settlements, Hong Kong SAR. Work on the conference and related volume was done while Mr. Packer was Head of Economics and Financial Markets at the Representative Office for Asia and the Pacific.

[2] Senior Economist, Representative Office for Asia and the Pacific, Bank for International Settlements, Hong Kong SAR.

Co-hosted by the Reserve Bank of New Zealand (RBNZ) and the BIS's Representative Office for Asia and the Pacific and held on 23–24 October 2014 in Wellington, this conference on cross-border financial linkages represents continuing efforts by the BIS to foster research on these important issues. The conference also marked the completion of the BIS Asian Office's research programme under the direction of the Asian Consultative Council of Governors of BIS member central banks.

Patterns of cross-border linkages

The two papers of the conference's first session document patterns and drivers of cross-border financial linkages in Asia-Pacific. Taken together, they address a number of questions: Why was the impact of the global financial crisis relatively muted in Asia? How has the landscape of international banking in the region evolved since then? Have the region's financial systems become more or less vulnerable?

The paper by Curcuru, Thomas and Warnock on cross-border portfolios: assets, liabilities and non-flow adjustments suggests that emerging Asia weathered the global financial crisis relatively well, thanks mainly to the region's limited external linkages. The authors combine a number of databases to compare the structure of emerging Asia's cross-border financial linkages with those of advanced economies. The focus is on non-flow adjustments, a broad term capturing the effects of asset price and exchange rate movements, as well as other statistical adjustments. Losses from non-flow adjustments are estimated to be $600 billion for emerging Asia between 2006 and 2011, a quite small amount in relation to GDP. That the losses were so limited reflected both the modest scale of Asia's external investments and the equally modest returns on such investments. The considerable home bias in investment also points to the importance of considering risks from domestic portfolios when assessing a country's overall portfolio risks.

In their paper on the channels and determinants of foreign bank lending, Ehlers and Wooldridge focus on international banking flows in Asia-Pacific. International banking can include business conducted locally by international banks' affiliates in host countries as well as business conducted from abroad, across national borders. The state of development and the fragility of the borrower countries' banking sectors are found to influence the form of foreign lending: foreign banks tend to lend locally in economies with fragile or less developed banking systems; cross-border lending is more common in economies with stable or advanced banking systems.

Ehlers and Wooldridge also identify another characteristic of financial linkages in Asia-Pacific – the regionalisation of banking activity. The Asia-Pacific economies now tend to have more diversified creditor bases than in the past; in particular, they have become more reliant on funds from regional banks. These trends may reduce the region's vulnerability to adverse shocks from individual creditor countries outside the region. Nonetheless, a different risk may have risen. Ehlers and Wooldridge show that the region's cross-border flows are mostly dollar-denominated, and may not be fully hedged against currency risk.

FX markets and exchange rate risks

Two conference papers addressed FX markets and exchange rates directly. Levich and Packer's comprehensive review suggests that the development and functioning of FX markets has progressed at a faster pace in Asia-Pacific than in other regions. The BIS's Triennial Central Bank Survey of foreign exchange and derivatives market activity in 2013 shows that turnover in the currencies of both developed and emerging Asian economies, particularly the Chinese renminbi, have seen rapid growth that is well above the global average. All segments of FX market turnover in the region (eg spot and derivatives, onshore and offshore) have expanded exponentially.

CLS bank and other payment-versus-payment (PVP) systems have significantly enhanced the institutional safeguards for trading in FX markets, despite the relatively light regulation and reporting requirements in these markets. At the same time, herding behaviour in FX trading appears to have become less pronounced in recent years. Reflecting these developments, increased robustness in regional FX markets was evident during the 2013 "taper tantrum". During that episode, Asia-Pacific currencies were in the main subject to less depreciation pressure than those in other regions, despite increases in exchange rate volatility. In contrast to the 2008–09 episode, there were no notable deviations from covered interest parity or significant moves in reported bid-ask spreads; and the withdrawal from the carry trade was orderly compared with earlier periods.

Levich and Packer present two policy recommendations for further enhancing the safety and resilience of FX markets in the Asia-Pacific. First, more countries should adopt CLS or another PVP system for their currencies. Second, crowdedness metrics for trading activity in FX markets should be refined and published regularly as indicators of financial market vulnerability.

Munro builds on her earlier work in analysing the risks and returns of Asia-Pacific currencies in "Exchange rates, expected returns and risk: what can we learn from Asia-Pacific currencies?". This paper proposes a more refined statistical test of uncovered interest parity (UIP). Significant deviations from UIP based on standard tests may be due to a failure to adequately account for certain types of risk. In particular, when the bond premium is taken into account, the estimated exchange rate response to changes in expected returns is considerably closer to that predicted by theory.

Munro's study further contributes to discussions on the Mundellian trilemma. The findings point to the significant difficulties in assessing the trade-offs between controls over capital, interest and exchange rates when expectations and risk are included in the analysis. The paper's empirical results also suggest that policymakers are not necessarily confined to "corner" solutions: through exchange management, Asian countries could trade a lesser degree of control over interest rates for lower exchange rate volatility.

Financial market spillovers in the region

The paper by Shu, He, Wang and Dong compares the influence of the US and Chinese financial markets in the Asia-Pacific region. Spillovers from US financial markets to the global markets have been well researched, while China's global influence in the real economy is much better understood than its influence on

financial markets. The paper represents the first attempt to systematically study the spillovers from China's financial markets to those of Asia-Pacific, and compare these spillovers with those from the United States.

The empirical analysis indicates that China's equity market and currency movements have become quite influential in the region. In normal market conditions, the impact of China's stock market in the region approaches that of the US stock market, although the impact of the US market still dominates strikingly during stress periods. Movements in the Chinese renminbi are a significant driver of regional currencies. By contrast, the Chinese bond market has a negligible impact on other financial markets in the region.

Policies to deal with capital flows and their effectiveness

In the final paper presented at the conference, Bruno, Shim and Shin assess the effectiveness of capital flow and macroprudential measures for 12 Asia-Pacific economies. The study uses a comprehensive data set for these measures and conducts panel regressions that isolate the impact of these policies by controlling for global and local factors.

Mixed results are found for policy effectiveness. Capital flow measures operating through the banking sector and bond market appear to have slowed down targeted flows before the global financial crisis, but not afterwards. At the same time, cross-border lending, bank credit and total credit are not much affected by macroprudential measures.

One major contribution of the paper to the capital control literature is in its documentation of policy spillovers, ie the unintended impact on untargeted sectors and markets. Indeed, there is evidence of significant policy externalities: banking sector measures are associated with higher international debt issuance, and bond market measures with an increase in cross-border bank lending. The important implication is that such policy spillovers need to be taken into account when considering macroprudential measures.

Global liquidity

Hélène Rey's keynote speech addressed the issue of how large capital flows affect the international transmission of monetary policy.[3] A number of trends have been widely recognised in recent years: massive credit growth globally; strong co-movements in capital flows; and a global financial cycle in risky asset prices. The speech drew on several studies done by Rey and her co-authors to account for these stylised facts.

Rey introduced a theoretical model to illustrate the role of financial intermediaries and leverage in transmitting financial conditions around the world. In contrast to the analysis of Bruno and Shin (2014), which focused on global banks, Rey's model includes heterogeneous financial intermediaries – including banks and asset managers. Risky asset prices across the world's financial markets are shown to depend on a global factor, which is a function of realised volatility and of time-

[3] The slides presented at the conference are available upon request from Margaret.Siu@bis.org.

varying effective aggregate risk aversion. In turn, this aggregate effective risk aversion depends on the risk-taking attitude of heterogeneous investors and on their leverage.

Rey provided an empirical assessment of the role that monetary policy in the centre country (the United States) plays in setting credit conditions worldwide and in affecting global banks' risk-taking. One global factor, extracted using the dynamic factor model, was shown to explain an important part of the variance of a large cross section of risky asset returns around the world. Further analysis based on large Bayesian VAR models suggests that US monetary policy is a driver of credit growth both at home and abroad, and has affected the cross-border credit flows and leverage of European banks in particular. US monetary policy thus can influence domestic financial conditions even in countries with flexible exchange rates.

Rey concluded that the major central banks drive the global liquidity cycle; for economies under the influence of the cycle, the policy predicament is reduced from a trilemma to a dilemma between free capital movements and independent monetary policy. Under these conditions, macroprudential policies can help enhance monetary policy independence.

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Programme

22 October 2014, Wednesday

19:00	Welcome dinner hosted by the BIS

23 October 2014, Thursday

09:00–09:20	Opening remarks by Graeme Wheeler (Governor, RBNZ) Chair: John McDermott (RBNZ)
09:20–10:40	Paper 1: "Cross-border portfolios: assets, liabilities, and wealth transfers" ***Stephanie Curcuru, Charles Thomas*** (Federal Reserve Board) and ***Frank Warnock*** (University of Virginia) Discussant: Martin Berka (University of Auckland)
10:40–11:00	Coffee break
11:00–12:20	Paper 2: "Channels and determinants of foreign bank lending" ***Torsten Ehlers*** and ***Philip Wooldridge*** (BIS) Discussant: Jennifer Corbett (Australian National University)
12:20–13:50	Lunch
13:50–14:50	Keynote Speech Introduction: Grant Spencer (RBNZ) Speaker: ***Hélène Rey*** (London Business School) Chair: Eli Remolona (BIS)
14:50–16:10	Paper 3: "Development and functioning of FX markets in Asia and the Pacific" ***Richard Levich*** (New York University) and ***Frank Packer*** (BIS) Discussant: Takatoshi Ito (University of Tokyo)
16:10–16:40	Coffee break
16:40–18:00	Paper 4: "Exchange rates, expected returns and risk: What can we learn from Asia-Pacific currencies?" ***Anella Munro*** (RBNZ) Discussant: Hugo Vega de la Cruz (Central Bank of Peru)
18:45	Conference dinner hosted by the RBNZ

24 October 2014, Friday

Chair: Roong Mallikamas (Bank of Thailand)

08:30–09:50 Paper 5:
"Regional pull vs global push factors: China and US influence on Asia-Pacific financial markets"
Chang Shu (BIS), ***Dong He*** (IMF) and Honglin Wang (HKMA)
Discussant: Ilan Noy (Victoria University of Wellington)

09:50–11:10 Paper 6:
"Comparative assessment of macroprudential policies"
Valentina Bruno (American University), ***Ilhyock Shim*** and ***Hyun Song Shin*** (BIS)
Discussant: Christie Smith (RBNZ)

11:10–11:30 Coffee break

11:30–13:00 Panel discussion
Chair: Grant Spencer (Reserve Bank of New Zealand)
Panelists: Guy Debelle (Reserve Bank of Australia)
Kazuo Momma (Bank of Japan)
Frank Warnock (University of Virginia)
Hyun Song Shin (Bank for International Settlements)

13:00–13:10 Concluding remarks

List of participants

Central banks

Reserve Bank of Australia	**Guy Debelle** Assistant Governor (Financial Markets)
People's Bank of China	**Bin Li** Director of Monetary Policy Department
Hong Kong Monetary Authority	**Cho-Hoi Hui** Head of Market Research Division of the Research Department
Bank of Japan	**Kazuo Momma** Assistant Governor
Bank of Korea	**Hyun-Jeong Kim** Deputy Director General of the Economic Research Institute
Central Bank of Malaysia	**Adnan Zaylani Mohamad Zahid** Director of Investment Operations and Financial Markets
Reserve Bank of New Zealand	**Graeme Wheeler** Governor
	Grant Spencer Deputy Governor
	John McDermott Assistant Governor
	Bernard Hodgetts Head, Macro Financial Department
	David Hargreaves Manager, Macro-Financial Policy
	Christie Smith Manager Research
	Anella Munro Senior Adviser

Central Reserve Bank of Peru	**Hugo Vega de la Cruz** Head of Monetary Programming
Monetary Authority of Singapore	**San Ling Lam** Executive Director of the Macroeconomic Surveillance Department
Bank of Thailand	**Roong Mallikamas** Senior Director of the Macroeconomic and Monetary Policy Department

Academic and policy institutions

Australia National University	**Jennifer Corbett** Pro Vice-Chancellor, Research and Research Training
National Graduate Institute for Policy Studies (Japan)	**Takatoshi Ito** Professor
University of Auckland (New Zealand)	**Martin Berka** Senior Lecturer
Victoria University of Wellington (New Zealand)	**Ilan Noy** Professor
London Business School	**Hélène Rey** Professor
Leonard N. Stern School of Business (United States)	**Richard Levich** Professor
University of Virginia (United States)	**Frank Warnock** Professor
International Monetary Fund	**Dong He** Deputy Director, Monetary and Capital Markets Department
Bank for International Settlements	**Hyun Song Shin** Economic Adviser and Head of Research
	Philip Wooldridge Head of International Banking and Financial Statistics

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Chang Shu
Senior Economist

Torsten Ehlers
Economist

Cross-border Financial Linkages: Challenges for Monetary Policy and Financial Stability

Graeme Wheeler[1]

On behalf of my Reserve Bank colleagues, I bid you a warm welcome to Wellington. I especially want to thank the conference organisers, and the participants and presenters who have travelled far to join us.

It is a great pleasure to co-host a conference with the BIS on Cross-Border Financial Linkages, as we think about these linkages a great deal. As the BIS triennial data indicates, the New Zealand dollar is the tenth most traded currency in the world with daily turnover of around USD105 billion. This is magnitudes beyond New Zealand's economic weight by any metric – and about 250 times our daily external trade flows.

In contrast with most other regions, the Asia-Pacific region has seen rapid growth in financial flows since the GFC. Asia-Pacific currencies are currently represented on 40 percent of global trades, up from 30 percent in 2007.

However, cross-border financial integration is much more than capital flows. It also embraces trade linkages, incipient flows, remittances, price arbitrage, and risk transfer instruments. In its broadest form financial integration offers enormous benefits, particularly when it finances efficient resource allocation, smoothes consumption, and distributes and diversifies risk. It is especially important when linked to the global transfer of skill-enhancing technologies, and the financing of innovation and catch-up technologies.

Cross-border flows can, however, present challenges for monetary policy and financial stability and it's to these issues that I turn.

Cross-border financial linkages and monetary policy

Cross border financial linkages can present difficult challenges for monetary policy for two main reasons. First, although the exchange rate is often the primary transmission channel for monetary policy, this channel is often stronger than we would wish. Second, and just as problematic, we often do not know what factors are driving the exchange rate and how efficient this transmission channel is.

In an economy with an open capital account, with active arbitrage it is possible to have either a stable exchange rate or an independent monetary policy capable of delivering price stability.

[1] Governor, Reserve Bank of New Zealand.

A speech delivered to the BIS Conference on Cross-border Financial Linkages, in Wellington, on 23 October 2014, pdf version available here: http://www.rbnz.govt.nz/research_and_publications/speeches/2014/5910028.pdf

Like New Zealand, many of the Asian economies have experienced an appreciation in their real exchange rate in recent years. In a floating exchange rate environment, this lowers inflation in the tradables sector and raises the real disposable incomes of many consumers. It also makes it cheaper for firms to acquire imported capital goods and new technologies, and can spur greater innovation and productivity in the tradables sector.

However, large swings in the real exchange rate impose significant adjustment costs for firms that are forced to exit and re-enter markets due to large movements in competitiveness. And it can generate particularly difficult headwinds for those export producers not experiencing high prices for their products, and for firms competing against cheaper imports.

An important issue for policy makers is whether the appreciation in the real effective exchange rate is *justified* and *sustainable*. A real effective exchange rate is unjustified when its level is inconsistent with the economic factors (such as commodity prices, economic growth, interest rate differentials) that can normally explain its movement during the business cycle. The level of the real effective exchange rate can be considered unsustainable when it is clearly deviating from its long-run equilibrium at the level that it would be expected to settle when business cycle factors have fully dissipated. In such a situation, persistent deviations from equilibrium are likely to result in external debt ratios that become unmanageable and cause misallocations of resources that can inhibit the country's long term growth potential.

Domestic monetary policy and changes in exchange rate regimes can do little to alleviate an overvalued real exchange rate. New Zealand has tried a variety of exchange rate regimes over the past 40 years – including a fixed exchange rate, crawling peg and floating exchange rate. However, the medium-term level and volatility of our real effective exchange rate has been largely unaffected by the type of exchange rate regime in place.

Often the appropriate policy response lies with measures to reduce demand pressures, or improve competitiveness and raise potential output growth. Such measures might include a better balance of fiscal policy, addressing impediments that distort saving and investment decisions, and undertaking reforms that raise productivity and improve competitiveness. They might also include prudential policies that address rising vulnerabilities directly.

Commentators, including the IMF, sometimes suggest that capital controls might play a role, but this is seldom a desirable option for countries with open capital accounts. An open capital account provides powerful incentives for improving productivity as it signals to domestic producers that they need to be competitive if they wish to attract capital and financing domestically and from offshore. Opening the capital account is therefore one of the most powerful economic reforms that a government can undertake. This is partly because of the benefits of the policies that are usually pre-conditions for removing capital controls. Such pre-conditions include achieving a reasonable degree of economic stabilisation, some liberalisation of the domestic financial market, and lower border protection (so that domestic savings do not flee offshore from a highly protected domestic capital market, and offshore capital does not flow into domestic sectors with high effective rates of protection).

Although much is known about the factors that influence exchange rates in theory, empirical links between exchange rates and their driving factors have been

difficult to pin down. Exchange rates are closely linked to interest rates in theory through uncovered interest arbitrage but, empirically, the connection is weak. Internationally, we see markets adopting risk-on and risk-off strategies that are often linked to expectations of the timing of monetary policy decisions by the Federal Reserve. And sometimes capital flows seem to matter: we see flights to quality and to more liquid markets accompanied by large exchange rate movements when risk and uncertainty increase.

In our own economy, several factors appear to play a role in foreign exchange markets: actual and expected movements in commodity prices, information relating to expected future movements in policy rates and appetite for New Zealand dollar risk. But, without a strong empirical understanding of what determines the exchange rate there is considerable uncertainty regarding the efficiency of the exchange rate transmission channel.

Cross-border financial linkages and financial stability

Cross-border financial linkages can have important implications for financial stability when large institutions react in a similar manner and herding behaviour causes financing flows to amplify financial market shocks. We have seen this desperate search for yield across borders many times before with investors taking on more and more risk and in doing so significantly lowering risk premia. Rather than requiring higher risk premia from increasingly leveraged borrowers, investors continue to provide financing at declining spreads, fearful of missing out on the returns of those who preceded them.

I would like to focus a little on the role that macro-prudential policy and liquidity management can play in reducing systemic risk in financial markets and will illustrate with reference to the New Zealand market.

Residential property prices have been rising rapidly in several Asia-Pacific countries in recent years. In New Zealand, these pressures have been accentuated by housing supply shortages, historically low mortgage rates, tax preferences that favour investment in housing, and offshore investor interest. Strong housing demand can add to financial stability risks, especially when accompanied by high household indebtedness. Housing market exuberance can be particularly problematic when interest rate responses are not warranted because economic growth is well below potential, and inflation in factor and product markets is benign.

Macro-prudential policies can be helpful in addressing financial stability concerns in such circumstances. But the introduction of macro-prudential policy requires policy makers to be clear about its goals, the duration of the measures, and how such measures might interact with monetary policy.

The Reserve Bank introduced macro-prudential policy in the form of speed limits on loan-to-value ratios (LVRs) in the residential housing market, on 1 October 2013. House prices - which were already significantly overvalued based on historical and international indicators - were accelerating rapidly in our two largest cities (that account for around half of the national market). In addition, household debt was at high levels, and banks were competing aggressively for mortgage lending to borrowers with small deposits. At the time, annual consumer price inflation was

running at 0.7 percent, the exchange rate was strong, and the economy had a negative output gap. It was not appropriate to raise interest rates, but the potential for further rapid house price inflation was considerable as sizeable supply-demand imbalances seemed likely to continue for several years.

We introduced a requirement that banks reduce their high LVR lending (defined as LVRs over 80 percent) to an average of no more than 10 percent of their mortgage commitments, and made this a condition of bank registration. The measure led to a significant reduction in high-LVR lending, a decline in house sales, and fall in house price inflation. While other factors, such as subsequent interest rate increases over the period March 2014 to July 2014 are also helping to constrain demand, annual house price inflation fell from around 10 percent to 5 percent currently, despite high levels of net immigration.

We established clear and separate primary objectives for monetary policy and macro-prudential policy. These primary objectives are price stability and financial system stability respectively.

There is an appropriate role for coordinating the use of monetary policy and a macro-prudential policy instruments provided they both affect outcomes relevant to the achievement of both policy objectives. This condition is likely to be met when the real and financial cycles are in sync and each policy can allow for the complementary effects of the other. The two policies will be in greatest potential conflict when the real and financial cycles are in opposite phases.

While LVRs have a financial stability goal, they have been an important consideration in our monetary policy assessment. We believe the dampening impact of LVRs on house price inflation and credit, and the diminished‘wealth effects’ on spending associated with it, have reduced consumer price inflation pressures by an amount similar to a 25-50 basis point increase in the OCR. In essence, the reduction in housing pressures allowed us to delay the tightening in interest rates, thereby reducing the incentive for any additional capital inflows into the New Zealand dollar in search of higher yields.

We have seen little financial sector disintermediation to date, and have indicated that the LVR speed limit is not intended to be permanent. It will be removed once housing market pressures have moderated and when we are confident there will not be a resurgence in house price inflation. We will be reviewing these criteria and their implications for LVR restrictions in next month’s Financial Stability Report.

My final comment is on liquidity risk

Liquidity risk and rollover risk are often the two major financial shocks that hit economies, and especially smaller economies, during episodes of financial market contagion. Unsurprisingly, given current yield curves, debt issuance almost everywhere has shifted towards longer-term funding.

We still have much to learn around liquidity risk and the emergence of‘black holes’ in funding and asset markets. Liquidity risk is a key concern for countries with large external borrowing needs, especially if investors become skittish, trading volumes begin to thin and some price gapping occurs. Left unabated, liquidity problems can mutate into solvency problems.

The Reserve Bank introduced a prudential liquidity policy in April 2010. This policy includes minimum liquid asset requirements, and a minimum core funding ratio. Like the Basel III net stable funding requirement scheduled for 2018, the policy requires a minimum proportion of total lending to be funded by more stable 'core funding' instruments such as retail deposits and long term borrowing (beyond one year).

In New Zealand, the commercial banks' core funding ratios fell to around 60 percent prior to the GFC. Today the banks' core funding ratios stand at around 85 percent (against a minimum of 75 percent) and the vulnerability of New Zealand banks to developments in offshore wholesale funding markets has been substantially diminished.

Concluding Comments

One of the eight lucky signs of Buddhist philosophy, drami or the'endless knot', illustrates how individuals and institutions across the world and over time are connected in a web of mutual interdependence.

Another valuable insight from Asia is that of the four friends (the elephant, the monkey, the rabbit, and the bird). By standing on each other's shoulders the bird is able to reach the fruit for all of them.

Preventing future global financial crises requires us to understand the web of mutual interdependence characterised by the endless knot, and the wisdom of the four friends.

Despite the invaluable data gathering and research by the BIS, our understanding of the drivers and impact of cross-border financial linkages remains limited in many areas. Our theoretical benchmark for much policy analysis continues to be based on capital-free arbitrage that assumes efficient and smooth changes in asset prices, with no material effect for capital flows.

We have excellent speakers and papers over the next two days and an opportunity to explore many of these and other important issues. I wish you productive discussions and deliberations. Certainly, my Reserve Bank colleagues and I will take a great deal of interest in the conference sessions.

Cross-border portfolios: assets, liabilities, and non-flow adjustments[1]

Stephanie E Curcuru,[2] Charles P Thomas,[2] Francis E Warnock[3]

Abstract

We document patterns of cross-border asset and liability positions, focusing on EME Asia and a five-year period around the global financial crisis. On EME Asia's external portfolio, we calculate cumulative five-year losses – or, more accurately, negative non-flow adjustments – of almost $600 billion. The "losses" are quite small relative to GDP, amounting to only 1% of GDP on the asset side. "Losses" are relatively small in part because of the substantial home bias in portfolios – the external portion of EME Asia's portfolios is small – but also because of modest average annual returns on foreign equities and foreign bonds.

[1] The authors are thankful for comments from Martin Berka, Guy Debelle, Torsten Ehlers, Frank Packer and participants in a seminar at the BIS Asian Office in Hong Kong SAR and at the RBNZ-BIS Conference on Cross-Border Financial Linkages. We thank Philip Lane for providing an update to his External Wealth of Nations dataset. The views in this paper are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Federal Reserve Bank of Dallas, the Board of Governors of the Federal Reserve System, or of any other person associated with the Federal Reserve System.

[2] Board of Governors of the Federal Reserve System.

[3] Darden Graduate School of Business, University of Virginia; Institute for International Integration Studies, Trinity College Dublin; Globalization and Monetary Policy Institute, Federal Reserve Bank of Dallas; National Bureau of Economic Research.

1. Introduction

Cross-border investment has surged over the last few decades. Gourinchas et al (2012) note that in 1971 US external claims and liabilities were 17% and 11% of GDP, respectively, but by 2007 had exploded to 119% and 131%. IMF (2014) reports that debtor and creditor countries now have net positions amounting to 15% of global GDP and that many countries have gross "stock imbalances" of around 50% of their GDP (eg Turkey at –50%, Germany at +50%).

Given the growth and size of cross-border positions, it is natural to worry about their inherent risks. IMF (2014) notes that large debtor economies are vulnerable to changes in market sentiment; economies with large net liability positions may become victims of disruptive external financial market conditions, including the sudden drying up of external financing (Catão and Milesi-Ferretti (2014)). Lane et al (forthcoming) note that international positions are so large that small exchange rate movements can generate large cross-border valuation adjustments.

Obstfeld (2012) uses the term "non-flow adjustments", which include the effects of price and exchange rate movements as well as survey sample and other statistical adjustments. We will follow the Obstfeld use of the term, as non-flow adjustments, while less exciting, is clearly more accurate than other terms used in literature such as valuation adjustments (which is one component of non-flow adjustments), gains or losses, or wealth transfers.[4] It is not that non-flow adjustments are necessarily benign. Obstfeld (2010, 2012) shows that with ever-expanding gross cross-border positions, more volatile "non-flow adjustments" have been evident and should be expected to persist.

In this paper we document the patterns of cross-border asset and liability positions, focusing on emerging Asia and the period from just before the global financial crisis (2006) to just after (2011). We, like Obstfeld and others, document large non-flow adjustments, with five-year net cumulative losses totalling almost $600 billion for emerging market economies in Asia(EME Asia). Much ($511 billion) of the cumulative non-flow adjustments were on the liabilities side of the balance sheet – that is, foreigners' earnings in EME Asia – whereas on the asset side EME Asia lost just less than $100 billion.

The cumulative non-flow adjustments on the asset side are small, however, when expressed as a share of GDP; they amount to just 1% of average 2006 and 2011 GDP. This is due to at least two reasons. First, home bias is alive and well in EME Asia. The external positions, especially the positions of private investors, are quite small relative to GDP. Second, even though our sample spans the global financial crisis (GFC) and thus asset returns were volatile, we compute that over the five-year period private EME Asia investors lost very little on their foreign equity portfolios (0.7% annually) and gained a bit (0.8% annually) on their foreign bond portfolios. When external positions are relatively small and returns are near zero, gains or losses on the international portfolio are modest.

The paper proceeds as follows. In the next section we discuss necessary caveats on the data. The main point of that section is that, while we have made a good faith effort to reconcile at times inconsistent data sources to present a complete picture

[4] See also Curcuru et al (2008) on this point.

of country-level foreign investments, our estimates are necessarily somewhat rough. In Section 3 we discuss the cross-border portfolios, along with the magnitude of non-flow adjustments. In Section 4 we briefly explore why EME Asia's non-flow adjustments are small relative to GDP. We conclude in Section 5.

2. A caveat on data

We begin with a description of the data. We stress that numbers reported in this paper should be viewed as estimates from imperfect and at times inconsistent data sources. They constitute our best guesses given the data constraints, but the reader should view the reported numbers as approximations illustrating the orders of magnitude of asset allocations.

Data on the overall size (by asset class) of countries' external assets and liabilities are from the IMF's International Investment Position (IIP). Such data are subject to revisions that at times can be substantial, but in general can be thought of as the most accurate estimate currently available. Somewhat less accurate are the data on the geographical distribution of cross-border positions. Data on external portfolio debt and equity assets and liabilities are from the IMF Coordinated Portfolio Investment Survey (CPIS) data set, which has many well documented shortcomings.[5, 6] External flows are from IMF Balance of Payments (BOP). Again, the magnitudes are likely to be reasonably accurate – given what is currently known – and the geography less so. Data that are straightforward to measure, and so should be accurate, include domestic stock market capitalization (from the World Bank's World Development Indicators database, or WDI), domestic bond market capitalization (from the World Bank's Financial Development and Structure Dataset), and GDP (WDI).

Using reported data, we calculate returns using two approaches. For each BOP asset class – portfolio equity, portfolio debt, foreign direct investment FDI, and the so-called "other" (which we will refer to as banking) – we compute implied returns from the IIP as the change in value of the IIP position minus BOP flows. This is surely not accurate; in particular, any inconsistency in revisions to IIP and BOP data will confound this approach. Thus, as pointed out in Obstfeld (2012), these valuation changes are more accurately labelled "non-flow adjustments" rather than return. As a check, for the two asset classes for which off-the-shelf returns indices are available (portfolio equities and portfolio debt), we also compute returns using MSCI total equity return indexes and JP Morgan GBI USD-denominated total return indexes. For portfolio equities and portfolio debt, we computed returns both ways (imputed "non-flow adjustments" from IIP and BOP, as well as using returns indices); our final estimates are a function of both approaches. For banking and direct investment, off-the-shelf returns indices that would enable a careful cross-check are not available, so what we call returns below are best thought of as Obstfeld's non-flow adjustments.

[5] An informative paper on a particular shortcoming of the CPIS data is Felettigh and Monti (2008).

[6] The geographical distribution of external DI assets and liabilities positions is available from IMF Coordinated Direct Investment Survey (CDIS), although we do not use such information in this paper.

3. Cross-border portfolios: assets, liabilities, and non-flow adjustments

In this section, we first present the evolution of the shares of "risky" (specifically, portfolio equity plus FDI) and "safe" (specifically, debt securities and deposits or loans) in aggregate EME and advanced economy (AE) assets and liabilities. We then examine by country the size and geography of cross-border positions before turning to the direction and magnitude of wealth transfers. In most of our analysis, we examine snapshots from just before the GFC in 2006 to just after, in 2011, as well as changes between those two dates.

3.1 Risky and safe assets and liabilities: the stylised facts

An oft-repeated stylised fact is that emerging market economies (EMEs) are long in relatively safe developed country assets, whereas advanced economies (AEs) are typically long in relatively risky EME assets. The world changed after the GFC in many ways. A reasonable question is whether this pattern also changed.

We start by dispensing with the terms risky and safe. What is termed in the literature "safe" debt securities and bank deposits or loans can be as risky as the assets which usually carry the "risky" label (specifically, portfolio equity plus FDI). In fact, the so-called safe assets are likely to stand behind most crises. Thus, we will use the terms "equity" to mean portfolio equity plus FDI and "debt" to be debt securities and deposits or loans.

Stylised facts about the nature of cross-border portfolios come from the Lane and Milesi-Ferretti (2007) External Wealth of Nations (EWN) global data set of the components of countries' foreign assets and foreign liabilities. We examine the data set to compare cross-border holdings before and after the crisis (eg 2006 and 2011, the end of the EWN data set) while presenting not only "total" but also the assets side, separating out "private assets" and "reserve assets".

Graph 1 presents, using EWN data through 2010, the Equity + FDI share in liabilities and assets for EMEs and AEs. The liabilities graph (top graph of Graph 1) shows that most AE liabilities are in bonds/banking (70%) while most EME liabilities are in equity/FDI (60%). The assets graph (lower graph of Graph 1) provides one view of the extent foreign portfolios are in "equity" and "debt" assets. Note one takeaway from Lane and Milesi-Ferretti (2007), which used the EWN data through 2004, was that EMEs' foreign assets were tilted away from equity/FDI and towards debt/banking. In 2004, only 18% of EMEs' foreign assets were in equity/FDI; the other 82% were in debt/banking. This contrasted strikingly with AEs' foreign portfolio, which had an almost 40% weight on equity/FDI. Two things have occurred since 2004. One, AEs' weight on equity/FDI has fallen and EMEs' weight on these has risen, such that the two are not substantially different, with both in the 30–35% range. Two, we must recognise that the EME Total line in Graph 1 includes both private and official EME investors. EMEs tend to have relatively large reserve holdings, which tend to be in bonds. The EME Private line in Graph 1 omits official reserve holdings and shows that private-sector EME portfolios now have equal portion in "debt" and "equity" foreign assets. Moreover, private sector EME portfolios now have a much higher share of equity/FDI than the equity/FDI share in AE portfolios.

3.2 Country details on the composition of cross-border assets and liabilities

Table 1 provides further detail on foreign assets, specifically the "equity" and "debt" foreign portfolios from IIP data. Note that in the table *Total* is *Equity* plus *Debt* plus *Reserves*, where *Equity* is defined as portfolio equity + FDI and *Debt* is portfolio bonds + banking. The top half of the table shows that in 2006 the bulk (61%) of EME Asian foreign assets were in reserves, while most private EME foreign assets were in "debt" assets (29% of total, of which most were in banking) and "equity" private foreign assets were small (10% of total, mostly in FDI). The bottom half of Table 1 shows a more recent (2011) snapshot. In 2011, the bulk (64%) of EME Asian foreign assets was still in reserves. Of private EME foreign assets, most were in "debt" assets (overwhelmingly in banking, representing a large increase since 2006), and "equity" private foreign assets were a small but increasing share (still mostly in FDI).

Table 2 provides information on equity and debt liabilities. In 2006, the bulk (60%) of EME Asia's liabilities was in equities, with most of those being direct investment. Of the debt liabilities, the vast majority (83%) were in banking. In 2011, the composition of liabilities was similar, with more equity than debt, more FDI than portfolio within equity, and more banking than bonds within debt. The composition is quite different in advanced economies, where liabilities are more debt than equity with roughly equal shares of FDI and portfolio within equities and of bonds and banking within debt.

3.3 Magnitude of non-flow adjustments

One view of the risks inherent in cross-border positions comes from valuation gains and losses on international positions. Table 3 shows gains and losses – so-called valuation changes but more accurately referred to as non-flow adjustments – in foreign portfolio (debt and equity) positions over the 2006–11 period. Valuation changes for all countries but the United States are implied not observed and hence are subject to the problems highlighted in Curcuru, Dvorak and Warnock (2008) and Curcuru, Thomas, and Warnock (2013). The table shows that private sector valuation changes for the international assets of most Asian EMEs were negative over the 2006–11 period, with the region's losses totalling $86 billion. Indonesia and India had the largest losses ($50 billion and $24 billion, respectively); much of the losses appear to have been in cross-border banking positions. Most countries' reserves positions gained in value; a notable exception is China. Turning to liabilities, the valuation changes for the liabilities of Asian EMEs were mostly positive over the period, in sharp contrast to AEs' liabilities, which had negative valuation adjustments.

The overall picture provided by Table 3 is that Asian EMEs lost on their foreign portfolios and provided foreigners with positive returns – a so-called "wealth transfer" to foreign investors. The table includes all asset classes – portfolio debt and equity, FDI, and banking – but we have a clearer picture of the portfolio debt and equity positions so we focus next on them.

Most of the losses by Asian investors on their foreign assets were in their portfolio investments. Table 4 focuses on the asset side and shows that Asian EMEs lost $63 billion on their private cross-border portfolio debt and portfolio equity

holdings, with all of the losses coming from cross-border bonds (and most of those being on China's external portfolio). This is miniscule compared with the $1.2 trillion lost by AE investors. Again, these valuation changes are imputed and are broadly consistent with the moves of broadly based market indexes, but they may be confounded by inconsistencies and revisions of positions and flow data and so are best termed "non-flow adjustments".

3.4 Geography of cross-border portfolio debt and equity positions

At the heart of any portfolio's returns are geographic allocations, the country weights within the portfolio. Indeed, the geographic allocations of EME Asian investors vary widely across countries. Table 5 provides information on the geography of foreign portfolio debt and equity positions as of 2006 (top panel) and 2011 (lower panel) from the CPIS. In 2006, private EME Asian equity and debt holdings were primarily in Europe and Japan, with the exceptions of the Philippines (tilted towards the United States) and India and Indonesia (large equity positions within EME Asia). By 2011, there was evidence of switching of portfolio holdings from Europe to Japan: EME Asian equity and debt holdings were primarily in Japan, with still substantial holdings in Europe and EME Asia. And there were declines in the large Philippine positions in US equities and large Indian and Indonesian equity positions in EME Asia observed in 2006.

Turning to the geographic distribution of liabilities, in 2006 the geography of investors in EME Asia's equities was about one third North America, one third Europe, and one fifth Japan. In contrast, 75% of debt investors were from Europe and Asia and only 15% from North America. In 2011, the geography was similar, but with a bit more equity investment from Japan.

3.5 The size of cross-border portfolios

The above analysis focused on proportional allocations and provided no indication of the size of the cross-border portfolios. Table 6 shows that private EME foreign portfolio (debt and equity) holdings are quite small relative to GDP. For EME Asia as a whole, private foreign equity holdings totalled only 6% of GDP in 2006, falling to 2% by 2011. Foreign debt holdings were similarly small. In contrast, advanced economies' holdings of foreign equities and foreign bonds were much larger at close to 40% of GDP. EME Asia's reserves are larger – about a third of GDP – but private EME investors' foreign equity and foreign bond portfolios are small.

The large amount of reserves prompts the question of whether countries with large reserves also have large foreign liabilities.[7] One view is that reserves accumulation is self-insurance in that governments have acquired reserves as a policy response to the private sector's accumulation of FX liability. Graph 2 suggests that the evidence is weakly consistent with this view.

[7] We thank Taka Ito for posing this question.

4. Why are EME Asia's non-flow adjustments so small?

Tables 3 and 4 suggest that private EME Asia's cumulative losses on their external portfolios were of the order of $86 billion, of which $63 billion was on positions in portfolio debt and equity, and reserve accounts had gains of $10 billion. These gains and losses are quite small relative to GDP, amounting to only 1% of the average GDP of 2006 and 2011. In this section we briefly explore why the non-flow adjustments were so small.

One reason for the small computed gains and losses is that there is still considerable home bias in EME Asia. Private EME Asia's external portfolios are quite small, as we showed in Table 6.[8]

But another reason for the small computed gains and losses is that EME Asia's returns on foreign equities and bonds were modest (Table 7). Average annual returns on EME Asia's external portfolios were modest at –0.7% for foreign equities and +0.8% on foreign bonds. Small external portfolios and modest rates of returns produce modest valuation gains and losses.

A comparison of the returns in Table 7 and the returns that would be implied from Table 4 is constructive and gets at the heart of why we are so hesitant to use the labels valuation changes and gains or losses. Table 7 shows our best guesses at returns on external portfolios, whereas the valuation adjustments in Table 4 are really non-flow adjustments that can include effects of statistical revisions (see Curcuru, Dvorak and Warnock (2008) and Curcuru, Thomas and Warnock (2013)). To compute the returns used in Table 7 we compared the return implied by the non-flow adjustments with relevant off-the-shelf returns indices. We note that off-the-shelf returns indices are reasonable but imperfect measures of the returns on a country's external portfolio, so the comparison is not foolproof. That said, for equities the implied returns for some countries were much too high or too low relative to returns computed from countries' MSCI index changes. Similarly, implied returns for bonds differ from returns observable from major indices. In particular, Table 4 suggests losses on EME Asia's external bond holdings, whereas Table 7 (our best guess) shows positive returns.

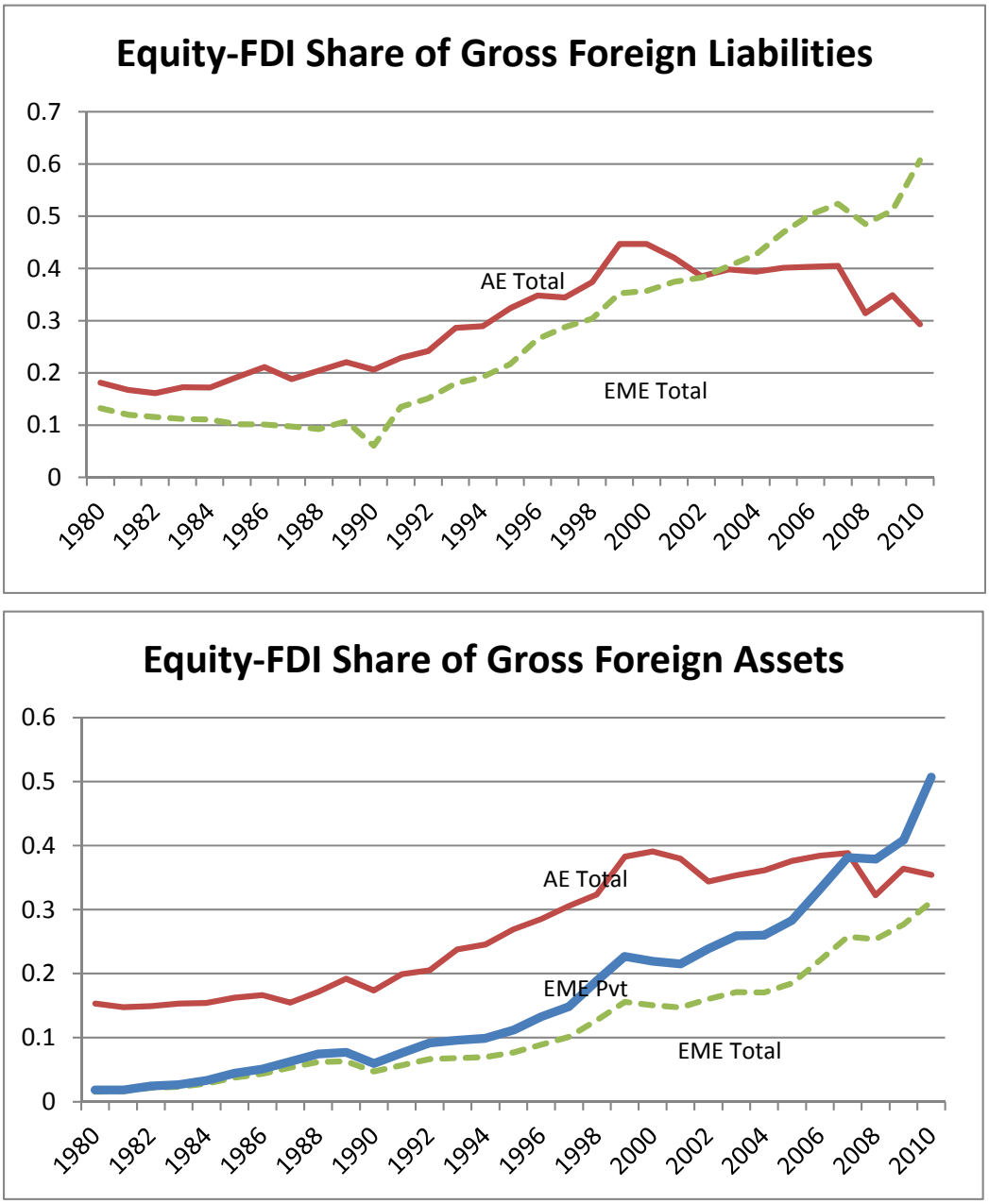
5. Conclusion

In this paper we have provided a descriptive analysis of cross-border asset and liabilities positions. We show that cross-border positions are, at least in most EMEs, small relative to GDP. Not surprisingly, the non-flow adjustments on the external portfolios – what some might call valuation adjustments or even international

[8] Of course, even small external positions can be problematic when debt is denominated in foreign currencies. One this dimension, EME Asia is doing quite well, with 96% of its bonds denominated in local (not foreign) currencies (Burger et al (forthcoming)). Even Latin America, the poster-child for "original sin", now has only 25% of its bonds denominated in foreign currencies, down from more than 50% only a decade ago. Another potential problem spot is EME Asian bond issuance through offshore subsidiaries; see, for example, McCauley et al (2013).

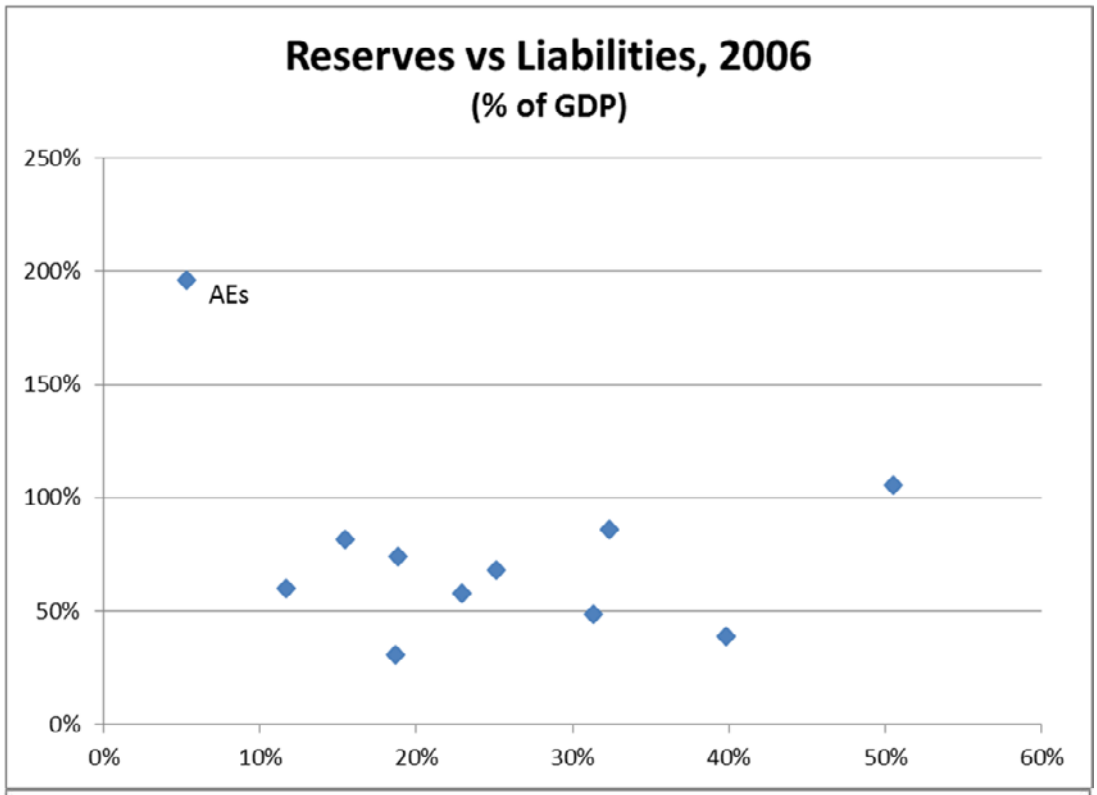
wealth transfers – are quite small too. In the context of the literature on international wealth transfers – after we get past taking issue with a term that suggests a zero-sum outcome – we can say that EMEs weathered the crisis relatively well because they have severe home bias and their annual average external returns were modest.

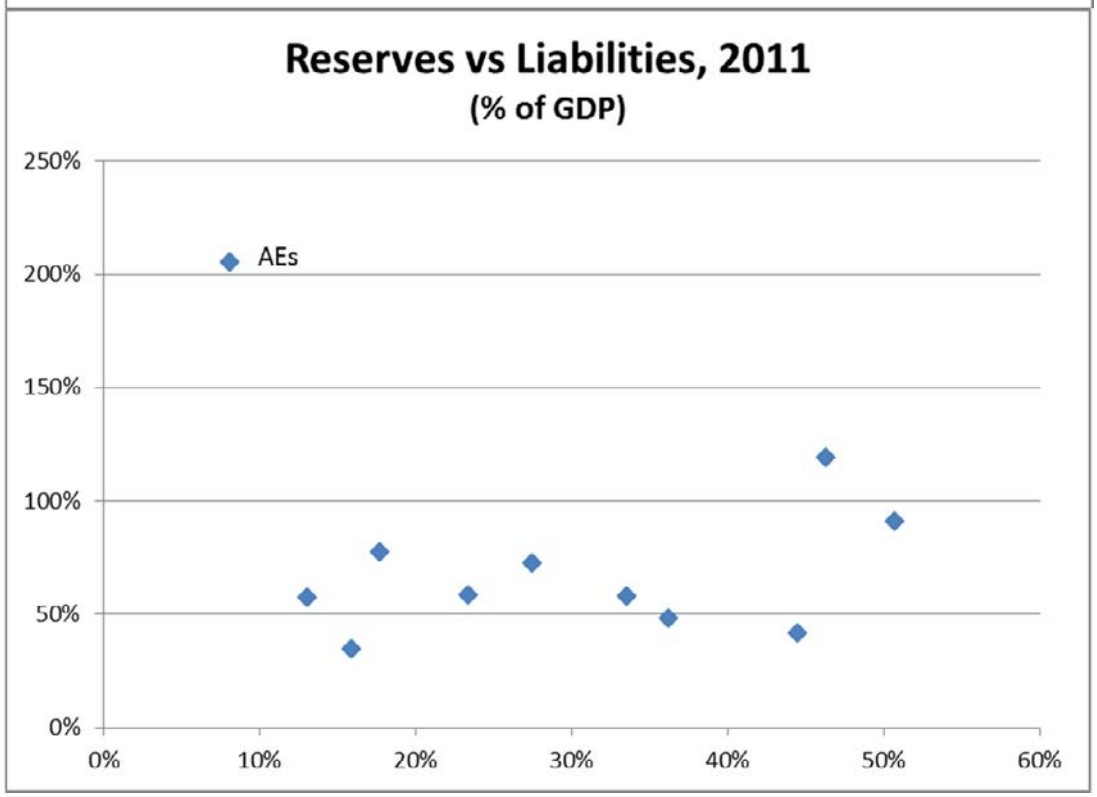
Graph 1: Equity-FDI share in foreign assets and liabilities



Source: EWN data of Lane and Milesi-Ferretti (2007) updated through 2010. Notes: In both charts, EME Total is dashed line and AE Total is thin solid line. In the bottom chart, EME Private is the thick blue line.

Graph 2: Reserves and liabilities (as a percent of GDP)





Note: Included are the aggregates of EME Asia, EME Asia ex China, EME Other, and Advanced Economies, as well as the individual Asian countries of China, India, Indonesia, Korea, Malaysia, the Philippines and Thailand Reserves are plotted on the horizontal axes; liabilities are on the vertical axes.

Table 1. "Equity" and "Debt" private and reserve assets in 2006 and 2011

		Equity (Portfolio + DI)			Debt (Portfolio + Banking)			Reserves
		Equity/ Total	DI share of equity	Portfolio Share of Equity	Debt/ Total	Portfolio share of Debt	Banking Share of Debt	Reserves/ Total
2006	EME Asia	10	83	17	29	42	58	61
	China	5	98	2	31	51	49	64
	India	12	98	2	12	2	98	76
	Indonesia	12	96	4	37	11	89	52
	Korea	19	57	43	30	44	56	51
	Malaysia	30	89	11	20	8	92	50
	Philippines	5	95	5	50	27	73	45
	Thailand	8	83	17	37	7	93	55
	EME Asia ex China	17	76	24	27	26	74	56
	EME Other	39	69	31	35	23	77	26
	Asia Fin. Center	44	65	35	48	27	73	8
	Advanced	41	53	47	56	39	61	3
2011	EME Asia	16	82	18	20	14	86	64
	China	11	83	17	20	12	88	69
	India	26	99	1	6	0	100	68
	Indonesia	13	94	6	21	19	81	66
	Korea	33	71	29	24	18	82	42
	Malaysia	43	83	17	20	19	81	37
	Philippines	7	99	1	22	33	67	71
	Thailand	17	88	12	20	27	73	63
	EME Asia ex China	28	82	18	19	19	81	53
	EME Other	36	70	30	29	20	80	34
	Asia Fin. Center	44	65	35	46	27	73	10
	Advanced	42	64	36	54	40	60	4

Note: All numbers in percent. Total=Equity + Debt + Reserves, where Equity=Portfolio Equity + FDI and Debt=Bonds + banking. Asia financial centres include Hong Kong SAR and Singapore.

Source: IMF, *International Investment Position*.

Table 2. "Equity" and "Debt" liabilities in 2006 and 2011

		Equity (Portfolio + DI)			Debt (Portfolio + Banking)		
		Equity/ Total	DI share of equity	Portfolio Share of Equity	Debt/Total	Portfolio share of Debt	Banking Share of Debt
2006	EME Asia	60	64	36	40	17	83
	China	69	85	15	31	4	96
	India	45	54	46	55	9	91
	Indonesia	43	67	33	57	20	80
	Korea	60	30	70	40	29	71
	Malaysia	63	57	43	37	31	69
	Philippines	36	53	47	64	38	62
	Thailand	67	68	32	33	11	89
	EME Asia ex China	55	47	53	45	23	77
	EME Other	66	64	36	34	48	52
	Asia Fin. Center	58	75	25	42	2	98
	Advanced	39	46	54	61	45	55
2011	EME Asia	63	76	24	37	22	78
	China	70	90	10	30	4	96
	India	48	65	35	52	15	85
	Indonesia	59	69	31	41	32	68
	Korea	52	32	68	48	49	51
	Malaysia	58	67	33	42	53	47
	Philippines	39	50	50	61	37	63
	Thailand	73	69	31	27	20	80
	EME Asia ex China	55	57	43	45	35	65
	EME Other	66	72	28	34	50	50
	Asia Fin. Center	56	81	19	44	3	97
	Advanced	36	55	45	64	48	52

Note: All numbers in percent. Total=Equity + Debt + Reserves, where Equity=Portfolio Equity + FDI and Debt=Bonds + banking. Asia financial centres include Hong Kong SAR and Singapore.

Source: IMF, *International Investment Position*.

Table 3. Foreign positions and breakdown of changes since 2006

	2006 position	Flows	Valuation Adjustments	2011 position
Assets (excluding reserves)				
EME Asia	1,095	1,438	-86	2,448
China	610	886	-17	1,479
India	54	106	-24	137
Indonesia	40	66	-50	57
Korea	225	208	-13	421
Malaysia	83	112	28	222
Philippines	28	17	-14	31
Thailand	55	42	5	102
Asia Fin. Centre	3,108	1,356	250	4,714
EME Other	1,624	1,457	-271	2,810
Advanced	64,693	16,554	-1,321	79,926
Reserve assets				
EME Asia	1,712	2,631	10	4,353
China	1,081	2,200	-25	3,256
India	177	112	8	297
Indonesia	43	65	2	110
Korea	239	68	-1	306
Malaysia	82	44	7	133
Philippines	23	43	9	75
Thailand	67	98	10	175
Asia Fin. Centre	263	238	7	508
EME Other	795	698	58	1,551
Advanced	1,829	750	776	3,354
Liabilities				
EME Asia	2,651	2,623	511	5,785
China	1,050	1,751	244	3,046
India	291	401	-37	655
Indonesia	219	114	151	485
Korea	650	178	-18	809
Malaysia	172	73	99	344
Philippines	91	30	10	131
Thailand	178	75	63	315
Asia Fin. Centre	2,523	1,254	266	4,043
EME Other	3,953	2,636	-62	6,527
Advanced	67,347	19,081	-1,130	85,299

Note: USD billions. Asia financial centres include Hong Kong SAR and Singapore.

Sources: IMF, *International Investment Position* (Positions) and *Balance of Payments* (flows).

Table 4. Private foreign portfolio positions and breakdown of changes since 2006

	2006 Position	Flows	Valuation Adjustments	2011 Position	Total Changes
Total Portfolio					0
EME Asia	388	61	-63	386	-2
China	265	-17	-44	204	-61
India	1	1	-1	1	0
Indonesia	4	8	-3	8	4
Korea	98	37	-31	103	6
Malaysia	8	13	19	40	32
Philippines	7	4	-3	8	1
Thailand	5	16	0	21	16
Asia Fin Centre	958	384	117	1,459	501
EME Other	284	188	22	494	210
Advanced	27,642	4,436	-1,224	30,853	3,211
Portfolio Equity					
EME Asia	47	134	12	193	146
China	1	65	20	86	85
India	1	1	-1	1	1
Indonesia	0	1	0	1	1
Korea	37	51	-17	72	35
Malaysia	6	10	11	27	21
Philippines	0	0	0	0	0
Thailand	2	5	-1	6	4
Asia Fin Centre	517	295	-7	805	288
EME Other	150	72	48	269	119
Advanced	12,996	1,185	-1,536	12,645	-351
Portfolio Debt					
EME Asia	341	-73	-76	193	-148
China	264	-82	-64	118	-146
India	0	0	0	0	0
Indonesia	3	6	-3	7	3
Korea	61	-15	-15	32	-29
Malaysia	3	3	8	14	11
Philippines	7	4	-3	8	1
Thailand	3	11	1	15	12
Asia Fin Centre	441	89	124	654	213
EME Other	134	116	-26	224	90
Advanced	14,646	3,251	312	18,208	3,562

Note: USD billions. Excludes reserves. Asia financial centres include Hong Kong SAR and Singapore. Total changes = flows + non-flow adjustments.

Sources: Source: IMF, *International Investment Position* (Positions) and *Balance of Payments* (flows).

Table 5. The geography of foreign (private) assets and liabilities, 2006 and 2011

2006		Foreign Destination (Assets)						Foreign Source (Liabilities)					
		Advanced				EME		Advanced				EME	
Type	Country	North America	Europe	Asia	Other	Asia	Other	North America	Europe	Asia	Other	Asia	Other
Equity	EME Asia	12	42	26	7	12	1	38	31	20	2	1	8
	China	0	0	98	0	1	0	29	26	42	1	1	2
	India	11	40	7	0	20	22	30	27	6	1	1	34
	Indonesia	1	1	5	1	92	0	46	39	8	1	1	6
	Korea	14	52	14	6	13	2	55	35	6	3	0	0
	Malaysia	7	16	59	8	9	1	32	39	23	2	1	3
	Philippines	71	22	5	1	1	0	55	35	8	1	0	0
	Thailand	6	33	5	47	9	0	35	43	17	2	1	1
	EME Asia ex China	13	47	18	8	13	2	43	34	8	2	1	12
	EME Other	32	58	1	4	1	4	55	41	2	1	0	1
	Asia Fin Center	12	21	8	28	31	1	44	37	12	5	2	1
	Advanced	18	53	10	7	6	5	32	57	6	2	1	2
Debt	EME Asia	39	19	28	7	5	2	16	38	35	1	4	5
	China	0	0	100	0	0	0	9	29	48	0	3	10
	India	5	1	76	0	17	0	7	45	18	1	1	28
	Indonesia	7	33	36	14	2	7	18	32	43	0	2	5
	Korea	54	23	8	10	4	2	17	36	45	1	1	1
	Malaysia	17	54	4	7	13	4	17	41	39	0	2	0
	Philippines	43	18	12	5	23	0	24	57	17	1	0	0
	Thailand	11	39	19	12	9	11	17	18	18	0	46	0
	EME Asia ex China	49	24	9	9	6	2	17	39	34	1	4	5
	EME Other	48	36	0	3	9	4	23	63	4	5	2	2
	Asia Fin Center	21	40	7	17	13	1	20	38	27	1	12	2
	Advanced	20	64	2	9	2	3	9	71	12	4	3	1

2011		Foreign Destination (Assets)						Foreign Source (Liabilities)					
		Advanced				EME		Advanced				EME	
Type	Country	North America	Europe	Asia	Other	Asia	Other	North America	Europe	Asia	Other	Asia	Other
Equity	EME Asia	24	13	43	5	9	5	33	30	27	1	2	7
	China	0	0	99	0	1	0	20	25	50	0	3	2
	India	13	42	9	21	13	2	30	24	10	1	1	34
	Indonesia	94	0	1	0	4	0	44	38	15	1	2	0
	Korea	35	21	13	7	15	8	50	37	11	2	0	0
	Malaysia	32	13	38	4	9	4	36	34	23	2	3	2
	Philippines	31	21	35	5	8	1	54	34	11	0	1	0
	Thailand	25	28	11	30	5	0	43	42	12	0	2	1
	EME Asia ex China	34	19	19	8	13	7	41	33	12	1	1	11
	EME Other	31	57	0	7	2	3	55	40	1	1	1	1
	Asia Fin Center	15	17	5	30	33	0	47	33	9	2	6	2
	Advanced	20	48	8	10	8	6	31	53	9	2	2	3
Debt	EME Asia	6	6	78	2	6	2	16	29	47	1	5	2
	China	0	0	100	0	0	0	2	9	84	0	3	1
	India	31	49	7	0	8	5	6	30	51	1	1	11
	Indonesia	5	44	10	4	37	1	25	36	32	3	4	0
	Korea	40	35	5	9	3	8	20	32	39	1	7	0
	Malaysia	12	18	25	8	26	10	22	37	29	1	9	0
	Philippines	30	13	6	9	41	1	29	47	19	4	1	0
	Thailand	10	10	10	6	51	13	13	41	33	0	13	0
	EME Asia ex China	24	26	10	8	24	9	19	35	36	2	6	2
	EME Other	41	44	1	2	6	6	25	55	7	6	4	4
	Asia Fin Center	22	26	10	9	32	1	19	42	27	2	10	0
	Advanced	22	59	3	9	4	4	10	65	14	3	6	2

Note: All numbers in percent of total foreign holdings. Excludes reserves.

Source: IMF, *Consolidated Portfolio Investment Survey*.

Table 6. Portfolio debt and equity positions shares of GDP, 2006 and 2011

	2006			2011		
	Private Foreign assets / GDP	Reserves / GDP	Foreign liabs / GDP	Private Foreign assets / GDP	Reserves / GDP	Foreign liabs / GDP
Equity						
EME Asia	1		11	2		7
China	0		4	1		3
India	0		6	0		6
Indonesia	0		9	0		11
Korea	4		29	6		25
Malaysia	3		28	9		23
Philippines	0		12	0		12
Thailand	1		19	2		20
EME Asia ex China	2		17	2		14
EME Other	4		20	4		13
Asia Fin Center	155		108	165		86
Advanced	38		40	30		34
Debt						
EME Asia	6	31	3	2	36	4
China	10	40	1	2	44	1
India	0	19	1	0	16	3
Indonesia	1	12	7	1	13	8
Korea	6	25	8	3	27	17
Malaysia	2	51	12	5	46	26
Philippines	5	19	18	3	34	13
Thailand	1	32	3	4	51	5
EME Asia ex China	3	23	6	2	23	9
EME Other	3	15	11	3	18	11
Asia Fin Center	133	79	8	134	104	10
Advanced	43	5	54	44	8	63

Note: All numbers in percent share of GDP.

Sources: IMF, *International Investment Position*, *Balance of Payments*, *Consolidated Portfolio Investment Survey*; World Bank, *World Development Indicators*, *Financial Development and Structure* data set; authors' calculations.

Table 7. Average annual returns on private portfolios, 2006–11 (%)

	Portfolio Equity	Portfolio Debt
EME Asia	-0.7%	0.8%
China	-4.2%	2.7%
India	1.3%	2.6%
Indonesia	-4.2%	1.5%
Korea	-0.6%	0.1%
Malaysia	1.9%	0.7%
Philippines	-0.8%	1.3%
Thailand	0.3%	2.0%
EME Asia ex China	-0.3%	0.3%
Asia Fin Center	-1.8%	-0.3%
EME Other	-0.8%	0.7%
Advanced	-1.8%	-0.3%

Note: Returns in this table represent our best guess at actual returns and so can differ from the returns implied in Table 4. See text for details.

Source: IMF IIP, BOP; MSCI; author's calculations

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Comment on: Cross-border portfolios: assets, liabilities and wealth transfers

Martin Berka[1]

Summary

The paper documents the geographical composition in domestic and international asset and liability positions in emerging economies, with a heavy focus on emerging market economies in Asia (EME Asia thereafter). The authors further study the changes in these positions between 2006 and 2011. This is a very interesting paper with potentially important implications for both international macroeconomics as well as finance.

The authors characterise domestic as well as international asset positions. They find that the overall change in the valuation of the external portfolio of the EME Asia was a loss of $63 billion. While this loss may appear to be large, it is dwarfed in comparison to the valuation gain of approximately $2 trillion in the EME Asia's domestic portfolio. This implies that the disproportionately large size of domestic portfolio should be explicitly taken into consideration when assessing the overall riskiness of the EME Asian portfolio, or a portfolio of any individual country. The authors also note that these valuations should not be misinterpreted as wealth transfers because both domestic and foreign investors gain when home equity prices increase.

The important main message of the paper is that cross-border portfolios constitute only a small fraction of EME Asia's overall portfolio. For example, the authors estimate that only 2.6% of equity and 5.7% of bond portfolio holdings in EME Asia are cross-border.

Comments

I now discuss some comments about the paper. I start with comments about the data that may help improve the paper. I then offer some suggestions on interpreting the findings and possible links to the literature.

Data

When discussing the data quality, the authors note that their findings are based on data of varying quality:

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"We want to stress that numbers reported in this paper should be viewed as estimates from imperfect and at times inconsistent data sources. They constitute our best guesses given the data constraints, but the wise reader should view the reported numbers with a healthy degree of skepticism."

The data come from four data sets. Three are from the IMF: the *International Investment Position* (IIP), *Coordinated Portfolio Investment Survey* (CPIS), and the *Balance of Payments* (BOP) data sets, while the World Development Indicators database of the World Bank provides the remaining data. More details on the exact nature of data inconsistencies would be beneficial for assessing the extent of the measurement error included in the authors' calculations. It could facilitate modelling of any measurement errors econometrically.[2]

Home bias

The severity of the home bias found in EME Asia's asset holdings is an important finding of the paper. The authors could significantly extend their discussion of this finding. In 2006, on average, 82% of EME Asian equity holdings were domestic (this number drops to 74% if one excludes China). This is actually lower than the domestic asset holdings in other emerging markets (84% of total) and not very far away from the advanced economies (70%). However, the distance of EME Asia from the advanced economies has risen by 2011. Furthermore, debt holdings see more home bias than equity holdings in EME Asia: 94% of debt is domestic (91% if one excludes China), compared with 80% in other emerging economies and 72% in the advanced economies. Given that the debt is generally considered to be less risky than equity, the larger extent of home bias in debt markets in EME Asia seems surprising. The authors should discuss this new aspect of the EME Asian asset home bias, possibly with the help of statistical analysis of the covariates of the "outward" and the "inward" home bias. Additionally, these ownership patterns could be illustrated with some geographic maps.[3]

Differences in foreign portfolio compositions

The authors also highlight the well known accumulation of foreign exchange reserves in Asia. According to their calculations, the pattern remains rather constant, with reserves constituting 61% of foreign assets in EME Asia (54% in EME Asia excluding China) in 2006, and 64% (53%) in 2011.

However, while the share of reserves remained roughly constant, the share of foreign equity in total foreign asset holdings rose from 10% to 16% in EME Asia and from 17% to 28% in EME Asia excluding China. Consequently, the debt holdings have shrunk from 29% to 20% in EME Asia and 27% to 19% in EME Asia excluding China.

[2] The reader would also benefit from an exact specification of the calculation of the portfolio equity and debt returns. These are calculated as a function of MCSI total equity return index (JP Morgan GBI USD-denominated total return index) and returns from the IIP and BOP data. However, said function is not specified.

[3] One interesting aspect that could be documented is whether these broad equity/debt home-bias patterns hold across the subcategories, or not.

This composition of foreign asset positions in EME Asia contrasts sharply with the composition in advanced economies. The table below summarises such compositional differences, in 2011.

	Reserves	Debt	Equity
EME Asia ex-China	53%	19%	28%
Advanced	4%	54%	42%

Assuming that reserves are least risky, the composition of foreign asset holdings in EME Asia is U-shaped in risk, while it has an inverse-U shape in the advanced economies. This observation is consistent with the earlier point about EME Asia's relatively stronger home bias in debt, and deserves further investigation.

Other comments

The current draft has a few links to a large literature about home bias in international asset markets. The authors should try to connect their results to this literature.

There are macroeconomic counterparts to asset market segmentation. International macroeconomics has long studied the growth of gross asset positions since the 1990s, and its macroeconomic implications. One topic worth highlighting for a possible link to a broader macroeconomic literature is the risk-sharing puzzle due to Backus and Smith (1993) and Kollmann (1995). This is one of the key puzzles in international macroeconomics as highlighted by Obstfeld and Rogoff (2000). In a world with complete financial markets, marginal utilities of consumption per dollar should be equalised between countries. Under some assumptions, this leads to a prediction that real exchange rates and consumption differentials should be perfectly positively correlated. However, evidence strongly contradicts this prediction: correlation is generally between –1 and 0. A plausible source of the Backus-Smith puzzle is a failure of an underlying assumption of the asset market integration. Indeed, the authors seem to provide strong evidence to support the notion that, in EME Asia, asset markets are not internationally integrated. Another side of the same coin relates to the home bias in consumption between countries. This tends to be difficult to explain in models with perfectly integrated capital markets, but becomes more theoretically justifiable if asset markets are segmented.

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Channels and determinants of foreign bank lending

Torsten Ehlers and Philip D Wooldridge[1]

Abstract

Recent crises invigorated debate about the financial stability risks associated with different forms of foreign bank lending. Would a more decentralised model of international banking – in which a greater proportion of international banking business is carried out in the country where banks operate rather than across borders – be more desirable from a financial stability point of view? This paper sheds light on aspects of this debate by using the BIS international banking statistics to investigate the channels through which foreign banks might transmit shocks across borders and to analyse the determinants of banks' decision whether to lend locally or cross-border. Focusing on the Asia-Pacific region, we find increasing concentration among foreign bank creditors, owing in part to the rising market share of banks headquartered within the region. Thus the region continues to be vulnerable to shocks in individual creditor countries. That said, foreign banks' share of aggregate bank credit is low in all but a few Asia-Pacific countries. We also find that the state of the banking system in the borrower country has a significant influence on the form of foreign lending. Intermediation by foreign banks takes the form of local lending where banking systems are relatively more fragile or less developed, and cross-border lending where banking systems are relatively more stable or advanced.

Keywords: Global banks; international lending; financial integration

JEL classification: F34, F36, F65, G21

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1. Introduction

Banks' and regulators' responses to the global financial crisis of 2008–09 and the subsequent euro area crisis are reshaping international banking. In response to deficiencies in their operations and risk management, as well as changes in supervision and regulation, banks are reconsidering their business models. Consequently, some banks are retrenching from international business, others are expanding, still others are restructuring their international operations, and many are adjusting their risk management. In this paper, we seek to illustrate how international banking is changing and what these changes might imply for risks to financial stability. In particular, we attempt to shed light on a question that has received much attention from policymakers since the 2008–09 crisis: would a more decentralised model of international banking – in which a greater proportion of international banking business is carried out in the country where banks operate rather than across borders – be more desirable from a financial stability point of view?

We adopt a broad definition of international banking, which encompasses business conducted locally via banks' affiliates in host countries as well as that conducted from abroad, across national borders. Since the mid-1990s, international banking has increasingly taken the form of local lending in preference to cross-border lending, especially in emerging markets (CGFS (2004), McCauley et al (2002). Recent crises invigorated debate about the relative benefits of different forms of international banking, particularly whether greater reliance on local funding sources could help to reduce vulnerability to external shocks while still providing the benefits of international banking (Fiechter et al (2011)). Indeed, some have called for tighter capital and liquidity requirements on international banks' affiliates (PRA (2014), Tarullo (2014)). Such reforms would weaken intragroup and thus cross-border links, but also potentially hinder the efficient flow of funds across borders (CGFS (2010)).

This paper contributes in two ways to the debate about the optimal form of international banking. First, we consider how the role of international banks in transmitting shocks across borders might have changed since 2007, drawing insights from the Asia-Pacific region. Studies of spillovers during recent crises highlighted the significance of funding structures. McGuire and von Peter (2009) show how shortages of US dollar funding drove cross-border banking flows in 2008. Ivashina and Scharfstein (2010) and de Haas and van Lelyveld (2014) find that reductions in credit were a function of banks' reliance on wholesale funding. Cetorelli and Goldberg (2012) conclude that when subject to a funding shock, parent banks reallocate liquidity within the group according to the differing funding and investment roles of their international affiliates.

However, funding structures are not the only channel through which international banks transmit shocks. We consider other channels to assess borrower countries' vulnerability to shocks, including the diversity of creditors. Focusing on the Asia-Pacific region, we find increasing concentration among foreign bank creditors, owing in part to the rising market share of banks headquartered within the region. That said, foreign banks' share of aggregate bank credit is low in all but a few Asia-Pacific countries.

A second contribution of this paper is to distinguish the determinants of local lending from those of cross-border lending. To this end, we are especially interested

in the relative importance of banking system factors versus trade and macroeconomic factors in banks' decision whether to lend locally or cross-border. Banking characteristics allow us to investigate whether countries with more stable, more profitable, or more efficient banking sectors exhibit different patterns of foreign bank intermediation.

Previous studies of international banking either did not distinguish between local and cross-border lending, or were narrow in their country coverage. For example, Buch (2003) and Focarelli and Pozzolo (2005) examine the decision of banks to expand overseas. Houston et al (2012) analysed the impact of cross-country differences in regulations on banks' international assets. García-Herrero and Pería (2007) study the determinants for intermediation through local claims, but they do not consider banking system factors and use data for only three creditor banking systems. Buch et al (2011) look at individual banks' productivity and find a pecking order in foreign banking activities, whereby more productive banks are more likely to lend through subsidiaries or branches. Yet their study is limited to German banks.

Our estimations take advantage of data for 31 creditor banking systems and more than 800 country pairs over a 13-year period through 2013. This large cross-section of data allows us to identify patterns in the data that are widely applicable. Also, the long time series enables us to identify how the variation in the determinants of the two forms of foreign lending – cross-border versus local – contributes to the observed dynamics in aggregate foreign lending growth over time.

We find that banking system factors have a significant impact on the form of international banking. In our sample, banking system characteristics explain as much of the observed variation in foreign lending growth as trade, gravity and macro factors combined. Overall, our results indicate that intermediation by international banks takes the form of local lending in borrower countries where banking systems are relatively more fragile or less developed, and cross-border lending where banking systems are relatively more stable or advanced.

The remainder of the paper is organised as follows. Section 2 documents changes in international banking activity since 2007, focusing for illustrative purposes on developments in the Asia-Pacific region. Section 3 explains the model and data used to distinguish the determinants of local lending from those of cross-border lending. Section 4 summarises the key results, and section 5 concludes with a discussion of the potential implications of the results for financial stability.

2. International banking in Asia-Pacific

The global financial crisis of 2008–09 triggered a discussion about a potential reversal in the tremendous expansion of international banking that had begun in the 1960s and accelerated in the late 1990s (Buch et al (2013), CGFS (2010), ECB (2012). To illustrate how international banking has evolved since 2007, we focus on developments in a region that was less affected by recent crises and where financial integration continues to advance: Asia and the Pacific.

We view developments through the lens of the BIS international banking statistics, which are the most comprehensive dataset available for monitoring banks'

international activities. The BIS compiles two sets of international banking data: the consolidated statistics, which exclude positions between affiliates of the same banking group, and the locational statistics, which include intragroup positions. Both sets consist of country-level rather than bank-level data.[2] The consolidated statistics capture the assets of all banks of a given nationality – all banks headquartered in a given "home" country – including the assets of their affiliates worldwide, whereas the locational statistics capture the assets of banks located in a given country, regardless of the nationality of those banks. Both sets distinguish between cross-border and local business. However, in the consolidated statistics local claims denominated in non-local currencies – for example, US dollar loans to residents of Japan – are included with cross-border claims.[3] The reason for this treatment is that such claims are typically funded from abroad, often via the head office of the bank (BIS (2013)).[4] Examples of the different forms of foreign lending are shown in Table 1.

Forms of foreign lending

Distinguishing between cross-border and local claims in the BIS international banking statistics Table 1

Creditor	Borrower	Currency of loan	Locational banking statistics	Consolidated banking statistics[1]
Bank's head office in country A	Corporation in country B	Currency of country A	Cross-border claim	Cross-border claim
Bank's head office in country A	Bank's affiliate in country B	Currency of country A	Cross-border claim	Not reported (intragroup position)
Bank's affiliate in country B	Corporation in country B	Currency of country A	Local claim in non-local (foreign) currency	Included with cross-border claim[2]
Bank's affiliate in country B	Corporation in country B	Currency of country B	Local claim in local currency	Local claim in local currency

[1] In the consolidated statistics, total claims (cross-border plus local claims) on residents of countries other than the "home" country of the bank are referred to as "foreign" claims. [2] In the consolidated statistics on an immediate borrower basis, the sum of cross-border claims and local claims in non-local currencies is referred to as "international" claims. In the consolidated statistics on an ultimate risk basis, local claims in non-local currencies are included with local claims in local currency. For simplicity, in this paper we refer to "international" claims as cross-border claims.

2.1 Asia-Pacific in context

We define Asia and the Pacific as the 18 countries in the region that demonstrate some level of openness to foreign investors. We proxy for openness by limiting our sample to countries included in either the MSCI All Country World equity index or

[2] Central banks collect data from the banks in their jurisdiction, compile national aggregates, and then send the national data to the BIS to calculate global aggregates.

[3] For simplicity, in this paper we do not distinguish between cross-border claims and the sum of cross-border claims and local claims denominated in non-local currencies; we refer to both measures as cross-border claims. In the BIS international banking statistics, the sum is labelled "international" claims.

[4] This approximation is not valid for dollarised economies, where deposits by local residents are likely to account for a large share of banks' foreign-currency funding.

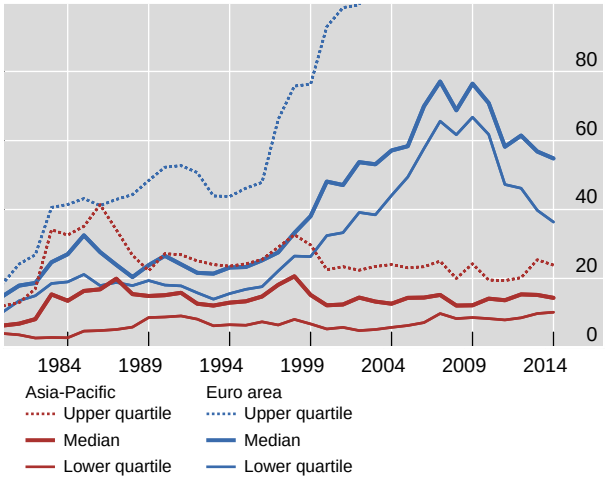
the MSCI Frontier Markets index. Within the region, MSCI identifies five developed markets (Australia, Hong Kong SAR, Japan, New Zealand, Singapore); eight emerging markets (China, Chinese Taipei, India, Indonesia, Korea, Malaysia, Philippines, Thailand); and four frontier markets (Bangladesh, Pakistan, Sri Lanka, Vietnam). We also include Macao SAR in our sample because it reports to the BIS international banking statistics.

As an example of how international banking is changing, Asia-Pacific has three advantages. First, by some measures financial integration is less advanced in Asia-Pacific than in other regions, which leaves open many possibilities for the eventual shape of international banking in the region. The left-hand panel of Figure 1 shows cross-border liabilities to banks as a percentage of borrower countries' GDP for our sample of Asia-Pacific countries plus the euro area. In Asia-Pacific the median value has fluctuated around 15% of GDP since the mid-1980s. This level and trend contrast with the euro area, where the median value rose steadily between the mid-1990s and 2007 to a peak of 77% of GDP. There are large differences across countries, as shown in the right-hand panel of Figure 1. Nevertheless, the upper and lower quartiles track the median reasonably closely.

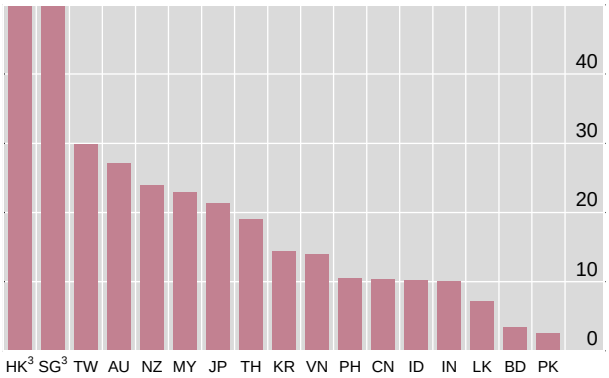
Cross-border borrowing from banks[1]

As a percentage of the borrower country's GDP — Figure 1

Distribution over time, for Asia-Pacific and euro area[2]



Distribution across borrower countries, end-March 2014



AU = Australia; BD = Bangladesh; CN = China; HK = Hong Kong SAR; ID = Indonesia; IN = India; JP = Japan; KR = Korea; LK = Sri Lanka; MY = Malaysia; NZ = New Zealand; PH = Philippines; PK = Pakistan; SG = Singapore; TH = Thailand; TW = Chinese Taipei; VN = Vietnam.

[1] Outstanding cross-border claims of BIS reporting banks, including banks' holdings of securities issued by residents of the borrower country. [2] Euro area comprises the 18 countries that were members of the euro area as of 1 January 2014. Cross-border claims include positions between members of the euro area. The upper quartile peaks at 178% in 2007 and declines to 125% at end-March 2014. [3] For HK, 217%; for SG, 202%.

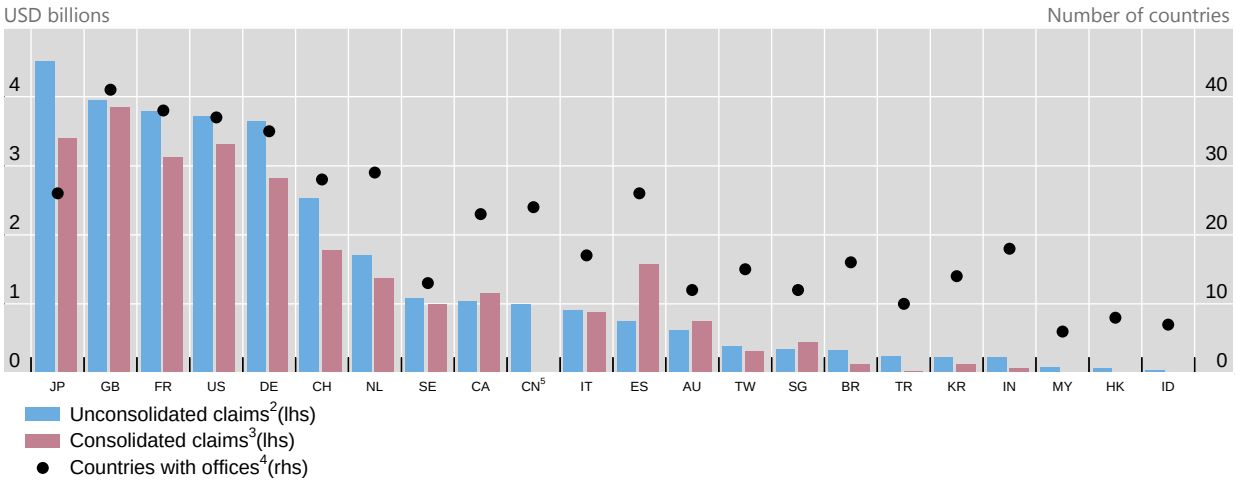
Source: BIS locational banking statistics by residence (Table 6); IMF World Economic Outlook database; authors' calculations.

Second, economies and financial systems in Asia-Pacific are developing rapidly, and this dynamism creates many opportunities (as well as risks) for international banks. Indeed, owing to this dynamism, the 2008–09 crisis seemed not to disrupt the growth of international banking in Asia-Pacific. Whereas in the euro area 2008 marked a clear inflection point in cross-border lending, in Asia-Pacific there was no noticeable change in trend (Figure 1, left-hand panel).

Third, banks headquartered in Asia-Pacific are expanding their presence in foreign markets and thus are likely to have an increasingly large influence on the process of financial integration in the region. At a minimum, they will influence the relative importance of regional versus global integration in Asia-Pacific, each of which potentially brings different benefits (Corbett and Findlay (2010), García-Herrero and Wooldridge (2007)). Japanese banks have long been among the banking systems with the largest international assets (Figure 2). While comparable balance sheet data are not reported to the BIS for Chinese banks, available information indicates that Chinese banks are moving up the ranks of the most active international lenders (CGFS (2014), McGuire and van Rixtel (2012)). For example, Chinese banks have entered new markets in recent years and are now present in about as many markets as Japanese banks (Figure 2). Among Asia-Pacific banks, Australian and Singaporean banks also have sizable international assets, although not as large as those of Japanese and Chinese banks.

International business of banks

By nationality (or "home" country) of the bank[1] Figure 2



[1] "Home" country is usually synonymous with the country where the parent bank (or the financial group of which the bank is a part) is headquartered. It captures the nationality of BIS reporting banks, as opposed to their residence. [2] Claims booked by banking offices located in the 44 countries that report the BIS locational banking statistics (ie the BIS reporting area), including intragroup positions and excluding local claims denominated in local currencies. [3] Claims booked by BIS reporting banks' offices worldwide, excluding intragroup positions and claims on residents of the home country of the parent bank. [4] Number of countries in the BIS reporting area where a parent bank has at least one office (subsidiary, branch or representative office). [5] For Chinese banks, unconsolidated claims are approximated as the claims of offices located inside the BIS reporting area whose home country is in Asia-Pacific but outside the BIS reporting area.

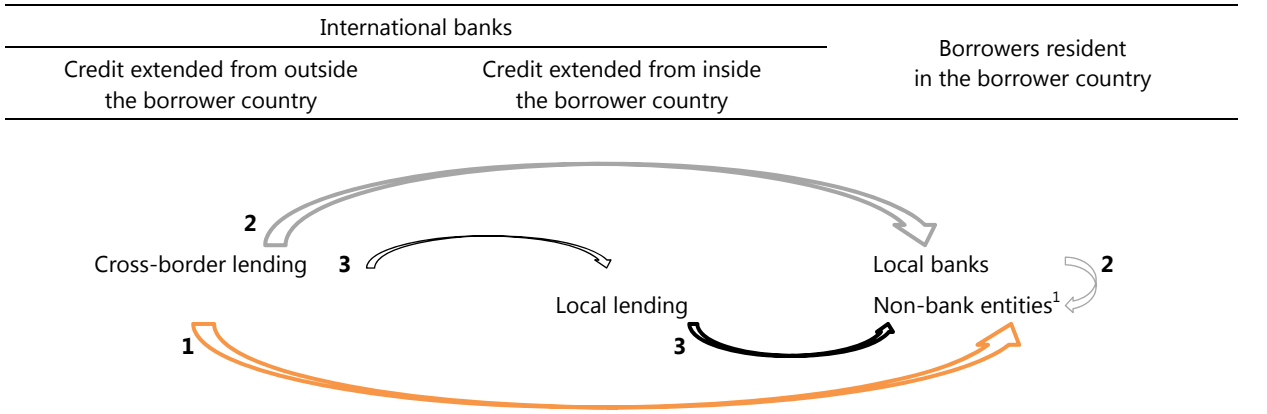
Sources: BIS consolidated banking statistics on an immediate borrower basis (Table 9B); BIS locational banking statistics by nationality (Table 8); authors' calculations.

2.2 Transmission channels

To illustrate how international banking in Asia-Pacific is changing, we consider channels through which it might impact a country's vulnerability to cross-border spillovers. Similar to Cetorelli and Goldberg (2011), we examine three transmission channels: (1) a contraction in direct lending by international banks induced by an exogenous shock beyond the borrower's control; (2) a contraction in cross-border interbank lending, which might trigger a shock to local banks' funding; and (3) a

contraction in local lending by international banks' affiliates. Figure 3 provides a visual representation of these channels.

Transmission of shocks via international banks — Figure 3



[1] Non-bank financial institutions, non-financial corporations, households and governments.

2.2.1 Common lender channel

If the same banks dominate cross-border lending to borrowers in different countries, then even in the absence of other economic or financial ties an adverse shock experienced by one country can trigger outflows from other countries. In particular, an unexpected loss in one country may lead creditors to reduce their exposure to other countries so as to restore capital adequacy ratios, meet margin calls, or adhere to the dictates of banks' value-at-risk or similar models. This is known as the common lender effect (Kaminsky and Reinhart (1999)).

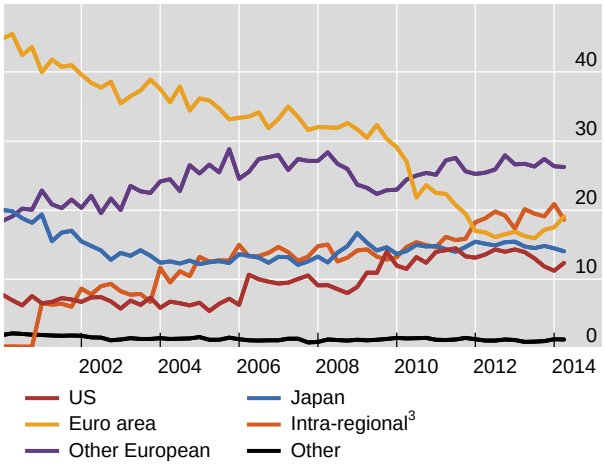
Whereas prior to recent crises analysis focused on adverse shocks emanating from borrowing countries, subsequently attention turned to shocks from creditor banks' home countries. International banks were previously seen as a source of strength to their affiliates, which helped to stabilise credit growth during periods of turmoil in the borrower country (De Haas and van Lelyveld (2010)). Events in 2008–09 demonstrated that international banks can have a destabilising impact if their parent is weak (De Haas and van Lelyveld (2014)). For example, parents that experience funding problems might scale back their international business and thereby increase the risk of a credit crunch in the borrower country.

During recent crises, concerns about a retrenchment by European banks were especially acute because of their fragile financial condition and large share of the market for foreign bank lending. At end-2007, European banks accounted for close to 60% of all international banks' cross-border claims on Asia-Pacific (Figure 4, left-hand panel). Among European banks, UK banks had the highest market share at that time, followed by German and Swiss banks (Figure 4, right-hand panel). In the face of funding difficulties and unexpectedly large losses on US and European assets, starting in 2008 European banks scaled back their presence in Asia-Pacific (and other regions). By end-2013 their collective market share had fallen to 44%.

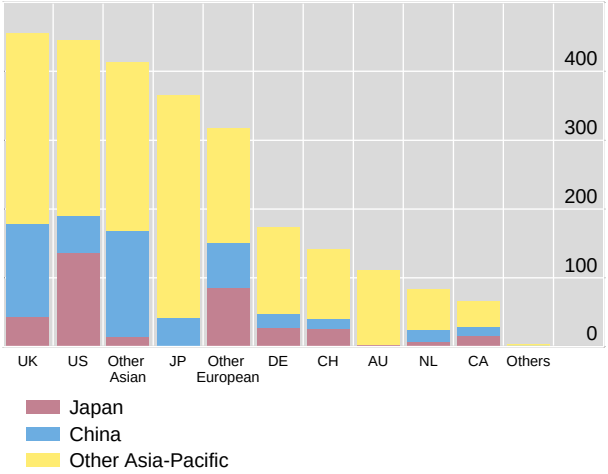
Market share of foreign lending to Asia-Pacific

By nationality of the creditor bank[1] Figure 4

Median market share over time[2]



Claims outstanding at end-March 2014[4]



AU = Australian banks; CA = Canadian banks; CH = Swiss banks; DE = German banks; JP = Japanese banks; NL = Dutch banks; UK = UK banks; US = US banks.

[1] Based on consolidated cross-border (international) claims of BIS reporting banks vis-à-vis residents of 18 Asia-Pacific countries. Excludes local claims denominated in local currencies and claims on the home country of the parent bank (eg excluding claims of Japanese banks on residents of Japan). [2] Median for the sample of 18 borrower countries in a given quarter. [3] Australian, Korean, Hong Kong, Indian, Singaporean and Taiwanese banks. [4] Sum of claims vis-à-vis China, Japan and 16 other Asia-Pacific countries.

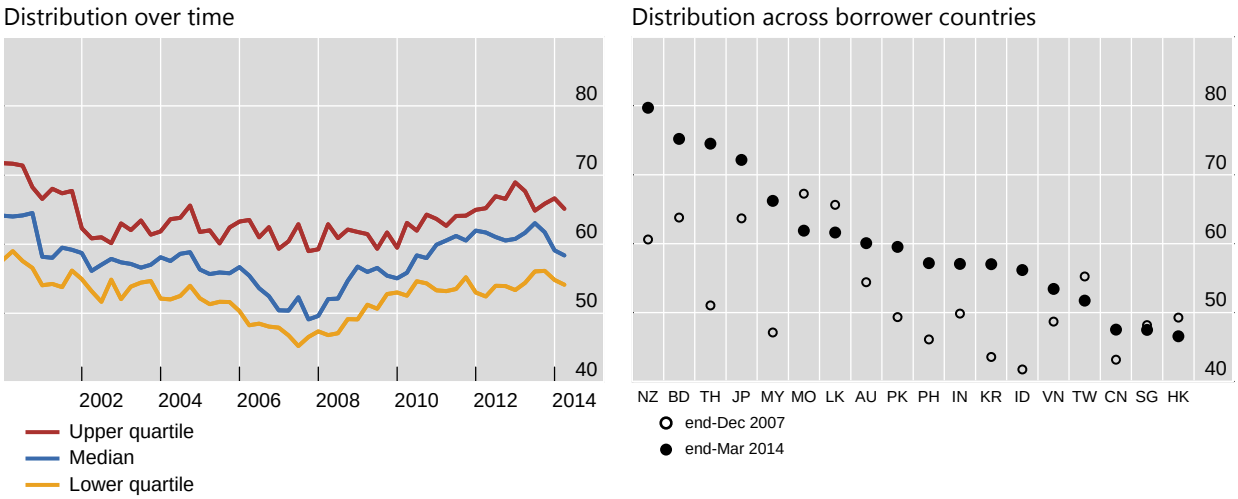
Sources: BIS consolidated banking statistics on an immediate borrower basis; authors' calculations.

Countries can reduce their vulnerability to common lenders by diversifying their sources of external financing. Diversification can take many forms. Asian Development Bank (2012), BIS (2006) and Dalla (2012) discuss the progress of initiatives to develop domestic bond markets and lengthen debt maturities. We focus on the diversity of bank creditors.

We first consider a simple measure of diversity: market concentration. The BIS consolidated banking statistics show that, in Asia-Pacific, exposure to the largest three creditor banking systems has increased since 2007. The median value of the market share of cross-border lending for the largest three was 50% at end-2007 and increased to 59% at end-2013 (Figure 5, left-hand panel). This trend is not driven by developments in a few countries: the lower and upper quartiles of the sample of 18 countries show a similar increase. This finding is not so surprising when considered in the context of the retrenchment of European banks; US, Japanese and other Asia-Pacific banks increased their market share as European banks retrenched. Countries that experienced especially large increases in concentration include New Zealand, Thailand and Malaysia (Figure 5, right-hand panel).

Concentration of bank creditors in Asia-Pacific

Market share of three largest creditor banking systems[1] Figure 5



AU = Australia; BD = Bangladesh; CN = China; HK = Hong Kong SAR; ID = Indonesia; IN = India; JP = Japan; KR = Korea; LK = Sri Lanka; MO = Macao SAR; MY = Malaysia; NZ = New Zealand; PH = Philippines; PK = Pakistan; SG = Singapore; TH = Thailand; TW = Chinese Taipei; VN = Vietnam.

[1] As a percentage of the consolidated cross-border (international) claims of all BIS reporting banks on a given borrower country, excluding the claims of banks headquartered outside of the BIS reporting area.

Sources: BIS consolidated banking statistics on an immediate borrower basis; authors' calculations.

To complement the concentration measure, we consider the similarity of creditors across the Asia-Pacific region. Are the largest creditors the same for each country? For each country pair, we calculate a common creditor index (CCI) using the formula of Van Rijckeghem and Weder (2001):

$$CCI_{ij} = \sum_{c} \frac{\left(b_{ic} + b_{jc}\right)}{\left(b_i + b_j\right)} \left[1 - \frac{\left| \left(\frac{b_{ic}}{b_i} - \frac{b_{jc}}{b_j} \right) \right|}{\left(\frac{b_{ic}}{b_i} + \frac{b_{jc}}{b_j} \right)} \right]$$

where i and j represent borrower countries, c stands for the common creditor, and b_{ic} equals the outstanding claims of creditor c on country i (and b_{jc} of creditor c on country j). The first component of the equation measures the overall importance of creditor c for countries i and j. The second component captures the extent to which countries i and j receive funding from the same creditors. An index value of 1 indicates that the composition of creditors is the same between countries i and j while 0 indicates no common creditor.

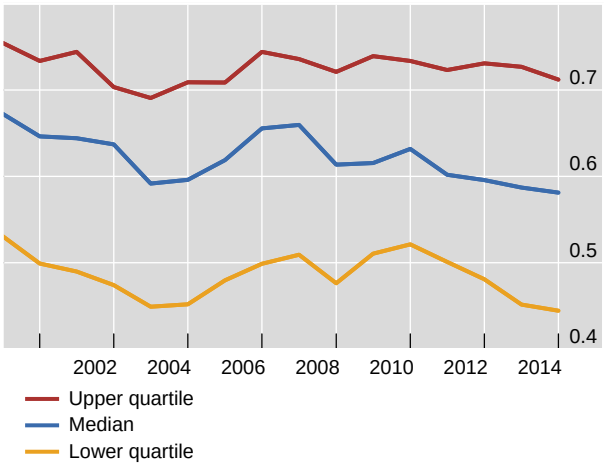
Figure 6 shows the CCI for the sample of 18 Asia-Pacific economies. The right-hand panel shows the full matrix of country pairs at end-March 2014, with index values greater than 0.6 highlighted in red. The left-hand panel shows the distribution across borrower country pairs over time. The CCI tended to increase prior to recent crises, reaching a local maximum around the end of 2007. The CCI then declined, suggesting that the diversity of lenders increased after the crisis. Interestingly, the CCI declined most for country pairs at the lower quartile; for country pairs at the upper quartile, the decline was much less pronounced. In other

words, for a minority of countries with highly similar creditor structures, the crisis did not increase diversity. As of end-March 2014, creditor structures were most similar for various combinations of Australia, China, Hong Kong SAR, India, Korea, Singapore and Chinese Taipei, and least similar for Pakistan.

Common creditor index

Based on consolidated cross-border claims of BIS reporting banks — Figure 6

Distribution over time for Asia-Pacific country pairs



Index values at end-March 2014[1]

	AU	BD	CN	HK	ID	IN	JP	KR	LK	MO	MY	NZ	PH	PK	SG	TH	TW	VN
AU																		
BD	0.32																	
CN	0.54	0.42																
HK	0.63	0.39	0.86															
ID	0.75	0.35	0.67	0.78														
IN	0.71	0.44	0.71	0.78	0.73													
JP	0.74	0.34	0.49	0.55	0.61	0.72												
KR	0.82	0.37	0.60	0.68	0.80	0.85	0.77											
LK	0.44	0.70	0.59	0.55	0.47	0.60	0.48	0.51										
MO	0.33	0.36	0.68	0.59	0.42	0.47	0.37	0.39	0.41									
MY	0.63	0.37	0.75	0.75	0.81	0.72	0.52	0.69	0.52	0.56								
NZ	0.84	0.17	0.37	0.48	0.48	0.47	0.41	0.49	0.22	0.19	0.43							
PH	0.74	0.38	0.69	0.75	0.74	0.77	0.67	0.79	0.58	0.44	0.69	0.45						
PK	0.41	0.53	0.54	0.49	0.44	0.56	0.53	0.50	0.58	0.41	0.49	0.23	0.51					
SG	0.72	0.43	0.72	0.84	0.79	0.86	0.63	0.77	0.57	0.42	0.73	0.50	0.77	0.58				
TH	0.67	0.22	0.53	0.59	0.73	0.53	0.57	0.59	0.30	0.32	0.67	0.39	0.58	0.27	0.56			
TW	0.60	0.36	0.76	0.81	0.69	0.82	0.68	0.75	0.59	0.50	0.69	0.45	0.81	0.60	0.77	0.50		
VN	0.65	0.34	0.61	0.64	0.66	0.61	0.61	0.74	0.41	0.38	0.59	0.42	0.72	0.47	0.61	0.53	0.62	

See Figure 5 for definitions of country codes.

[1] Red highlighting indicates index values between 0.60 and 1.00.

Sources: BIS consolidated banking statistics on an immediate borrower basis; authors' calculations.

In summary, the CCI indicates that the diversity of creditor structures across countries has increased since 2008. At the same time, the concentration measure indicates that the diversity of international lenders to a given country has declined. Ceteris paribus, this implies that countries in Asia-Pacific remain vulnerable to shocks in creditor countries, but creditor-driven shocks in one country are less likely than in the past to have a synchronous impact across the region.

That said, our indicators probably underestimate changes in creditor structures in recent years because they exclude some banks headquartered in Asia, most notably Chinese banks. As discussed in section 2.1, Chinese banks have expanded their presence abroad, yet they do not report to the BIS international banking statistics, on which our indicators are based. Moreover, considering that Asia-Pacific banks have increased their market share as European banks have retrenched, then the CCI may underestimate the importance of intra-regional links. In other words, while creditor structures have become more diverse across countries, the region as a whole is more reliant on funding from regional banks than in the past.

2.2.2 Interbank funding channel

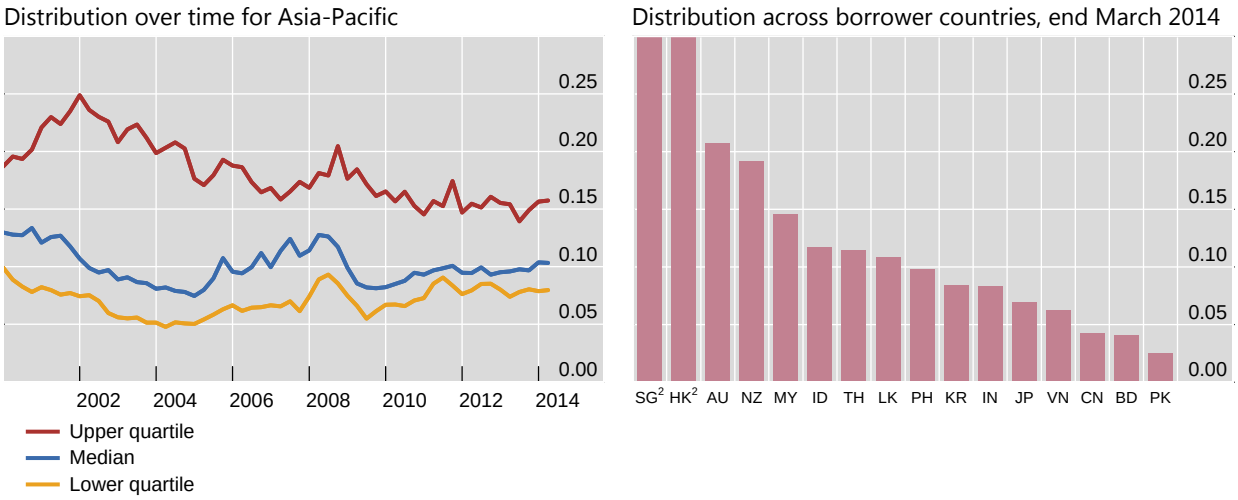
Another potential source of vulnerability that came under increased scrutiny as a result of recent crises is local banks' reliance on wholesale funding – so-called "non-core" liabilities. If retail deposits – core liabilities – cannot keep pace with asset growth, then banks will turn to other funding sources, including external sources. Hahm et al (2013) suggest that growing reliance on non-core liabilities can indicate a build-up of risks. Cornett et al (2011) show that US banks with higher core

liabilities exhibited more stable lending patterns during the financial crisis. Corbett et al (2010) find that in Asia changes in bank lending during the global crisis varied with the degree of banks' reliance on money market funding and not with their direct exposure to Lehman Brothers.

A key component of non-core liabilities is interbank funding, including from banks abroad. Bruno and Shin (2014) build a "double-decker" model of international banking where regional banks borrow in US dollars from global banks in order to lend to local corporate borrowers. Interbank funding might take the form of unsecured lending, repurchase agreements or purchases of debt securities. History indicates that banks experiencing rapid credit growth often turn to banks abroad for financing. Indeed, Avdjiev et al (2012) find that in many emerging markets in the 2000s the rapid growth of bank credit to non-bank borrowers involved a greater reliance on international credit, including locally extended credit financed with net borrowing from abroad. In recognition of the potential role of cross-border lending in fuelling domestic credit growth, the latest international standards on banks' capital adequacy and liquidity, known as Basel III, expect supervisors worldwide to require their banks to respect countercyclical capital buffers set by authorities in the borrower country (Basel Committee on Banking Supervision (2010)).

Banks' reliance on non-core liabilities

Ratio of cross-border interbank liabilities to customer deposits[1] Figure 7



See Figure 5 for definitions of country codes.

[1] For banks resident in a given country. Interbank liabilities refer to BIS reporting banks' cross-border claims on banks in a given country and include claims unallocated by sector of the counterparty. Customer deposits refer to demand deposits plus time, savings and foreign currency deposits. [2] For SG, 1.42; for HK, 0.52.

Sources: BIS locational banking statistics by residence; IMF International Financial Statistics; authors' calculations.

Figure 7 shows cross-border interbank liabilities as a ratio of banks' customer deposits (for banks resident in a given country, ie not by bank nationality). Not surprisingly, the ratio is highest in international financial centres that intermediate flows between countries, eg Hong Kong SAR and Singapore (right-hand panel). It is also high in countries with a recent history of current account deficits, eg Australia and New Zealand. It is low in countries less integrated with the global financial system, eg Bangladesh and Pakistan. For our sample of Asia-Pacific countries, the median value of the ratio fell in late 2008, during the convolutions in global

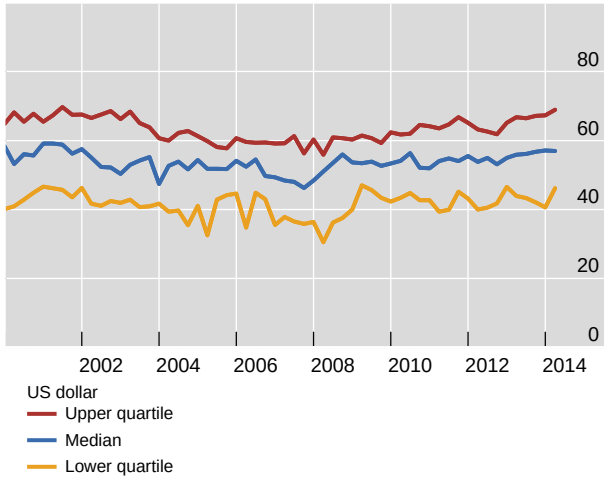
interbank markets that followed the collapse of Lehman Brothers (left-hand panel). While the ratio has inched up since then, recent trends appear unremarkable.

Even where local banks are not unduly reliant on cross-border interbank funding, such funding might still heighten their vulnerability to shocks if foreign currency borrowing is left unhedged. Historically, foreign bank lending to countries in Asia-Pacific was denominated mainly in US dollars. To the extent that borrowers do not hedge their dollar liabilities – either directly using derivatives or indirectly through dollar earnings – cross-border borrowing can give rise to currency mismatches.[5] In Asia-Pacific, various initiatives aim to promote greater use of a regional currency in intra-regional transactions (BIS (2012), Rhee and Sumulong (2014)). Nevertheless, the US dollar's share of cross-border lending shows no signs of declining. The median value for the dollar's share has fluctuated around 55% since 2009, which is similar to its long-term average (Figure 8, left-hand panel). The dollar's share is lowest for borrowing by New Zealand residents, where a significant proportion of external liabilities to banks are denominated in Australian and New Zealand dollars (right-hand panel). The US dollar's share is highest in India, Chinese Taipei and Vietnam.

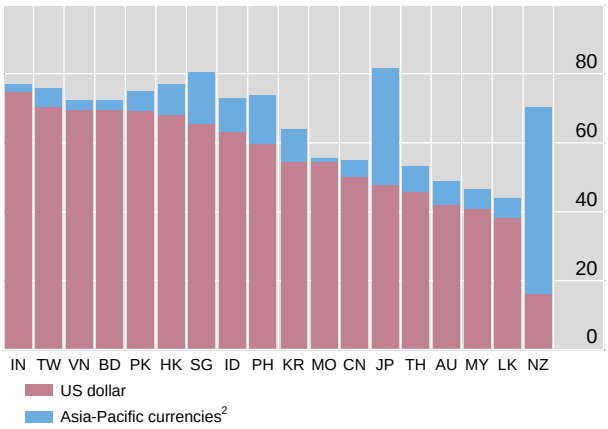
Currency composition of cross-border borrowing from banks

As a percentage of BIS reporting banks' claims allocated by currency — Figure 8

US dollar's share, distribution over time for Asia-Pacific



Distribution across debtor countries at end-March 2014



See Figure 5 for definitions of country codes.

[1] Excludes claims of banks in countries that do not report a detailed currency breakdown to the BIS, notably Hong Kong SAR, Macao SAR, Curaçao and Singapore. [2] Mainly JPY, plus small amounts of AUD and 16 other Asia-Pacific currencies. Coverage of currencies other than JPY is incomplete.

Sources: BIS locational banking statistics by residence; authors' calculations.

In Asia-Pacific, vulnerabilities arising from foreign currency borrowing are less of a concern today than they were in the run-up to the Asian financial crisis of 1997–98. Avdjiev et al (2012) estimate that US dollar credit now accounts for a small share of total credit (local plus cross-border credit) to non-financial private sector

[5] Even when the borrowing bank hedges its exposure, it may remain exposed to currency risk if the final borrower is unhedged.

borrowers. Nevertheless, its future evolution merits attention because the growth of dollar credit has in recent years outpaced that of total credit, and aggregate data may mask currency mismatches in particular sectors.

2.2.3 Local lending channel

The final transmission channel that we consider is local lending by international banks' affiliates abroad. Locally funded lending is considerably less volatile than cross-border lending (García-Herrero and Pería (2007), Hills and Hoggarth (2013), McCauley et al (2012)). And recent crises revealed that local lending via subsidiaries is less volatile than that via branches (Hoggarth et al (2013)). Thus, subsidiarisation is one potential way to reduce the risk of adverse shocks spilling across national borders, albeit at the potential cost of hindering the efficient flow of funds across borders (Fiechter et al (2011)).

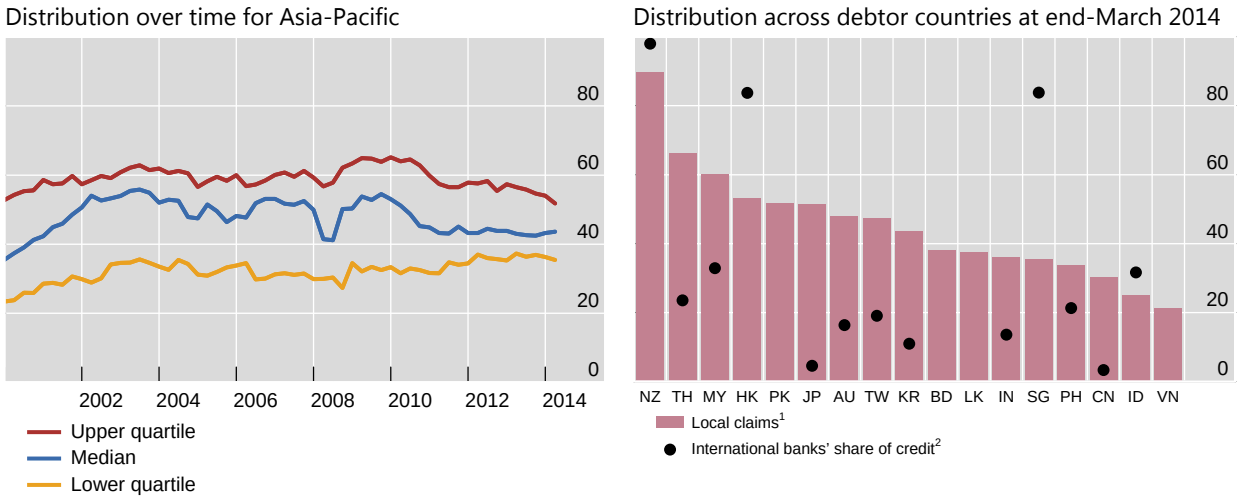
Subsidiaries of international banks typically fund and manage their activities in the same location as where they are supervised. They are separate legal entities and often entail substantial investment of capital. Subsidiaries usually hold a banking license in the host country and as such can perform the same banking services as a domestic bank. In contrast, branches of international banks are usually restricted in the activities they are allowed to engage in – in particular in their ability to collect deposits or raise short-term funding in the host country. As a consequence, they rely more heavily on direct funding from their parent. Branches can be less costly to set up and operate because, in many jurisdictions, they are not subject to the same capital and liquidity rules of authorities in the host country as domestic banks. Instead, they are often supervised primarily by authorities in the home country.

The BIS international banking statistics do not reveal a noticeable shift in Asia-Pacific policymakers' preference for subsidiarisation in recent years. While data for subsidiaries are not separately reported, claims booked via local affiliates – subsidiaries and branches combined – and denominated in the local currency of the country where the affiliate is located are a reasonable proxy because they are closely correlated with local funding and subsidiaries account for the bulk of local funding.[6] Figure 9 shows international banks' claims booked via local affiliates as a percentage of these banks' total (cross-border plus local) claims on residents of the borrower country. The median value fell from 52% before the crisis to 43% in 2011, as the growth of cross-border claims outpaced that of local claims (left-hand panel). The ratio of international banks' local to total claims on Asia-Pacific borrowers is broadly similar to that in other regions. However, international banks' share of aggregate bank credit is low in all but a few Asia-Pacific economies, notably New Zealand, Hong Kong SAR and Singapore (right-hand panel).

[6] In 2014 data for subsidiaries and branches started to be reported in the BIS international banking statistics, as part of a major set of enhancements (Committee on the Global Financial System (2012)).

Claims of international banks' local affiliates[1]

As a percentage of international banks' total claims on the borrower country Figure 9



See Figure 5 for definitions of country codes.

[1] Claims of local affiliates on residents of the borrower country, denominated in the currency of the borrower country. Excludes claims of international banks headquartered outside the BIS reporting area. [2] Total consolidated claims of international banks (cross-border plus local claims) on non-bank borrowers, as a percentage of aggregate bank credit to non-bank residents (credit from international and local banks). Local claims include claims on banks and thus international banks' share of aggregate bank credit to non-bank borrowers is overestimated.

Sources: BIS consolidated banking statistics on an immediate borrower basis (Table 9A); authors' calculations.

2.3 Summary

In summary, since 2007 international banking in Asia-Pacific has seen changes in the composition of creditors, yet these do not appear to have had a distinct impact on the channels through which international banks might transmit shocks across borders. Some international banks have retrenched, which has contributed to increased concentration. Yet others have expanded, which has resulted in greater diversity in creditors across countries. In particular, Chinese and other regional banks increased their activity in the region. Cross-border interbank funding remains a reasonably important source of funding for local banks. And there has not been a noticeable shift away from cross-border lending towards local subsidiaries.

3. The determinants of cross-border versus local intermediation

The previous section explained the channels through which different types of foreign lending – cross-border or local – might transmit shocks across borders. We now turn to an analysis of banks' decision whether to lend locally or cross-border. Specifically, we analyse what factors determine the relative importance of different types of foreign lending, and how well these factors explain observed dynamics. By analysing how borrower-specific versus creditor-specific factors influence the type

of foreign bank intermediation, we seek to better understand the potential transmission channels of financial shocks and the potential risks they pose to financial stability.

3.1 International lending decision

The international lending decision of a given bank at a given point in time generally involves two, not necessarily independent, dimensions: (1) whether to increase or decrease their foreign claims on a given country; and (2) to which extent the increase or decrease should be intermediated cross-border or locally. Our focus is on the effects of cross-border versus local intermediation. These effects can vary over time and this time variation is crucial for any potential effect on financial stability risks. If, for instance, a compositional change towards less cross-border lending happens when overall foreign lending growth is declining, then this would mean an amplification of the foreign lending cycle. Depending on how severe this amplification is, this could indicate increased financial stability risks. Without looking at the dynamic dimension and the quantitative impact on foreign lending, the relevant policy implications would be unclear.

3.2 Econometric model

In order to study the dynamic effects on international lending growth, we estimate a model in growth rates. To concentrate on the effects of a change in the composition of foreign lending, the model takes the growth rates as given and focuses on explaining the variation in the shares of cross-border and local claims:

$$\frac{\Delta forClaims_t^{c,i}}{forClaims_{t-1}^{c,i}} = \Gamma_1 X_{1,t-1}^{c,i} \frac{\Delta xborderClaims_t^{c,i}}{xborderClaims_{t-1}^{c,i}} + \Gamma_2 X_{2,t-1}^{c,i} \frac{\Delta locClaims_t^{c,i}}{locClaims_{t-1}^{c,i}} + \varepsilon_t^{c,i}$$

with superscript *c* denoting the credit country and *i* denoting the debtor country. All explanatory factors *X* are interacted with either the growth in cross-border and foreign currency claims (*xborderClaims*) or with the growth in locally intermediated claims in local currency (*locClaims*). Γ_1 and Γ_2 are the vectors of coefficients to be estimated.

The terms $\Gamma_1 X_{1,t-1}^{c,i}$ and $\Gamma_2 X_{2,t-1}^{c,i}$ have a direct economic interpretation as the shares of cross-border and local claims in total foreign claims. Starting from the definition of total foreign claims (*forClaims*),

$$forClaims_t^{c,i} \overset{\text{def}}{=} xborderClaims_t^{c,i} + locClaims_t^{c,i}$$

the growth rate of total foreign claims is a weighted average of the growth rates in cross-border claims and local claims:

$$\frac{\Delta forClaims_t^{c,i}}{forClaims_{t-1}^{c,i}} = \underbrace{\frac{xborderClaims_{t-1}^{c,i}}{forClaims_{t-1}^{c,i}}}_{\beta_{1,t-1}^{c,i}} \times \frac{\Delta xborderClaims_t^{c,i}}{xborderClaims_{t-1}^{c,i}} + \underbrace{\frac{locClaims_{t-1}^{c,i}}{forClaims_{t-1}^{c,i}}}_{\beta_{2,t-1}^{c,i}} \times \frac{\Delta locClaims_t^{c,i}}{locClaims_{t-1}^{c,i}}$$

Hence, the term $\Gamma_1 X_{1,t-1}^{c,i}$ can be interpreted as an estimate for share of cross-border claims in total foreign claims ($\beta_{1,t-1}^{c,i}$) and $\Gamma_2 X_{2,t-1}^{c,i}$ as an estimate for the share of local claims ($\beta_{2,t-1}^{c,i}$). As the shares are both varying across country pairs *c,i* as well as over time *t*, admissible explanatory factors can be time-varying, varying across countries/country pairs, or both.

While the growth rates of the different types of claims can be volatile, the shares for cross-border and local claims are more stable. Therefore, our model can be seen as explaining the relatively slow-moving intermediation trends in the data. Ceteris paribus, this should facilitate finding robust statistical relationships with macroeconomic variables and gravity factors, which are typically also less volatile. At the same time, the model still allows us to make predictions of the impact of the changes in the intermediation shares on the dynamics of foreign claims.

We consider a wide range of explanatory factors:

$$X_{f,t}^{c,i} = \left[1, T_t^{c,i}, G^{c,i}, M_t^c, M_t^i, B_t^c, B_t^i, d\left(\cdot\right)_t^{c,i}\right]'$$

where *T* refers to bilateral trade shares, *G* to gravity factors (which are typically time invariant), *M* to macroeconomic conditions in creditor *c* as well as borrower *i* countries, and various dummies *d*. Our main variables of interest are the banking sector characteristics *B*. Details are provided in Table 2.

We do not impose the restriction $\Gamma_1 X_{1,t-1}^{c,i} + \Gamma_2 X_{2,t-1}^{c,i} = 1$.[7] Therefore we are estimating an over-identified model. As explained in the following section, many of our explanatory factors *X* do not vary across country pairs or over time. Hence, requiring $\Gamma_1 X_{1,t-1}^{c,i}$ and $\Gamma_2 X_{2,t-1}^{c,i}$ to add up to one would be unnecessarily restrictive. Note that the explanatory factors are lagged by one period in our econometric model, which should mitigate potential endogeneity issues stemming from feedback effects of, for instance, cross-border lending on net interest margins or trade.

[7] In our estimations, $\Gamma_1 X_{1,t-1}^{c,i} + \Gamma_2 X_{2,t-1}^{c,i} = 1$ generally does not hold and the error term will pick up the unexplained fraction in growth of total international claims. Also note that, even though $intClaims_t^{c,i} = xborderClaims_t^{c,i} + locClaims_t^{c,i}$, the growth rates $\frac{\Delta xborderClaims_t^{c,i}}{xborderClaims_{t-1}^{c,i}}$ and $\frac{\Delta locClaims_t^{c,i}}{locClaims_{t-1}^{c,i}}$ are not necessarily perfectly negatively correlated. In fact, in our sample the correlation between the two is low and positive (0.15). Hence, using an identical set of explanatory factors for both interactions does not pre-impose our results. Many of the result tables show the same signs for coefficients $\gamma_{1,j}$ and $\gamma_{2,j}$ for various explanatory factors *j*. In this respect, our model is more flexible than a setup where the share of local claims itself is regressed on a set of explanatory factors (as in García-Herrero and Pería (2007)). As per definition $\frac{locClaims_{t-1}^{c,i}}{intClaims_{t-1}^{c,i}} = 1 - \frac{xborderClaims_{t-1}^{c,i}}{intClaims_{t-1}^{c,i}}$, the estimated effect on one share is exactly equal to the negative effect on the other share. Hence, the absolute magnitude (and statistical significance) of the marginal effects would be the same across shares in this kind of setup. In our setup, the marginal effects and significance of explanatory factors can, and do, vary for *xborderClaims* and *locClaims*.

Summary of variables[1] Table 2

Category	Name	Definition
Foreign lending	xborderClaims	Cross-border and foreign currency claims of banks headquartered in creditor country *c* against residents in borrower country
	locClaims	Local claims in local currency: claims extended through local operations in the borrower country which are owned by a bank headquartered in the creditor country against residents in borrower country
	forClaims	Total foreign bank claims = sum of xborderClaims and locClaims. All claims are valued in USD.
Trade factors	exportShare	Share of exports from creditor country to borrower country
	importShare	Share of imports to borrower country from creditor country
Gravity factors	dist	Distance between capitals of creditor and borrower country (logarithm of distance in km)
	comborder	Dummy(=1) if creditor and borrower country have a common border
	comlang	Dummy for common language
	comcol	Dummy for common colonial history
	comlegal	Dummy for common legal system
	finCentre	Dummy for borrower country being a financial centre
	financial-Freedom	Annual index for financial freedom in the borrower country
	chinnIto	Chinn-Ito index for current account openness
	logGDP	Log of nominal GDP in the borrower country in billions of USD
Macro factors	GDPGrowth	Annual GDP growth rate in the borrower country in percent
	banking-Crisis	Dummy for banking crisis, based on Laeven and Valencia (2013)
	Creditor-BkCrisis	Same as above, but for creditor country
Banking system factors: Stability of borrower country	impairedLoanRatio	Face value of impaired loans divided by total loans, aggregate for all banks in borrower country
	loanDepositRatio	Net loans divided by total customer deposits, aggregate for all banks in borrower country
	equityRatio	Book equity (capital + capital reserves) divided by total assets, aggregate for all banks in borrower country
Banking system factors: Profitability of borrower country	netInterestMargin	Net interest revenue divided by earning assets, aggregate for all banks in borrower country
	returnOnAssets	Net income divided by total assets, aggregate for all banks in borrower country
	bankingSector-Concentration	Aggregate total assets of the 3 largest banks divided by aggregate total assets of all banks in borrower country
Banking system factors: Efficiency of creditor country	ratioNonInterestInc-TotInc	Non-interest income divided by total income, aggregate for all banks in creditor country
	costToIncomeRatio	Operating expenses divided by total income, aggregate for all banks in creditor country
	ratioOverhead-TotAssets	Operating expenses divided by total assets, aggregate for all banks in creditor country

[1] For a more detailed variable description and data sources, see Table A3 in the appendix.

3.3 Sample selection

A key conceptual issue that arises in many international banking studies is the treatment of banks that do not lend abroad, or lend only cross-border. While the former is not of significance in our study on foreign lending between countries, there are many country pairs for which foreign lending takes solely the form of cross-border lending.[8]

We choose to restrict the sample to country pairs where the creditor country exhibits both types of foreign lending. The reasons for doing so are both conceptual and technical. Conceptually, we are mostly interested in the question of how banks decide on how much foreign lending to extend through a given channel. This presumes that there is a choice between different types of foreign intermediation, ie that foreign affiliates already exist. The question of whether or not banks decide to establish local affiliates is different in nature and also would most likely depend on different kinds of explanatory factors. Technically, taking account of potential threshold effects would require a structural model and potentially restrictive assumptions.[9] We prefer to retain a high degree of flexibility when analysing the data.

3.4 Banking system characteristics as determinants for intermediation channels

Banking sector characteristics are potentially important determinants for a bank's decision of whether to lend cross-border or locally.[10] Banking system characteristics contain information about the state of a banking sector. In this light, they are potentially informative for policymakers. While the set of factors we analyse cannot give a full picture of the advantages or disadvantages of decentralised intermediation, we concentrate on one particular hypothesis: are there signs that local claims are *relatively* more supportive towards more fragile or less developed banking systems?

We are particularly interested in the stability and profitability of the banking sector in a given borrower country, and the efficiency of the banking sector in a

[8] There are also country pairs for which international lending is intermediated solely through local affiliates, but their number is far smaller.

[9] As setting up foreign operations presents substantial fixed costs for banks, there is a certain threshold which banks have to overcome before they invest abroad and therefore have the option to intermediate foreign bank claims locally. Buch et al (2009) argue that banks with a certain size and productivity are more likely to overcome this threshold and develop an ordered Probit model to take this unobserved threshold into account.

[10] See De Haas and van Lelyveld (2006) for evidence in Central and Eastern European recipient countries during the crisis and García-Herrero and Pería (2007) for Italian, Spanish and US creditor banks. Claessens and van Horen (2014), using a large database on foreign banks, argue that the effect of between private credit and foreign bank presence importantly depends on host country and banks' characteristics. However, as argued above, shocks in the home country of the creditor may transmit to their foreign branches and subsidiaries (Cetorelli and Goldberg (2011, 2012))

creditor country. Each of these categories is captured with three different factors, for a total of nine potential banking system factors.[11]

The stability of the banking sector in borrower countries is represented by the impaired loan ratio, loan-to-deposit ratio, and equity ratio. A high impaired loan ratio is a sign of potential weaknesses in the banking sector, which may cause banks to reduce risks and cut down on lending going forward. If local intermediation strengthens credit supply in weaker banking systems, then we should see a higher share of *locCLaims* for banking systems with higher impaired loan ratios.[12] A similar line of argumentation applies to the loan-to-deposit ratio. Loan/deposit ratios are a key indicator for liquidity mismatch risk (Kashyap et al (2002)). Deposits are viewed as a more stable source of funding (Ivashina and Scharfstein (2010), Cornett et al (2011)). Loan-to-deposit ratios tend to be positively correlated with, the supply of credit and willingness of banks to take on risks – in addition to a generally greater liquidity mismatch (van den End (2013)). Thus, if our hypothesis holds true, high loan-to-deposit ratios should be correlated with a lower share of local intermediation. Banking systems with higher equity ratios tend to be more stable (BCBS (2011)), and perhaps face more stringent regulatory requirements. Thus we postulate higher equity ratios to be associated with a relatively higher share of *locClaims*, if *locClaims* are associated with relatively lower financial stability risks.

To measure the profitability of the banking sector in borrower countries, we look at net interest margins, banking sector concentration and return on assets. High net interest margins are generally a sign of limited competition, restricted access to credit or high economic uncertainty (Ho and Saunders (1981), Claessens et al (2001)). Thus the interaction term of net interest margins with *locClaims* should be positive, if they are relatively more important in less developed or more fragile banking systems. The same applies to banking sector concentration. The influence of higher return on assets on the form of intermediation is a priori not clear. It could reflect the same drivers as for net interest margins, and thus expected to be positively correlated with *locClaims*. Alternatively, it could reflect higher risk taking, which we would expect to be positively correlated with *xborderClaims*.

The final category of banking system factors we consider is the efficiency of the banking system in the creditor country. Our proxies are the ratio of non-interest income to total income, the ratio of costs to total income, and the ratio of overheads to total assets. Ideally, more efficient banking sectors should support less efficient ones. If local claims fulfil this function, then this would imply that the interaction terms of *locClaims* growth with the ratios of cost to income as well as overhead to total asset would have a negative sign. Niepman (2013), for instance, develops a model where more efficient banking sectors export capital and set up foreign operations. We do not have a clear hypothesis with respect to the ratio of non-interest to total income, which is a measure for banks' activities outside traditional bank lending and deposit taking.

[11] We have also checked financial stability and profitability factors for the creditor country and banking sector efficiency characteristics for debtor countries. However, these factors are generally not significant in our model.

[12] Local affiliates of foreign banks could also have an informational advantage. This could tilt foreign bank intermediation towards local claims. In the face of informational asymmetries, local claims would most likely be preferable from a financial stability point of view.

3.5 Data

For our estimations, we exploit the richness of the BIS consolidated banking statistics. These statistics capture the outstanding claims of 31 national banking systems on counterparties in over 200 countries going back to 1999.[13] This results in a large cross-section of country pairs as well as a long time series for many pairs. Furthermore, the consolidated statistics distinguish between cross-border and local claims – subject to the caveat discussed in section 2 that local claims in non-local currencies are included with cross-border claims. Their compilation by nationality of the reporting bank is especially important for our purposes because, in a world where international banks operate through affiliates in many countries, nationality is a more meaningful indicator than residence of where the underlying economic decisions are taken.

Our sample is based on year-end data and covers the period 2000–13. To limit potential biases from outliers, we exclude observations where annual growth in *xborderClaims* or *locClaims* is greater than 500%. Moreover, as argued above, the dataset is restricted to observations where *locClaims*>0. This latter restriction causes roughly half the number of potentially available observations to drop out.[14] As shown in Table A1 in the appendix, the relative impact on the number of available observations is similar for both borrower regions and creditor regions, with a relatively smaller impact on the number of observations that involve countries from Asia-Pacific. The final sample comprises 813 country pairs and is geographically balanced across advanced economies and emerging markets. Table A2 in the appendix provides a list of all creditor and borrower countries in our sample and the number of observations associated with them. We have on average 9 annual observations for country pair, which yields a total of 7290 observations.

Table 3 provides the summary statistics and regional distribution of observations for the different types of foreign lending. Cross-border claims account for the largest share of foreign lending across countries in our sample; the median share of *locClaims* is only 25.2%. However, the growth rates for *locClaims* are generally higher. Also, country pairs that exhibit large values of foreign bank claims tend to intermediate large sums locally as well, driving up the sum of outstanding *locClaims*. As a result, at the end of 2013 the aggregate sum of outstanding *locClaims* was almost as large as that of *xborderClaims* (conditional on *locClaims*>0): USD 10.9 trillion versus USD 11.7 trillion.

[13] The data start in 1983 for a subset of mainly developed countries.

[14] While focusing on the restricted sample allows a more straightforward identification of the determining factors, it naturally renders our sample less representative for global foreign lending dynamics. While our model fits the sample very well, our results are not applicable to the unrestricted sample, as the scope of our research question is different. We are interested in the expected effect of various determinants, given that a banking sector exhibits both types of flows (ie given that there is an explicit choice through which channel to intermediate flows).

Summary table for data sample on foreign bank claims[1] Table 3

In percent, unless stated otherwise

	Country pairs: Creditor countries → borrower countries			
	All->All	All → Asia Pacific	Asia-Pacific → Asia-Pacific	Asia-Pacific → All
Number of observations	7290	2086	585	1123
Number of country pairs	813	217	68	134
Mean *forClaims* growth	13.6	16.3	17.4	15.9
Standard deviation (Std) of *forClaims* growth	45.8	45.8	32.3	33.7
Mean *xborderClaims* growth	16.2	20.3	19.7	17.9
Std *xborderClaims* growth	57.2	58.9	43.5	43.5
Mean *locClaims* growth	21.2	22.5	26.1	23.6
Std *locClaims* growth	88.8	78.7	64.9	74.3
5% percentile of *locClaims* share	0.17	0.9	3.3	0.8
Median *locClaims* share	25.2	31.1	25.6	17.6
95% percentile of *locClaims* share	80.7	78.8	75.1	68.9
Sum of *forClaims* at end of 2013, in billions of USD	22609.4	4416.2	1503.8	3998.0
Sum of *xborderClaims* at end of 2013, in billions of USD	11684.3	2275.5	808.5	2567.7
Sum of *locClaims* at end of 2013, in billions of USD	10925.1	2140.7	695.3	1430.2

[1] Data sample is based on observations for which *locClaims*>0, as described in section 3. The data are annual (outstanding claims at the end of year) for 2000–13.

Sources: BIS consolidated banking statistics; authors' calculations.

In US dollar terms, the volatility of growth rates of *locClaims* is considerably higher than that of *xborderClaims*. The standard deviation of the former is 89%, compared to 57% for the latter. This in part reflects the impact of exchange rate movements. As discussed in section 2, in many borrower countries cross-border claims are denominated principally in US dollars. By contrast, local claims are by definition in the consolidated banking statistics denominated in the currency of the borrower country. Considering that we take growth rates as given in our empirical model, and that the exchange rate effect is the same on both sides of the equation, we do not expect exchange rate movements to bias our results. Methodological changes between periods, such as changes in the reporting population, would bias the results. But we are able to control for these and adjust the growth rates for so-called breaks in series between periods.[15]

For the banking system factors, we calculate country aggregates using individual bank data from BankScope.[16] While the data from BankScope may not

[15] The BIS publishes a list of breaks on its website (www.bis.org/statistics/breakstablescons.pdf).

[16] Our approach is conceptually identical to the one taken in Beck et al (2000) for the World Bank's Financial Development and Structure Dataset. However, the method of calculating country

cover all banks, they cover almost the entirety of the larger banks that reside in a given country. For calculating banking system ratios, BankScope should therefore be an adequate source for borrower countries. Considering that the international bank lending data are consolidated based on the nationality and not the residence of the bank, our banking sector characteristics for the creditor country are an imperfect proxy. But in many creditor countries, the largest banks are local ones, not foreign owned. Based on the full set of annual unconsolidated balance sheet data,[17] we calculate ratios for each individual bank for which data are available, and then calculate a weighted average (weighted by the denominator) for all banks incorporated in a given country.[18] For countries where data for less than three banks are available, the observation is assumed to be missing.

4. Empirical results

In tackling our main empirical question regarding the determinants of the relative importance of different types of foreign lending, it is useful to start with a thought experiment: if the share of foreign intermediation through the different channels is constant across country pairs and constant over time, how much of foreign lending dynamics can be explained?[19] The answer to this question provides a relevant benchmark for our research questions. Only the fraction of variation in foreign lending that remains unexplained can possibly be determined by factors which capture country-specific and time-varying differences in the shares of *xborderClaims* and *locClaims*.

If both shares are constant across countries and over time, then both channels exhibit the same properties regardless of the state of banking sectors or the state of the credit cycle. In this case, both channels would have similar characteristics and would not be of great relevance to policymakers. The cross-country and time variation in the shares we measure allows making a statement about the *relative* features of intermediation channels.[20] Further, the share of the unexplained variance

aggregates is different as are the type of income statement and balance sheet characteristics that we cover.

17 We take all banks with consolidation levels U1 and U2. Banks are institutions with any of the following BankScope "specialisations": "Commercial Banks", "Bank Holding & Holding Companies", "Investment Banks", "Cooperative Bank", "Savings Bank", "Real Estate & Mortgage Bank", "Specialized Governmental Credit Institution", "Islamic Banks", "Group Finance Companies", "Micro-Financing Institutions".

18 In this way, we avoid biases due to missing data for either the denominator or nominator, which would occur if the ratio was calculated as the ratio of country aggregates.

19 Alternatively, one can think of this thought experiments as conditioning on banks' decision in a given creditor country by how much to increase total foreign lending, keeping the relative importance of the channels of intermediation unchanged.

20 Taking growth rates of *xborder* and *locClaims* as given, we investigate whether the change in the relative importance between the two is of any relevance for policymakers. As most of the variation in the data is driven by the growth rates themselves, the absolute impact in credit in a given debtor country is probably driven by the growth rates themselves, rather than the changes in the relative importance of intermediation channels.

Regressions with trade, gravity factors and financial development factors

Generalised least squares allowing for heteroscedasticity across country pairs — Table 4

Explanatory variable	Category	(1)	(2)	(3)	(4)
xborderClaims growth		0.700***	0.327***	0.350***	0.219***
locClaims growth		0.154***	0.327***	0.321***	0.344***
Interaction terms with *xborderClaims* growth:					
exportShare	Trade		-0.215	-0.269	-0.252
importShare	Trade		-0.851***	-0.773***	-0.953***
dist	Gravity		-3.244***	-3.325***	-3.896***
comborder	Gravity		5.229***	5.055***	5.927***
comlang	Gravity		-17.936***	-17.526***	-15.908***
comcol	Gravity		-12.123***	-12.125***	-13.281***
comlegal	Gravity		7.607***	8.285***	10.052***
finCentre	Gravity		6.416***	7.165***	8.542***
financialFreedom	Gravity		-0.086***	-0.099***	-0.098***
chinnIto	Gravity		2.773***	2.532***	3.331***
logGDP	Gravity		5.001***	4.823***	5.657***
GDPGrowth	Macro				0.924***
bankingCrisis	Macro				6.507***
Creditor_BkCrisis	Macro				0.912
Interaction terms with *locClaims* growth:					
exportShare	Trade		1.039***	0.966***	1.011***
importShare	Trade		-0.711***	-0.609***	-0.639***
dist	Gravity		0.053	0.444*	0.215
comborder	Gravity		3.369***	2.768**	2.958***
comlang	Gravity		8.353***	8.464***	8.020***
comcol	Gravity		3.513**	2.469	3.969**
comlegal	Gravity		-4.404***	-4.310***	-4.837***
finCentre	Gravity		-1.488***	-2.153***	-1.429**
financialFreedom	Gravity		0.105***	0.115***	0.100***
chinnIto	Gravity		-3.512***	-3.500***	-3.483***
logGDP	Gravity		-1.595***	-1.821***	-1.749***
GDPGrowth	Macro				-0.099
bankingCrisis	Macro				-2.831***
Creditor_BkCrisis	Macro				1.718***
Constant		0.135	0.245**	-0.402	0.266***
Time dummies		No	No	Yes	No
Unadjusted R^2		**0.7428**	**0.7890**	**0.7909**	**0.7899**
Number of obs		7290	6949	6949	6949

Source: Authors' estimation.

sets a benchmark for how much variation in foreign lending growth is left to be explained by variation in the type of intermediation across country pairs and over time.

Model (1) in Table 4 presents the results of this thought experiment.[21] In our sample, the explained share of variation of growth in *forClaims* for this simple model is around 74% (unadjusted R2=0.743). In other words, around one quarter (26%) of the variation in foreign lending growth is due to the variation in patterns of foreign intermediation across country pairs and time. The additional explanatory power of our determinants is to be judged against this remaining quarter of unexplained variation.

4.1 Trade, gravity and macro factors

As the dataset covers a relatively large number of country pairs, the results for the trade, gravity and macro factors provide a benchmark on how relevant they are for the type of foreign bank intermediation. Importantly, they also provide a reference point for the explanatory power of the banking system characteristics.

Introducing trade and gravity factors in model (2) explains an additional 4.2% of the total variation – or roughly 16% of the variation unexplained by model (1). Consistent with many other studies on foreign bank lending or trade, both trade factors and gravity factors have statistically significant explanatory power for observed lending patterns. But in which way do they influence the *type* of foreign bank intermediation?

As far as trade is concerned, two main results emerge – which are consistent across all our model specifications. The first observation is that, overall, trade factors are more relevant for explaining the share of locally intermediated claims than they are for explaining the share of cross-border claims. In particular, when banking system-specific factors are introduced, trade factors are generally insignificant in explaining cross-border claims.[22] Models (2)–(7) suggest that if the borrower country is a financial centre, the share of *xborderClaims* is 6%–9% higher, everything else being equal. The size factor (logGDP) is strongly positive for *xborderClaims* and strongly negative for *locClaims*. The same applies to current account openness, as measured by the Chinn-Ito index. Financial flows, ie flows which are unrelated to trade activity, tend to be more prevalent among large countries, and cross-border bank claims may be an important means to facilitate these flows.

A second observation is that if a trading relationship is important for a creditor country, the creditor country is more likely to intermediate bank claims locally. Hence, our results suggest that banks are more likely to engage in local operations in important export markets. The coefficient for the interaction term of *locClaims* growth and *exportShares* is around one for models (2)–(4), which would imply an additional one percentage point in the share of locally intermediated claims for every one percentage point increase in export shares. However, if the importance of a trade relationship is greater for a borrower country (higher import share), the

[21] Model (1) in Table 4 amounts to $\frac{\Delta forClaims_t^{c,i}}{forClaims_{t-1}^{c,i}} = const + \gamma_1 \frac{\Delta xborderClaims_t^{c,i}}{xborderClaims_{t-1}^{c,i}} + \gamma_2 \frac{\Delta locClaims_t^{c,i}}{locClaims_{t-1}^{c,i}} + \epsilon_t^{c,i}$. In this case the terms interacted with growth in *xborderClaims* and *locClaims* are simply the coefficients γ_1 and γ_2, which are constant across country pairs and time.

[22] We do not report the results for estimations with trade and banking system characteristics, as the signs and magnitudes of both the coefficients on trade factors and banking system characteristics do not change noticeably. The only exceptions are coefficients for the interaction terms of trade factors and *xborderClaim* growth, which become insignificant.

share of *locClaims* is lower on average. An exporter would have no reason to engage in relatively more costly local intermediation if the importance of the trade relationship lies with the importing/borrower country.

The various gravity factors in models (2)–(4) exhibit similarly consistent patterns and results are in line with our expectations. A common border, proximity, a common legal system, and current account openness, as well as a larger and financial centre borrower country, favour cross-border lending. A common language and common colonial history tend to be associated with higher shares of locally intermediated bank claims. Model (4) introduces the macro-factors. They broadly have the expected effects, but do not noticeably increase the share of explained variance.

4.2 Banking system characteristics

Three main results emerge for the three sets of banking system factors.[23] First, banking system stability factors in the borrower country have the most overall explanatory power among the banking system characteristics we study. Second, differences in banking system characteristics explain approximately the same share of the variation in observed growth of foreign bank claims as do trade, gravity and macro factors together. Third, taking into account differences in banking system characteristic across countries and time, there are various indications that locally intermediated lending by international banks is supportive of relatively weaker and less developed banking systems.[24]

A model with banking stability and gravity factors captures 80% of the observed variation in foreign lending growth (Table 5, model (5)) – the highest goodness of fit among all our specifications. Banking stability and gravity factors hence explain 22.6% of the variation that cannot be explained by the benchmark model (1) with constant shares of claims across countries and over time.

But the other banking system characteristics also have significant additional explanatory power (models (6) and (7)). With all three sets of banking system factors together in model (8), but without gravity factors, the resulting unadjusted R^2 is 0.781. This implies an additional explanatory power which is similar to the trade and gravity variables in model (2), where the share of explained variance is around 0.789. In this respect we can support the general thrust in the international bank lending literature, that heterogeneity among international lenders and borrowers – in our case creditor and borrower countries – is a relevant determining factor.

Among the three sets of factors, most results are robust across specifications and reveal a general pattern that locally intermediated claims are relatively more

[23] We tested all three sets of factors for both creditor and recipient country. Banking sector stability and profitability factors for the creditor country yield no significant results; neither do banking sector efficiency proxies for the recipient country.

[24] Results are robust against exchange rate changes. As discussed in section 3.3, growth in local claims in USD terms is subject to exchange rate changes, as local claims are denominated in the local currency of the borrower country. Including percentage changes in exchange rates for major currencies as an interaction terms with cross-border claims and percentage changes in exchange rates of the borrower's currency with local claims does not change the statistical significance in a measurable way and has only a very marginal impact on the coefficients and the explanatory power in our models.

supportive of weaker and less developed banking systems. The signs of the coefficients for the banking stability factors point towards the direction discussed in section 3.2, whereas the same coefficients on *xborderClaims* generally point in the opposite direction. For instance, when impaired loan ratios are higher in a borrower country, then on average a higher share of claims is intermediated locally – and a lower share through cross-border claims.

A similar picture emerges when looking at the banking profitability proxies. Local intermediation tends to be significantly higher if net interest margins in the borrower country are high and return on assets is low. This is typically the case when banking sectors do not face a lot of competition and are inefficient – or unprofitable because of underlying economic problems.

Regressions with banking system factors

Generalised least squares allowing for heteroscedasticity across country pairs — Table 5

Explanatory variable	Category	(5)	(6)	(7)	(8)
xborderClaims growth		0.377***	0.484***	0.276***	0.690***
locClaims growth		0.365***	0.258***	0.363***	0.155***
Interaction terms with *xborderClaims* growth:					
impairedLoanRatio	BKStab	-0.465***			-0.389***
loanDepositRatio	BKStab	0.058***			0.094***
equityRatio	BKStab	0.527***			0.256***
netInterestMargin	BkProf		-2.398***		-3.856***
returnOnAssets	BkProf		0.639*		-0.966***
bankingSectorConcentration	BkProf		0.046**		-0.108***
Creditor_ratioNonInterestIncTotInc	BkEff			0.121***	-0.02
Creditor_costToIncomeRatio	BkEff			0.207***	0.214***
Creditor_ratioOverheadTotAssets	BkEff			-0.983***	-2.929***
Interaction terms with *locClaims* growth:					
impairedLoanRatio	BKStab	0.315***			0.250***
loanDepositRatio	BKStab	-0.030***			-0.041***
equityRatio	BKStab	-0.067			-0.029
netInterestMargin	BkProf		2.696***		2.455***
returnOnAssets	BkProf		-1.626***		-0.714***
bankingSectorConcentration	BkProf		0.068***		0.104***
Creditor_ratioNonInterestIncTotInc	BkEff			-0.053***	0.030**
Creditor_costToIncomeRatio	BkEff			-0.114***	-0.152***
Creditor_ratioOverheadTotAssets	BkEff			-0.271*	-0.196
Constant		-0.004	0.041	0.103	0.131
Gravity factors		Yes	Yes	Yes	No
Unadjusted R^2		**0.8010**	**0.7943**	**0.7908**	**0.7813**
Number of observations		6650	6993	7113	6772
Avg number of obs per country-pair		8.5	8.9	9	8.5

Source: Authors' estimation.

In addition, less efficient creditor banks seem to intermediate proportionately more through cross-border claims. Higher cost-to-income ratios signal higher share of cross-border and lower shares of locally intermediated claims. However, less efficient banks, as measured by the ratio of overhead to total assets, tend to intermediate less internationally in general. Our results for the share of non-interest income to total income are not consistent across specifications.

4.2.1 Economic significance

For policy analysis it is important to establish which factors are of highest economic significance and therefore the most relevant to be monitored by policymakers. Model (8) (last column of Table 5) uses all banking system characteristics simultaneously in our econometric model. With the general pattern of results unchanged, we can study the relative importance of each individual factor.

How important the individual banking system characteristics are in explaining foreign lending growth dynamics can be illustrated by a simple variance decomposition exercise. Using the fact that $cov(x+y) = cov(x) + cov(y)$ for any random variables *x* and *y*, the variance contribution of each individual factor *f* in our model can be decomposed as follows:

$$\frac{cov\left(g_{forClaims_t^{c,i}}, g_{forClaims_t^{c,i}}\right)}{var\left(g_{forClaims_t^{c,i}}\right)} = 1 = \sum_f \frac{cov\left(\gamma_{1,f} X_{f,1,t-1}^{c,i} g_{xborderClaims_t^{c,i}}, g_{forClaims_t^{c,i}}\right)}{var\left(g_{forClaims_t^{c,i}}\right)}$$
$$+ \sum_f \frac{cov\left(\gamma_{2,f} X_{f,1,t-1}^{c,i} g_{locClaims_t^{c,i}}, g_{forClaims_t^{c,i}}\right)}{var\left(g_{forClaims_t^{c,i}}\right)} + \frac{cov\left(\varepsilon_t^{c,i}, g_{forClaims_t^{c,i}}\right)}{var\left(g_{forClaims_t^{c,i}}\right)}$$

With the total adding up to one, the summation terms can be interpreted as a share of explained variance. The shares can be negative, if the interaction term associated with factor *f* is negatively correlated with $g_{forClaims_t^{c,i}}$. The sign of the correlation is therefore important for financial stability considerations, as it indicates whether certain factors are pro-cyclical or support international lending growth in downturns. The absolute contribution is a relevant indicator of the importance of an individual factor for explaining the variation in the growth of foreign claims across countries and over time.[25] As the share of local intermediation is generally smaller, so is its overall economic significance for foreign lending growth (Table 6).

Overall, we can identify one factor within each of our three categories that explains a considerable share in the variation of observed growth of foreign claims: the loan-to-deposit ratio (9.2% through *xborderClaims* and -3% through *locClaims*) for banking stability; the net interest margin (-8.1% and 4.8%) for banking system profitability; and the cost-to-income ratio for the creditor banking system efficiency (12.1% and -7%).

[25] Naturally, the shares represent the explained co-variance within our sample. As our sample is restricted to observations with *locClaims*>0, the measured variance contributions are not representative for the observed variation in an unrestricted sample.

Co-variance contributions by individual factors for model (8)[1] Table 6

Term	Contribution share[2]	Term	Contribution share[2]
xborderClaims growth	69.3	*locClaims* growth	12.1
Interaction terms with *xborderClaims* growth		Interaction terms with *locClaims* growth	
impairedLoanRatio	-2.51	impairedLoanRatio	2.07
loanDepositRatio	9.19	loanDepositRatio	-2.98
equityRatio	2.30	equityRatio	-0.22
netInterestMargin	-8.08	netInterestMargin	4.78
returnOnAssets	-0.66	returnOnAssets	-0.35
bankingSectorConcentration	-6.50	bankingSectorConcentration	5.02
Creditor_ratioNonInterestIncTotInc	-0.83	Creditor_ratioNonInterestIncTotInc	1.00
Creditor_costToIncomeRatio	12.01	Creditor_costToIncomeRatio	-6.96
Creditor_ratioOverheadTotAssets	-4.25	Creditor_ratioOverheadTotAssets	-0.21

[1] For estimation result of model (8), see last column in Table 5. The co-variance contribution share of the error term is 15.76.
[2] Contribution shares are multiplied by 100.

Source: Authors' calculations.

Our results imply that in borrower/creditor countries where these characteristics change, the implied change in foreign lending growth can be noticeable. Borrower banking sectors where loan/deposit ratios are relatively high on average exhibit higher growth in foreign lending through cross-border claims. Similarly, borrower countries with high net interest margins may choose to monitor growth in cross-border claims closely. Creditor countries where cost-to-income ratios are rising may want to scrutinise outflows of cross-border credit.

Apart from the factors which also have a relatively strong impact through the cross-border claims channel (but in the opposite direction[26]), two additional factors for local claims can be highlighted: banking sector concentration (5%) and the impaired loan ratio (2.1%). Our results suggest that for borrower banking sectors in which banking sector concentration and impaired loan ratios are high, a higher local presence of foreign banks will on average have a positive impact on bank lending growth.

4.3 Model implications for Asia-Pacific

How well does our model fit the data for borrower countries in Asia-Pacific? This is an important question, as Asia-Pacific as a region exhibits patterns of international lending which are, on average, different from the other country pairs in our sample.[27]

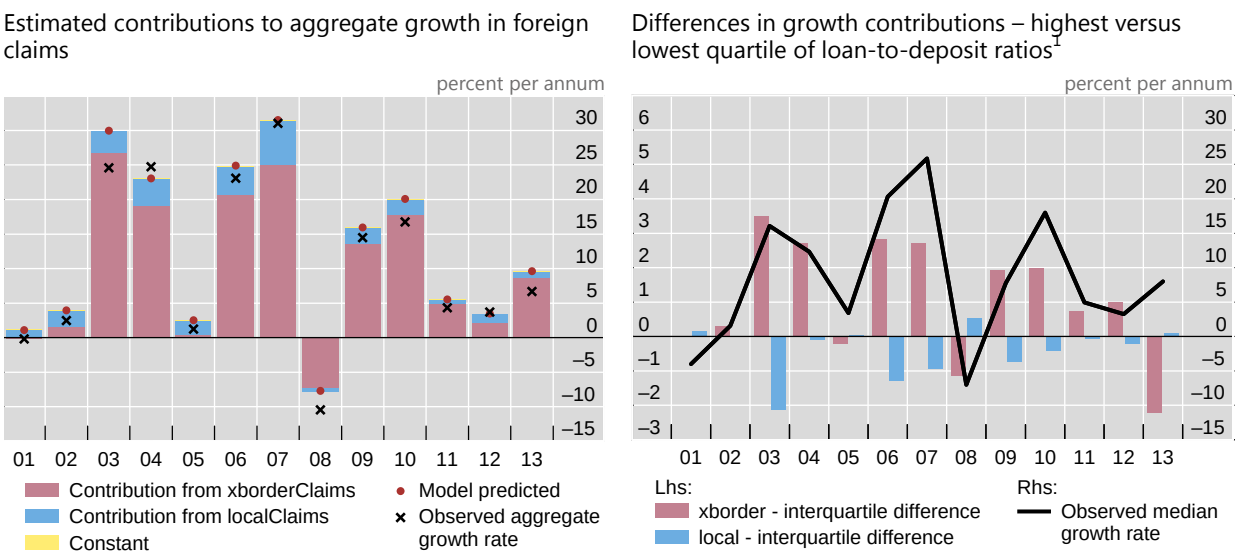
[26] As pointed out above, the correlation between *xborderClaims* growth and *locClaims* growth is low (0.15) and non-negative. The fact that factors have co-variance contribution with a similar magnitude and opposite signs is therefore to not at all superimposed by our model.

[27] See sections 1 and 2.

One test for a good specification of our model is whether the observed aggregate international lending dynamics for the region can be sufficiently well replicated by the model. As aggregate growth in foreign claims is derived from the whole distribution of growth in claims across all countries in our sample, tracking aggregate growth over time is a steep task.[28] If either the coefficient estimates are not representative for Asia-Pacific or the error terms across countries exhibit some non-random pattern, then aggregate deviations can become very large.[29] However, the model tracks the time series variation in aggregate growth very closely (Figure 10, left-hand panel). Further, Figure 10 illustrates the thrust of our results for Asia-Pacific. The contribution from cross-border claims has not only been more prevalent during the times when international ending was booming, but it has also been much more volatile (Figure 10, left-hand panel).

In-sample predictions for borrower countries in Asia-Pacific

Contributions to growth in foreign claims from cross-border and local intermediation — Figure 10



[1] Interquartile difference in growth contribution to median growth rate. The differences are calculated as the growth rate for the median borrower country in the highest quartile of loan/deposit ratios minus the growth contribution for the median country in the lowest quartile – everything else being equal. It is equal to the marginal effect of loan-to-deposit ratios multiplied by the inter-quartile difference in median loan-to-deposit ratios in a given year.

Source: Authors' calculations.

One illustration of the generally supportive nature of local claims for weaker and less developed banking systems in Asia-Pacific is given in the right-hand panel of Figure 10. It shows the differences in foreign claims growth between borrower

[28] With the share of a country pair's international claims in total international claims of the recipient country i (within a region R) vis-à-vis all creditor countries c equal to $\frac{intClaims_{t-1}^{c,i}}{\sum_{i\in R}\sum_c intClaims_{t-1}^{c,i}}$ we can aggregate across a set of recipient countries i within region R to obtain aggregate growth in international claims of region R as $\sum_{i\in R}\sum_c \frac{\Delta intClaims_t^{c,i}}{intClaims_{t-1}^{c,i}} \times \frac{intClaims_{t-1}^{c,i}}{\sum_{i\in R}\sum_c intClaims_{t-1}^{c,i}} = \frac{\sum_{i\in R}\sum_c \Delta intClaims_t^{c,i}}{\sum_{i\in R}\sum_c intClaims_{t-1}^{c,i}}$.

[29] In addition, we are effectively looking at just a sub-sample of the data that were used to estimate the parameters by GLS, which gives lower weight to country pairs with more volatile growth rates and hence potentially compounds the error from aggregating over the cross-section.

banking systems with high loan-to-deposit ratios and low loan-to-deposit ratios. The median loan/deposit ratios within a given quartile do not vary much over time.[30] However, the growth contributions through the two different channels of foreign lending vary considerably. When overall growth in foreign claims is high, cross-border claims contribute a significant extra amount of lending growth for borrower banking systems with higher loan-to-deposit ratios. The growth contributions from local claims, on the other hand, tend to cushion the cycle.

5. Conclusions

The global financial crisis of 2008–09 and subsequent euro area crisis triggered changes in international banking that are still under way. In the Asia-Pacific region, foreign lending is modest relative to GDP and aggregate bank credit, but financial development and cross-border integration are advancing rapidly. This leaves open many possibilities for the eventual shape of international banking in the region – and provides opportunities for regional banks to increase their international presence.

The global financial crisis turned policymakers' attention to the role of international banks in transmitting shocks across borders. Developments since then give a mixed picture for Asia-Pacific in terms of its vulnerability to such shocks. Generally, Asia-Pacific economies have diversified their creditor base, and therefore the region as a whole should be less vulnerable to adverse developments in individual creditor countries, which were of a particular concern during the intensification of the euro area crisis. While the creditor base for many countries has diversified, the region as a whole is more reliant on funding from regional banks than in the past. And with strong economic and credit growth in the region, cross-border credit has become an important source of funding for banks in some jurisdictions. This cross-border funding is mostly denominated in US dollars and may not be always fully hedged against currency fluctuations.

A key policy question that arose following recent crises is whether a more decentralised model of international banking – in which a greater portion of international banking business is carried out in the country where they operate rather than across borders – is more desirable from a financial stability point of view. While not investigating risks to financial stability per se, this paper attempts to shed light on this question by focusing on one particular aspect: are there signs that locally intermediated claims support relatively more fragile and less developed banking systems? Our analysis of a very large panel of creditor-borrower country pairs seems to suggest so. We find that banking system factors – measures of the stability, profitability and efficiency of banking systems – explain a significant fraction of the variation in growth in foreign lending; on average they explain as much of the variation as trade and gravity factors. Moreover, they are also important determinants of whether to lend cross-border or locally. In borrower countries where banking systems are weak, international banks tend to lend locally. They thus contribute to a strengthening of the banking system. In borrower

[30] The cutoff points for the lowest quartile are between 47% in 2002 and 63% in 2012 and the cutoffs for the highest quartile are between 85% in 2009 and 99.2% in 2011.

countries where credit appears to be readily available, cross-border lending is relatively more important than local lending. In other words, cross-border credit tends to move in tandem with the foreign lending cycle, thereby potentially contributing to the credit cycle.

While our analysis helps to shed light on the nexus between types of foreign bank lending and financial stability, it leaves many avenues for extension. First, our approach discards countries for which intermediation through local claims cannot be observed. Future research could explore the differences between countries that do not receive local claims against countries that exhibit a high degree of local claims. Second, whether intermediation takes place cross-border or locally could be related the nature of claims. For instance, banks which extend long-term loans to large industries abroad may favour local lending to avoid asset-liability mismatches. This may be an important driver of the mode of intermediation, which in itself would have implications for financial stability risks. Third, our analysis concentrates on explaining the cross-sectional differences in the shares of cross-border versus locally intermediated foreign claims. The growth dynamics of international lending itself may be driven by other factors – factors which could potentially be even more informative for financial stability considerations. To the extent that financial cycles have a lower frequency than business cycles (Drehman et al (2012) and Borio (2013)), our analysis on the relatively slow-moving evolution of the channels of intermediation probably captures a part of the international lending dynamics which is relevant for policymakers.

A third aspect of financial stability which is not considered in this paper is the ability to share risks stemming from creditor country or borrower country shocks. The recent literature has paid heightened attention to the severity of the shock transmission from creditor to borrower countries during the recent crisis (Cerutti and Claessens (2014)). However, financial stability also depends on the ability to offset given shocks. An important question for future research is therefore whether shocks from creditor countries or borrower countries can be better shared or insured against, if intermediation through cross-border or local claims is more prevalent.

Appendix A

Differences between unrestricted and restricted (*locClaims*>0) sample

Number of observations Table A1

	Unrestricted sample		Sample conditional on *locClaims*>0	
	Number of observations	Average share of *locClaims* in percent	Number of observations	Average share of *locClaims* in percent
All	14255	16.5	7289	31.0
Borrower country regions				
Asia-Pacific	3177	23.1	2085	34.6
Central and Eastern Europe	2425	16.4	1017	36.8
Western Europe	3985	12.5	2318	20.2
Latin America	1128	19.8	583	37.1
Middle East and Africa	3012	10.6	866	35.3
North America	528	33.9	420	41.4
Creditor country regions				
Asia-Pacific	2462	11.2	1123	23.4
Central and Eastern Europe	427	2.3	47	18.4
Western Europe	9545	17.0	4955	31.3
Latin America	151	13.7	86	22.1
North America	1670	25.2	1078	38.7

Sources: BIS consolidated data; authors' calculations.

Summary of country pairs in the sample[1]

Table A2

	Creditor country (yes=1)	Borrower country (yes=1)	No obs[2]	No of country pairs[2]		Creditor country (yes=1)	Borrower country (yes=1)	No obs[2]	No of country pairs[2]
AE	0	1	78	13	KR	1	1	158	31
AR	0	1	120	13	KW	0	1	23	3
AT	1	1	262	39	KZ	0	1	43	6
AU	1	1	266	37	LB	0	1	48	5
BD	0	1	37	6	LK	0	1	55	6
BE	1	1	463	57	LT	0	1	32	5
BG	0	1	90	10	MA	0	1	43	6
BH	0	1	64	7	MU	0	1	30	5
BR	1	1	210	28	MX	0	1	101	10
CA	1	1	428	52	MY	0	1	128	13
CH	1	1	604	68	NG	0	1	30	3
CL	0	1	116	13	NL	1	1	724	69
CN	0	1	167	20	NO	1	1	178	22
CO	0	1	57	9	NZ	0	1	100	9
CZ	0	1	127	11	OM	0	1	32	5
DE	1	1	770	77	PE	0	1	65	8
DK	1	1	162	35	PH	0	1	115	12
EE	0	1	26	6	PK	0	1	77	7
EG	0	1	68	7	PL	0	1	171	17
ES	1	1	479	52	PT	1	1	236	29
FI	1	1	120	20	QA	0	1	32	5
FR	1	1	908	88	RO	0	1	96	13
GB	1	1	996	86	RS	0	1	36	7
GR	1	1	207	34	RU	0	1	131	15
HK	0	1	202	19	SE	1	1	320	55
HR	0	1	38	5	SG	1	1	406	36
HU	0	1	124	12	SI	0	1	41	5
ID	0	1	126	13	TH	0	1	135	14
IE	1	1	236	27	TN	0	1	25	2
IL	0	1	40	6	TR	1	1	144	18
IN	1	1	349	39	TW	1	1	329	32
IT	1	1	519	55	UA	0	1	85	10
JO	0	1	29	3	US	1	1	1070	89
JP	1	1	587	58	VN	0	1	104	10
KE	0	1	50	6	ZA	0	1	112	11

[1] Country names are represented with 2-digit ISO country codes. See en.wikipedia.org/wiki/ISO_3166-1_alpha-2. [2] The number of observations indicates whether the country appears as *either* a creditor *or* a borrower. Hence each country is counted twice and the sum of the number of observations (No obs) and country pairs amounts to twice of those in our sample.

Variable description and sources

Table A3

Variable	Description	Source
Cross-border claims	Cross-border and foreign currency claims of banks headquartered in creditor country against residents in borrower country; in USD.	BIS consolidated statistics
Local claims	Local claims in local currency, through local operations in borrower country owned by a bank headquartered in the creditor country against residents in the borrower country; in USD.	BIS consolidated statistics
Foreign claims	Sum of cross-border and local claims	BIS consolidated statistics
Export share	Annual exports in USD from creditor country to borrower country, divided by total annual exports of the creditor country	IMF – Direction of Trade statistics
Import share	Annual imports in USD by borrower country from creditor country, divided by total annual imports of the borrower country	IMF – Direction of Trade statistics
Distance between capital cities	Logarithm of distance between capital cities of the creditor and borrower countries in kilometer. For creditor-borrower country pairs where distances between their capital cities are not available in the above sources, the distances are obtained using an online tool	Primarily based on Kristian Skrede Gleditsch's dataset on distance between capital cities: http://privatewww.essex.ac.uk/~ksg/data-5.html, supplemented by Feenstra et al. (2001) and Spiegel and Rose (2009).
Common language	Dummy equal 1 if the home and host countries share the same language.	Feenstra et al. (2001) and Spiegel and Rose (2009).
Common border	Dummy equal 1 if the home and host countries share a land border	Feenstra et al. (2001) and Spiegel and Rose (2009).
Common colonial history	Dummy equal 1 if the home and host countries were ever colonies after 1945 with the same colonizer or have colonial relationship	Feenstra et al. (2001) and Spiegel and Rose (2009).
Common legal system	Dummy equal 1 if the home and host countries have the same legal system.	The World Factbook (Central Intelligence Agency)
Free trade agreement	Dummy equal 1 if the home and host countries have the free trade agreement	Feenstra et al. (2001) and Spiegel and Rose (2009); in addition dummy for members of European Union.
Chinn-Ito index	Annual index measuring a country's degree of capital account openness	Chinn and Ito (2008); http://web.pdx.edu/~ito/Chinn-Ito_website.htm.
Log GDP level	Logarithm of annual nominal GDP in billions of US Dollars	World Economic Outlook (IMF)
Financial centre	Dummy=1 for Great Britain, Hong Kong, Ireland, Japan, Mauritius, Singapore, Switzerland, Chinese Taipei, and the United States.	
Financial freedom	Annual index for financial freedom in the borrower country. (Index from 0, for lowest financial freedom, to 100). The index measures the extent of state intervention through direct and indirect ownership, extent of financial and capital market development, government influence on the allocation of credit, and openness to foreign competition.	Heritage foundation www.heritage.org/index.
GDP growth rate	Annual growth rate of real GDP in percentage	World Economic Outlook (IMF)
Inflation	Annual change of consumer prices in percentage	World Economic Outlook (IMF)
Banking-crisis dummy	Dummy equal to 1 if the country was hit by banking crisis in the corresponding year, based on Laeven and Valencia (2013). For crises which are indicated as "ongoing" in Laeven and Valencia (2013), the dummy equals 1 from the start of the crises to 2012.	Laeven and Valencia (2013)

Capital account openness	Measured by the Chinn-Ito index (updated to 2012)	The Chinn-Ito Index website: http://web.pdx.edu/~ito/Chinn-Ito_website.htm
Bank-credit-to-GDP ratio	Ratio of bank credit at year-end to annual nominal GDP	International Financial Statistics (IMF) World Economic Outlook (IMF)
Bank-deposit-to-GDP ratio	Ratio of bank deposit at year-end to annual nominal GDP	International Financial Statistics (IMF) World Economic Outlook (IMF)
Loan-to-deposit ratio	Annual gross loans (series no 2001) divided by total customer deposits (series no 2031), aggregate value for all banks in borrower country	Bankscope,[1] annual data
Impaired loan ratio	Aggregate face value of impaired loans (series no 2170) divided by gross loans (series no 2001) for all banks in borrower country	Bankscope,[1] annual data
Equity ratio	Aggregate book equity (series no 2055) divided by total assets (series no 2025) for all banks in borrower country	Bankscope,[1] annual data
Net interest margin	Aggregate net interest revenue divided (series no 2080) by aggregate earning assets (series no 2010) for all banks in borrower country	Bankscope,[1] annual data
Return on assets	Aggregate net income (series no 2115) divided by aggregate total assets (series no 2025) for all banks in borrower country	Bankscope[1], annual data.
Banking sector concentration	Aggregate total assets (series no 2025) of the 3 largest banks divided by aggregate total assets of all banks in borrower country	Bankscope,[1] annual data
Ratio of non-interest income to total income	Aggregate ratio of non-interest income (series no 2085) to total income (sum of series no 2085 and series no 2080) for all banks in the creditor country.	Bankscope,[1] annual data.
Cost-to-income ratio	Aggregate ratio of operating expenses (series no 2090) to total income (sum of series no 2085 and series no 2080) for all banks in the creditor country.	Bankscope,[1] annual data
Ratio of overhead to total assets	Aggregate ratio of operating expenses (series no 2090) to total assets (series no 2025) for all banks in the creditor country.	Bankscope,[1] annual data

[1] See section 3.3 for details on how the aggregate ratios are constructed. Some ratios are based on definitions form the World Bank Financial Development database, though they are calculated by a different method.

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Comments on: Channels and determinants of foreign bank lending

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This paper is, in effect, two in one: a descriptive paper and an analytical one. Each part is interesting in its own right but it is not entirely clear how the parts relate to each other from the paper as it is presented. My own interpretation of the authors' intended link is presented in concluding remarks below.

The first, descriptive, part asks who borrows and lends, and in what form, in the Asia-Pacific region. The underlying question is whether borrower countries in the Asia-Pacific region have become more vulnerable to potential "sudden stops" in credit flows from foreign banks. The authors are fairly sanguine on this front: despite some concentration of lenders after the withdrawal of European banks, the region is not seriously exposed to "common lender risk". Banks in the region are not heavily reliant on non-core liabilities and, although the proportion of foreign lending accounted for by local affiliates has fallen somewhat, the overall share of foreign banks in total credit in the region remains small.

In the second part, on the drivers of different channels of cross-border lending, the authors focus their econometric model on what influences the share of cross-border versus local lending, comparing the effects of trade flows and standard gravity factors with the role of banking system factors. Here the concern is with what gives borrowers access to "safer" local lending rather than more "volatile" cross-border financing. The authors conclude that the local lending channel is more prevalent where borrower systems are more fragile. They suggest that this provides countercyclical, ie stabilising, credit for weaker systems.

Why is it interesting to consider these questions in the context of Asia? There are several reasons. The authors note that much of the work on contagion of bank shocks has been done for Europe, leaving a gap in the research. As they also point out, the region provides a lens on how the international banking system might change because the region's financial system is developing rapidly from a low level of exposure to (or reliance on) cross-border claims.[1] Furthermore, banks headquartered in the region are beginning to lend across borders themselves. There are other reasons why Asia is interesting. Why wasn't the impact of the global financial shock bigger in Asia? Why was it so short-lived? Why was it felt mainly in trade and not in the financial system? Is the financial system more, or less, vulnerable to shocks now? Does involvement of "foreign" banks help offset risks or increase them? The paper provides answers to some but not all of these, which leaves avenues for further research with the valuable data they have compiled.

There are several insights in the first, descriptive, part which owe a considerable amount to the authors' detailed understanding of the structure of the BIS data. The first is to clarify the various ways in which loans can be made, distinguishing

[1] They use the term financial integration for the measure of cross-border lending to GNP but this is a contested terminology, which some authors prefer to avoid.

between cross-border loans by international banks direct to non-banks (companies or individual) in the borrower company and cross-border loans by international banks to local banks, which then on-lend to local borrowers. Foreign banks may also lend via their affiliates inside the borrower country resulting in "foreign" lending that is not cross-border, which the authors call "local lending". Given the importance of this distinction, the diagram of the different channels used in the conference presentation would be a useful addition to the paper.

The descriptive data show increased concentration of lenders and provide some evidence of several common routes for the transmission of shocks: common lender effects, interbank funding exposures and lending by local subsidiaries of foreign banks (considered less volatile than other forms). The paper concludes that the risk of common lender effects seems to have decreased despite a growth in the share of the top three lenders as European banks have withdrawn. This is an important, and new, element of the paper but receives less analytical attention than it might.

The calculation of the "common creditor index" is interesting but captures only one element of the exposure of the region. The CCI measures the commonality of (third-party) creditors between pairs of countries, and we are shown the average value of country-pair CCIs over time, whether particular pairs of countries have more common creditors over time and whether the distribution of the CCI of pairs of countries has widened or narrowed. What question does this allow us to answer for the region? It only indirectly tells us whether the region as a whole has a higher concentration of common creditors because the focus remains at the country-pair level. It allows (with some effort) an understanding of the likelihood that a shock affecting one (or a particular group) of the lender banks which are important to one country might also impact other countries. We can, for example, identify that a shock affecting the creditors to Chinese Taipei has a higher probability of also affecting credit to China, Hong Kong SAR, Indonesia, India, Japan, Korea, the Philippines and Singapore than of impacting on credit to Bangladesh, either because the former have more creditors in common with Chinese Taipei than the latter or because those they share account for a large proportion of their foreign borrowing. This is one part of the picture of common lender effects but here the authors could usefully delve more deeply to think about measures that capture the full network effects of inter-related lending around the region. What we really want to know is whether a shock to a particular set of international lenders will affect many or few countries in the region and to what degree.

The data on interbank funding and local lending patterns provide a useful segue to the second part of the paper, which asks what affects the share of each lending channel in the total. Starting from the proposition (backed by some evidence in the literature but not directly examined here) that "local" lending by foreign creditors (particularly via subsidiaries rather than branches) is more stable than cross-border lending, the second part unpacks what determines the respective shares.

This part of the paper is initially somewhat difficult to follow because the estimated equations are not set out explicitly and there are some issues of the approach that could be clearer.

Section 3.1 presents a definition of total foreign claims divided into the two components of cross-border claims and "local" claims. Each has a share in the total. The authors state that the paper will *estimate* the shares and will examine what

factors determine the share of each component. Readers may be distracted at this point by recognising that the shares can be calculated from the data (so why estimate them?) and that they should necessarily add up to one (so, once we know one, we will automatically know the other). What precisely is going on here?

What the authors do, in fact, is to express the identity in terms of rates of change (the growth of total foreign claims is equal to the weighted sum of the two channels, cross-border and local), recognise that there is some noise in the data so that an error term enters[2] and argue that the estimated coefficients representing the shares are not constant across time and geographical space. Given this latter point, a standard regression of the growth in total foreign claims on the growth in values of the different types of claim, delivering a pair of coefficients representing the shares, would be misleading. However such a standard analysis is useful as a benchmark.

They establish that benchmark by regressing the growth of total foreign claims on growth in cross-border and local claims. This explains about 74% of the variance of the growth in the total value and generates single coefficients on each channel that would represent the share of each under the assumption of fixed coefficients. Next they argue that the way to capture the effects of various factors determining different shares for each channel across time and across countries, is to regress the growth of total claims on multiple variables interacted with each of the two channels. This is their method for capturing the effect of multiple underlying variables on the share coefficients for each channel (as they describe in the equations of Section 3.1). They assess how significant these various factors are by comparing the proportion of unexplained variance in regressions with different sets of variables included (ie comparing R^2).

Their results are suggestive but some methodological concerns urge caution in interpretation. First is the question of how much the variation in the share of local claims matters and how best to understand it. We know from Table 3 that the variation in shares of local claims is wide but we don't know the distribution of the variation so it's hard to judge how important it is to explain the differences in shares (do countries cluster around the mean?). And if the question of interest is to explain cross-country (and over time) variation in the share of local claims, then using panel data methods directly on a model of the local claims share would be informative and arguably more obvious,[3] and would give more direct ways to interpret the coefficients contributing to differences between countries.

Second is the problem of sample selection bias. The authors exclude observations in which the creditor country does not do both cross-border and local lending. Their justification is flexibility but the potential sample selection bias from excluding those with no local lending cannot simply be ignored. Creditors' choice about whether or not to establish a local subsidiary is highly likely to be based on local banking characteristics. The impact of those same local characteristics on the choice between local and cross-border lending for those banks that have made a

[2] Which explains why the estimating equation is not an identity and why the adding up constraint is not applied.

[3] They dismiss a similar method used by Garcia-Herrero and Peria arguing that it imposes an adding up constraint but that would not be necessary if each share were separately used as the dependent variable.

prior decision to go in to a market is likely to be different from the overall impact of those characteristics on cross-border lending.

Third is the method for determining the significance of groups of factors. The authors use comparisons of R^2 to determine which groups of variables are most important but this is less robust than using a full general-to-specific method in which all variables are first included and then systematically excluded on the basis of any of a number of information criteria tests. This matters because the authors draw inferences from the size of the coefficients (eg "trade factors are more relevant for explaining the share of locally intermediated claims than they are for explaining the share of cross-border claims"). They also rely on the change in coefficients on some factors when other factors are added ("when banking system-specific factors are introduced, trade factors are generally insignificant in explaining cross-border claims"). Indeed, they note in footnote 21 that, when all factors are included, some interaction terms become insignificant. Each of these statements suggests that exactly which factors are retained does have an important impact on both the size and significance of other factors. In these circumstances, the only way to reliably draw inference is to systematically exclude factors until the parsimonious model is identified. This also impacts on the test they use to determine which are the most important factors within groups of variables (Table 6). If the size and variance of the estimated coefficients are unreliable because they are not derived from a parsimonious model, then the calculation of their contribution to total variance will also be affected.

Finally there is a matter of terminology. Even if the conclusions on the importance of different factors were sustained under more robust estimation, I would still take issue with the language used in interpretation. The banking factors that have been used show not the stability of a system but its health. These terms are used interchangeably by the authors but should not be confused. High ratios of impaired loans and other indicators of poor banking health do indicate fragility but implications for the *stability* of the system do not automatically follow. There may be no link between poor health and the *variability* of credit for example, and much will depend on policy responses to deteriorating bank health. This point does not undermine the conclusions the authors are trying to draw about the role of local lending in borrower countries with weak banking systems, but it does reduce the clarity of their message.

Conclusions

It must be borne in mind that the authors begin with a view (not a hypothesis that is tested) that "decentralised" banking (ie local lending with local funding) is more stable in times of crisis than cross-border lending. The paper is not testing this for the region (which would be another valuable exercise) but is trying to understand what factors give rise to more decentralised (local) lending by foreign creditors, on the assumption that it is a desirable outcome. This is where the disconnect between the first part of the paper and the second part arises.

The paper does not, despite the claim in the abstract and introduction, shed much light on the optimal form of international banking, nor on the role of foreign lending in transmitting shocks. The reason is that the paper is actually more limited in its ambitions and reasonably so, given the complexity of what is attempted. The

main focus is on the empirical model aimed at understanding what factors result in different shares of the channels of foreign lending. The first part of the paper is thus scene-setting. It is useful and quite wide-ranging, but it does not tell us how shocks have been transmitted nor what role is played by foreign lending (via either channel) in shock transmission. It does not, therefore, establish why a focus on the determinants of the shares of cross-border lending and local lending should matter.

Furthermore, the element of the transmission of shocks that is the focus of this paper is only part of the picture. There are many other theories of contagion of a financial shock in lender countries that are not addressed in this paper. Other literature considers whether shock transmission comes primarily via trade effects or via financial flows, even when the initial shock is a financial one in the lender country. If the transmission mechanism is financial, there is still the question of whether the transmission is via quantity or price. While no paper can address everything, the interpretation in this paper that the "decentralised" model of cross-border lending (ie via local lending through subsidiaries) gives greater stability and lower transmission of shocks does need to be set in the context of whether the financial flows channel matters much at all. In the Asian region this is still an open question. The history of two major shocks gives different answers.

Given the implicit assumption here that the quantitative transmission of shocks via flows of foreign lending matters, another elephant-in-the-room is the classic identification problem. Variations in bank lending can be the result of demand (borrower) side changes as well as supply side. The empirical model used here could be regarded as a version of a reduced form, including both demand and supply factors, but the interpretation concentrates on the supply side drivers as if these were the only choice variables of interest.

Despite these observations, we learn a great deal about foreign bank lending in the Asia-Pacific region from this paper. The authors have access to valuable data and are very familiar with their intricacies. They have a strong knowledge of the way foreign creditor banks behave and bring that to bear on important questions that may affect financial stability in the region. Even allowing for some caveats about the robustness of their econometric results in their current form, it's clear that they point in the direction of additional important research that is needed to strengthen policymakers' awareness of the benefits and potential risks in integrating with external credit markets. And even if the size and significance of their estimates may be affected by the methodology, their main conclusions remain plausible and important. These are that:

- the share of local lending is greater in more fragile and less-developed banking systems;
- banking system factors are important determinants of the choice between local and cross-border lending; and
- banking system factors are probably as important as other drivers (trade, gravity) in the variation in the growth of lending.

These observations should certainly give policymakers in the region food for thought.

Development and functioning of FX markets in Asia and the Pacific[1]

Richard M Levich[2] and Frank Packer[3]

Abstract

Global foreign exchange (FX) trading volume in traditional FX products and derivatives in Asia and the Pacific has expanded rapidly over the last 15 years, more so than in other regions. Asian currencies also have experienced exceptional growth in offshore turnover, including that of non-deliverable forwards (NDFs). Trading activity on this scale, spread across many countries and currencies, underscores the need for a smoothly functioning infrastructure and exceptional risk management processes. While settlement risks are mitigated for the vast majority of turnover through systems such as CLS Bank, the Asia-Pacific region would benefit by having more countries and currencies become CLS-enabled or tradable under other payment-versus-payment (PVP) systems. Although their volatility was less pronounced than during the global financial crisis, FX markets in the region experienced added turbulence during the "taper tantrum" of 2013. High-turnover currencies tended to depreciate more after the taper announcements, although volatility rose more sharply in currencies with low turnover. The FX market is a prominent venue for carry trades that are subject to crash risk. While there is some evidence of herding behaviour exacerbating this risk over the past decade, the measures calibrated more recently do not suggest exceptional crowding into carry trades ahead of the "taper tantrum" in 2013. At the same time, our measures of crowdedness for the carry trade show considerable variation over time. It might be useful to make crowdedness measures publicly available.

[1] We thank Jimmy Shek for his research assistance and participants at a BIS workshop in 2013 for helpful comments on an initial outline. We have also benefited from the remarks of participants at the 2014 conference in Wellington, in particular from discussant Takatoshi Ito. We also thank Mychal Campos, Sammie Chan, Juan Gutierrez, Rachel Hoey, Dino Kos and Andreas Schrimpf for comments. The views expressed here are those of the authors and do not necessarily reflect those of the BIS.

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1. Introduction

Global foreign exchange (FX) trading volume has expanded rapidly in recent years. According to BIS data, daily turnover in traditional FX products and derivatives grew from an estimated $590 billion in 1989 to $5.3 trillion in 2013. Between 2010 and 2013 alone, turnover increased by 35%. The trading volume in the currencies of the 12 Asia-Pacific jurisdictions that are the focus of this paper – Australia, China, Hong Kong SAR, India, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Thailand and New Zealand – have increased even more quickly over the past three years, at 56%. Trading activity on this scale, spread across this many countries and currencies, underscores the need for a smoothly functioning infrastructure and exceptional risk management processes.

Our paper is organised as follows. Part 2 will cover recent trends in FX markets in Asia and the Pacific, presenting salient facts from the BIS Triennial Central Bank Survey of foreign exchange and derivatives market activity, including growth, location of turnover for the major Asia-Pacific currencies as well as turnover by counterparty. Part 3 will shift attention to the evolution of institutional safeguards in FX trading, notably CLS Bank and its role in enhancing FX market resilience during the global financial crisis (GFC) in 2008–09, as well as the current situation and outlook for the evolution of institutional safeguards in Asia-Pacific. Part 4 will present a brief conjunctural analysis of the resilience of market functioning in Asian currencies over the past decade and a half, while Part 5 will then focus on a particular type of trade – the carry trade – which has at times accounted for a sizeable proportion of FX transactions in the Asia-Pacific currencies. Using newly developed measures of crowdedness and liquidity, we ask how prevalent the carry trade has been and what is the evidence concerning its contribution to instability in FX markets in the region, most notably during the global financial crisis and the more recent "taper tantrum" episodes in 2013.

2. Trends and patterns in FX trading in Asia-Pacific: Evidence from the Triennial Survey

The 2013 BIS Triennial Survey gives a snapshot of evolving trends in the FX markets, and allows us to gauge how future economic expansion and possible institutional changes in the region might impact FX trading activity and risk exposures. Conducted every three years since 1989, the latest survey was completed in 2013. Some 53 central banks participated and collected data from about 1,300 banks and dealers about their FX trading activity during April. Turnover in more than 40 currencies was reported for spot, outright forwards, FX swaps, currency swaps and FX options transactions.

2.a Trading in Asia-Pacific currencies vs others

While the latest triennial survey documented robust global growth in FX turnover, the Asia-Pacific currencies showed stronger growth on the whole than other major currencies. Table 2.1 documents the evolving share of foreign exchange market turnover for the six most actively traded currencies of advanced economies, as well

as for the New Zealand dollar. The three currencies of the Asia-Pacific economies (JPY/AUD/NZD) have gained share since 2010 relative to other advanced economy currencies, rising to 23%,[4] 9% and 2% of overall turnover, respectively, well above the shares of the 2010 survey, as well as those of the survey of nine years earlier (2004). The 2010–13 growth rates of the yen, Australian and New Zealand dollars of 63%, 53% and 66% were well above overall growth rates of turnover, both for advanced economy currencies (34%) and for the global sample of currencies (35%).

Similarly, turnover in many of the currencies of emerging market economies in Asia-Pacific have grown relatively rapidly (Table 2.2). The fastest growing currency is the Chinese renminbi: its turnover grew by 249% between 2010 and 2013, and it now comprises the second largest share of trading among emerging market currencies (after the Mexican peso). The Thai baht, Malaysian ringgit, Indonesian rupiah and Indian rupee all show very robust growth well above global averages at 123%, 95%, 50% and 40%, respectively. Similar to other emerging market economy (EME) currencies, growth in turnover has been far in excess of related country trade growth, consistent with the ongoing "financialisation" of currencies (McCauley and Scatigna (2011)). The one biggest single exception to robust growth has been the Hong Kong dollar, where a decline of 17.6% since 2010 likely reflects its displacement by the renminbi in a significant number of transactions in Hong Kong SAR.

The triennial survey also shows that the US dollar (USD) remains the dominant global currency, as one of the currencies in more than 87% of transactions globally (Table 2.1). Asian currencies also overwhelmingly trade against the USD, though at proportions somewhat lower than the global average. For the bulk of this paper, when we focus on issues of liquidity and performance of FX trades in Asia, we will focus on the USD pairs of Asia-Pacific currencies. The potential for other currencies to rise as significant alternatives to the US dollar – a phenomenon which has not yet been observed in the BIS Triennial Survey – we leave for other research.

2.b Offshore trading

FX trading is increasingly taking place offshore, or outside the jurisdiction where a currency is issued. Indeed, the past few triennial surveys have shown that the offshore share of total FX transactions to be steadily rising across a broad spectrum of currencies. As a result, growth in EME currencies has been much more buoyant than the growth of FX transactions taking place in EME jurisdictions (71% vs 32%, from 2010 to 2013).

Table 2.3 lists the offshore trading of currencies in the Asia-Pacific alongside some comparable currencies. Among advanced economies, the Japanese yen, and Australian and New Zealand dollar have significantly higher offshore shares in global turnover than other advanced economy currencies on average, ranging between 83% and 93%. The growth in offshore trading since 2007 also outpaces advanced country currency averages as well.

[4] Increases in Japanese yen trading relative to the 2010 survey were in part due to a surge in late 2012 and early 2013 due to expectations and implementation of a change in economic and monetary policy in Japan. Data from other FX surveys show signs of a subsequent decline from the peak (Bech and Sobrun (2013)).

Among emerging market currencies, once again the renminbi stands out, with by far the largest share of offshore trading at 72%, or $86.1 billion per day. Growth in renminbi offshore trading since 2007 has been 56%, on an *annualised basis*. At the same time, the offshore trading of most other Asia currencies also grew significantly more rapidly than the average for emerging market currencies, at annual rates of 40%, 30%, 26%, 24%, and 23% for the Malaysian ringgit, Indian rupee, Thai baht, the Philippine peso, and Indonesia rupiah, respectively (Table 2.3). Overall, growth in the daily offshore turnover of Asian EME currencies contributed 35 percentage points to their total growth of 41% in the 2010–13 period (Ehlers and Packer (2013)).

Compared with other emerging market currencies, emerging Asian currencies are by far the most traded within their geographical region. More than a quarter of trading takes place both offshore and within emerging Asia. The renminbi is increasingly prominent in this respect: nearly two thirds of its offshore volume is in Asia.

But it is not just the renminbi that attests to a strong regional influence of trading in Asian currencies. Some 20–40% of turnover in the Korean won, Indian rupee, Indonesian rupiah, Malaysian ringgit and the Philippine peso takes place offshore and in Asia, well above the EM average for offshore, intra-regional turnover of 12.6%. The only exceptions here are the Hong Kong and Singapore dollars – which tend to trade outside Asia when they trade offshore – possibly because the associated jurisdictions are large offshore trading hubs, themselves with abundant turnover and liquidity across a range of currencies.

That said, the United Kingdom continues to serve as a major offshore trading hub for Asian currencies. Despite the presence of Hong Kong and Singapore, nearly one fifth of trading in emerging Asian currencies trading takes place in the United Kingdom, while the United States lags considerably at 8%. Hong Kong SAR and Singapore together account for 25.3% of offshore trading in emerging Asian currencies.

Non-deliverable forwards. London is noted in particular as a hub for trades in non-deliverable forwards (NDFs), ie forward contracts which are valued based on movements in a currency's exchange rate, but settled in US dollars. More than one third of $127 billion in daily NDF trading reported by the 2013 Triennial Survey took place in London. (Asian financial centres remain quite important for trading in NDFs in some currencies such as the Chinese renminbi and Korean won.) Not requiring transactions in a currency, NDFs allow investors to speculate in a currency even in the presence of capital flows and trading restrictions, and thus tend to take place offshore (McCauley et al (2014)). They account for one fifth of all forward trading, and have grown rapidly.

There is evidence that, for many currencies including those in Asia, the NDF market has dominated the deliverable venue for price discovery during periods of volatility, perhaps reflecting a tendency for global factors such as VIX to be incorporated more into the pricing of NDFs than that of deliverable forwards.[5] Below, we will examine the time series of relative pricing in NDF vs deliverable

[5] See Goyal et al (2013), Cadarajat and Lubis (2012) and Kim and Song (2010) for evidence in the case of India, Indonesia and Korea.

forward markets as one of the indicators of liquidity in the currency during periods of turbulence in financial markets.

2.c Turnover by counterparty

Given its rapid growth, the FX market clearly serves other functions than simply supporting international trade in goods and services, and cross-border international financial transactions in equities, bonds, and other instruments. A large share of trading is the result of dealers trading with one another during the day in an effort to control risk as they respond to order flow from incoming trades and provide liquidity for buys and sells. However, non-dealer financial institutions in Asia-Pacific jurisdictions account for more than one quarter of daily FX trading volume, both in advanced and emerging economies (Table 2.4). The implication is that many non-reporting banks, institutional investors and hedge funds use the FX market to either (a) hedge their outstanding exposure to foreign currency assets and liabilities and the expected cash flows generated by these positions, or (b) take on new risky foreign exchange exposures. In addition, a substantial share of non-dealer bank volume fulfils so-called "prime-brokered" activity whereby third-party financial institutions trade under the name and credit standing of their bank. Given the scale of the FX market and its reach across all countries with distinct regulations, it is essential that the market is not exposed to risks that could jeopardise its operations or the larger financial system. We turn to this issue in the next section.

3. Institutional safeguards in FX trading

3.a Risk and regulation in the FX market

At more than $5 trillion per day the global FX market has the largest volume of daily turnover of any financial market. It may be surprising that a market so large and so critical to the global economy is not subject to significant regulatory oversight and does not meet the reporting and transparency standards that are commonly found in organised markets for equities, futures, and even more recent financial innovations such as swaps and other derivative instruments. The explanation for this outcome is partly historical and a function of the market itself, and partly the result of recent innovations intended to mitigate and largely eliminate the major sources of systemic risk in FX trading.

The FX market can be characterised as a globally dispersed, broker-dealer market. The foreign exchange market is not a place one can visit like the New York Stock Exchange or the Chicago Mercantile Exchange. Currency trades in an interbank market through many banks and trading rooms around the world. Trading is facilitated by various electronic trading platforms (some operated by single banks as well as systems developed by Reuters and Electronic Broking Systems [EBS]) but trades facilitated via voice-brokers or simply direct calls between

dealers remain a significant part of the market.[6] There are no set standard trading hours, no centralised record of transactions, and no unique closing price as there is for a listed stock or futures contracts.

In their discussion of FX market structure and its evolution, King, Osler and Rime (2011) observe that "The vast majority of FX trading is essentially unregulated, in striking contrast to the extensive regulations in most equity and bond markets."[7] The authors point out that FX dealers could move elsewhere if threatened by regulation. But surely the design of regulations would be daunting, with every currency pair involving two countries and dealers from third countries representing banks headquartered in still other countries. As a result, regulations that are familiar in some markets are absent in the FX market. Short-sale restrictions, for example, would have no meaning in FX as the purchase of one currency is simply the sale of another. Front-running of customer orders is not illegal, but it is heavily discouraged by market convention and best practices. So-called FX Committees in six cities act as self-regulatory organisations to establish standards for traders, relationships with customers, and so on.[8]

That there is minimal regulation implies that there is minimal reporting by banks to regulatory agencies. Data pertaining to specific trades between Bank A and Financial Institution B or Customer C are private information and are therefore not reported to an exchange or central bank. As a result, most research on currency trading relies on proprietary data sets and sometimes reflects data on indicative quotes rather than actual transaction prices, and may reflect only a narrow segment of the market.

The GFC in 2008–09 provided the impetus for policymakers in all countries to reassess their oversight of all financial institutions and marketplaces. In general, the new regulations call for higher capital requirements at banks and greater reliance on the use of central counterparties (CCP) to make trading in certain derivatives more transparent and they also rely on CCP margin requirements and marking to market to lessen the ongoing risks in derivative positions.

Importantly, outright forward and swap transactions (which together accounted for 55% of global FX trading in 2013) are exempt from the CCP mandate which the Dodd-Frank Act imposes on most derivative transactions. The US Treasury Department, in coordination with other US regulators and other countries, approved the exemption in November 2012. In their proposal brief, the Treasury referred to a number of unique factors that limit the risk in FX swaps and forward markets compared with other derivative markets.[9] Among these factors, the Treasury cited the shorter duration of FX swaps and forwards (noting that roughly 68% of the market matures in one week or less, and 98% matures in one year or less). And, in contrast to other derivatives, FX swaps always require both parties to physically exchange the full amount of currency on fixed terms that are set at the outset of the

[6] See 2013 BIS Triennial Survey, Table 26. The data show that voice execution accounts for 34.5% of spot turnover while electronic execution accounts for 63.8%. Voice accounts for a higher percentage in outright forwards, FX swaps, currency swaps, and 62.0% for FX options.

[7] Exchange-traded FX futures and options are an exception to this general observation.

[8] The six cities are London, New York, Tokyo, Toronto, Sydney and Singapore.

[9] See US Treasury Department (2011).

contract. Market participants know the full extent of their own payment obligations and their exposure to their counterparty throughout the life of the contract.

These features could be moot were it not for one last feature of the foreign exchange market which the Treasury described as a "well-functioning settlement process", in reference to CLS Bank. The CLS Bank is undoubtedly the most critical innovation in the last 20 years to touch the infrastructure of the foreign exchange market, especially with respect to safeguarding the market and mitigating the risks of trade settlement. In the remainder of this section we review the historical events leading up to the founding of CLS Bank, together with its structure and activities. Then we gauge its presence in different products, countries and currencies, and discuss what risks remain with special reference to the Asia-Pacific region.

3.b Historical background to the founding of the CLS Bank

For most of its history, the nature of the foreign exchange market dictated that FX transactions were to be settled on a bilateral basis. Netting systems reduced the gross amount of funds necessary to flow between counterparties, but settling a transaction still required counterparty A to pay away funds in one currency to counterparty B without complete assurance that counterparty B would deliver its leg of the transaction. This possibility became a reality one day in 1974 when Herstatt Bank received Deutsche marks at its offices in Cologne, Germany, but was subsequently closed down and forced to cease operations by German banking regulators, and was thus unable to deliver US dollars to its counterparties once US banks opened for business. This form of credit risk, known as delivery risk (but naturally enough quickly enshrined as "Herstatt risk") resulted in a total loss of principal for Herstatt's counterparties.

Soon afterwards, market participants and regulators began searching for a solution to what could only be a growing problem given the ongoing globalisation of markets and financial transactions. Working through the BIS, in 1996 the Committee on Payment and Settlement Systems issued a comprehensive report on "Settlement risk in foreign exchange transactions". The so-called Allsopp Report assessed the relative merits of delivery-versus-payment (DVP) and payment-versus-payment (PVP) settlements systems and two potential payment/receipt relationships: a guaranteed receipt system (where counterparties are guaranteed that they will receive what they are owed if they fulfil their own settlement obligation) and a guaranteed refund system (where counterparties are guaranteed that their settlement payment will be cancelled or returned if their counterparty fails to pay what they owe). The report did not seem to take a stand on which settlement system would best serve the foreign exchange market. In their words, "While any of the various settlement mechanisms described above could potentially eliminate FX settlement exposures, each has particular strengths and weaknesses that should be considered."[10]

The report did, however, come down clearly in favour of private sector rather than public sector provision of enhanced settlement services. Among the reasons given were the need for ongoing innovation, pressure to provide cost-effective arrangements and private sector methods for controlling risk. Having said this, the

[10] The Allsopp Report (1996), p 24.

report noted the important role for central banks in promoting the safety and soundness of their domestic financial institutions needed to support a multicurrency settlement system. In addition, the Report expressed concern as to the speed of progress and the need for central banks to "induce rapid private sector progress". Given that the Herstatt Bank failure occurred 22 years earlier, the Report noted that "Among the impediments at the individual bank level is a belief held by some banks that the probability of an actual settlement loss is too low to justify the cost of reducing exposures."[11]

Not long after the Allsopp Report was issued, CLS Bank International was founded in 1997 and commenced operations in 2002. CLS Bank is an Edge Act corporation located in New York and is regulated and supervised by the US Federal Reserve. The Federal Reserve also acts as the lead overseer of CLS Bank in a cooperative oversight arrangement with the central banks whose currencies are settled by CLS Bank. CLS Bank is a subsidiary of CLS Group Holdings AG based in Switzerland, which itself is owned as of June 2014 by 76 shareholders representing many of the world's largest financial institutions from 23 countries.

In a little over a decade, CLS Bank has grown to become the "sole global multi-currency settlement system of its kind, offering both liquidity savings and settlement risk mitigation across all major currencies".[12] In July 2012, the Financial Stability Oversight Council (FSOC), established under the Dodd-Frank Act, designated CLS Bank as a systemically important financial market utility (SIFMU) based on several criteria that attest to the volume of transactions processed by CLS Bank, but also to its critical role in the interconnectedness of the FX market and the costs and risks to financial stability if the ability to rely on PVP settlement for major FX transactions were jeopardised.[13] Being classified as a SIFMU, CLS Bank is subject to enhanced regulatory oversight by the Federal Reserve Bank and other market regulators.

3.c Basic activities and dimensions of CLS Bank

CLS Bank, taking its name from a so-called Continuous Linked Settlement process, operates a payment-versus-payment (PVP) settlement service which mitigates settlement risk in the FX transactions of its Settlement Members and their approved customers (known as Third Parties). Although the details of this global operation are complex, the basics of the PVP settlement process are straightforward.[14] CLS Bank receives detailed information from both counterparties about their FX transaction and then matches the two legs of the transaction scheduled for delivery on date *T*. On the settlement date, *T*, during a window of several hours, CLS Bank receives

[11] The Allsopp Report (1996), p 27.

[12] Financial Stability Oversight Council (2012, p 157).

[13] In total, the FSOC designated eight SIFMUs including the Clearing House Payments Company (CHIPS) and the Depositary Trust Company (DTC).

[14] The main text offers a stylised description of a CLS transaction, which is not intended to capture the complexity of all possible outcomes. For instance, of transactions submitted to the CLS, only those that are matched and not rescinded will be settled. CLS Bank generally processes transaction details within seconds or minutes of the trade. In addition, the CLS system multilaterally nets all positions and it is the netted amount on matched trades for which CLS requests payment from each settlement member in each currency on the value date.

currency A from one counterparty and waits for the receipt of currency B from the second counterparty. Once both legs of the trade have been received and CLS has verified that all details match, CLS releases the funds and pays out to both counterparties. Once settlement has been concluded, it is irrevocable. If counterparty B cannot deliver due to failure, CLS suspends the member and returns the full amount of principal to counterparty A and avoids settlement risk (or what the Allsopp Report labelled a "guaranteed refund system"). The transaction between A and B is left to settle in some other manner.

At its launch in 2002, CLS Bank settled transactions for seven currencies on behalf of 39 settlement members. At present, there are 17 CLS-eligible currencies including nine of the top 10 currencies by volume from the 2013 Triennial Survey, as well as other currencies with smaller turnover (see Table 3.1). Collectively, these 17 currencies accounted for 93.7% of global turnover in the 2013 survey although this overstates the potential reach of CLS because both currencies as well as both counterparties in a trade must be CLS-eligible to utilise CLS. As of June 2014, there are 64 settlement members and more than 11,000 third-party members. And while members have the right to settle eligible transactions through CLS, they are under no obligation to do so.

As shown in Graph 3.1, total CLS trading volume across all eligible currency pairs and products has increased substantially since 2007.[15] The average number of daily transactions hovered in the 300,000–400,000 range in 2007 and expanded to reach 1.25 million per day in the first half of 2013 before declining to about 1 million per day in the first half of 2014. In the interim, the volume of transactions experienced a slight decline associated with the GFC, and also a temporary burst of volume in the first half of 2013 largely as the result of a dramatic jump in JPY trading associated with the change in Japanese monetary policy.[16] Assuming that the jump in JPY trading is a one-time event, CLS trading volume appears to be stable or slightly rising since 2011.

The average value of CLS trades was roughly $3.5 trillion per day in 2007 and then rose to more than $4 trillion per day before dropping to about $2.8 trillion per day in December 2008. This is a far greater decline than observed in the volume of trades per day during the GFC. Since then, the value of trades has gradually drifted upwards to a little over $5 trillion per day in the first half of 2014. We do not observe as pronounced a rise in the value of trading in the first half of 2013 compared with the spike in transaction volume.

It is critical to note that CLS processes both sides of a trade and includes both sides in its trading value calculation. Therefore to make CLS value data consistent with BIS survey turnover data, we divide the CLS settlement values by two. To begin to illustrate the importance of CLS to the FX market, consider the Triennial Survey estimate for the global value of daily FX trading in April 2013, which was $5.3 trillion. CLS reported $5.0 trillion as their average daily value settled in April 2013. Dividing the CLS figure by two, in gross terms, CLS would appear to settle around $2.5/$5.3 = 47.2% of global FX trading. Later in this section, we will provide

[15] The data represent matched trades rather than settled trades.

[16] The daily volume of USDJPY transactions processed by the CLS Bank jumped from about 100,000 in the last half of 2012 to over 300,000 in the summer of 2013. Data here represent three-month rolling averages, and input volumes, not matched trades.

additional detail to explore why the resulting implied share of global FX trading that remains subject to settlement risk (100%–47.2%, or 52.8%) is an overestimate.

Despite the considerable progress made by CLS Bank, as well as other institutional measures to reduce FX settlement risks, in 2013 the Basel Committee on Banking Supervision (BCBS) concluded that "substantial FX settlement-related risks remain due to the rapid growth in FX trading activities."[17] Adding that many banks are prone to underestimate these risks and that their impact can be outsized during periods of market stress, the report called for continued efforts to reduce or manage FX settlement risk. "In particular, the efforts should concentrate on increasing the scope of currencies, products and counterparties that are eligible for settlement through PVP arrangements."[18] This leads us to examine how much FX settlement risk may remain with special reference to the Asia-Pacific region.

3.d Trading, CLS and PVP in Asia-Pacific (estimates of risk mitigation)

In this section, we offer estimates on the availability and utilisation of CLS and other PVP settlement systems in Asia-Pacific. One way to benchmark the CLS footprint in the Asia-Pacific region is based on the turnover data in the 2013 BIS survey. In Table 3.2, the data indicate that 13 Asia-Pacific countries account for slightly over 21% of all global FX turnover whether we measure in terms of trading location or the currencies traded. By several measures, Asia-Pacific countries appear to be well represented in the CLS community. In terms of the governance of CLS, of the 76 shareholders of CLS Group Holdings, 15 are from the Asia-Pacific region. CLS shareholders are headquartered in 23 countries including five in the Asia-Pacific region. In term of settlement, there are six Asia-Pacific currencies among the 17 CLS-enabled currencies. There are 64 settlement members including 18 from Asia-Pacific. And finally, CLS settlement services extend to a large number of third-party members including more than 770 from the Asia-Pacific region or about 6.7% of the total. By comparison, three countries (the United States, United Kingdom and Luxembourg) tally more than 7,000 third-party members. These countries are home to many investment management companies who may elect to establish third-party membership for individual funds, each of which may stand as separate legal entities. Apart from third-party membership, in a general sense, the data suggest that Asia-Pacific countries have a presence in CLS on a scale that reflects their activity in the global FX market.

In addition, various Asia-Pacific countries have developed PVP systems, or alternative risk mitigation measures to address delivery risk in their home currencies that are not presently CLS-enabled. The Philippines uses a real-time gross settlements (RTGS) system with PVP for Philippine peso vs US dollar trades. In 2006, Malaysia instituted the first cross-border PVP link in the region with the Hong Kong Monetary Authority (HKMA) for settling ringgit-US dollar trades. In 2010, Indonesia established a similar arrangement with the HKMA for settling rupiah-US dollar trades. The Bank of Thailand is exploring a link with the HKMA to enable settlement

[17] Basel Committee on Banking Supervision, "Supervisory guidance for managing risks associated with the settlement of foreign exchange transactions", February 2013.

[18] BCBS (2013, p 3).

of baht-US dollar trades.[19] Notably, once an HKMA link is established, settling trades against the EUR, HKD, and CNY would become feasible. And even though India presently does not have a PVP system or a link to one in place, the Reserve Bank of India relies on a detailed system of margin, lines of credit and penalties in the event of a shortfall to reduce settlement risk in rupee-US dollar trades.[20]

To examine the potential use of CLS and PVP more closely, we obtained disaggregated turnover data from the 2013 BIS Survey for a 40 x 40 currency matrix including all 17 CLS-enabled currencies and 23 other currencies. A diagram of the matrix is shown in Graph 3.2. Currency combinations with positive turnover data are indicated by the numeral "1." Rows and columns are arranged to list the non-Asia-Pacific currencies first (11 CLS-enabled currencies followed by 16 others) and the Asia-Pacific currencies next (six CLS-enabled followed by seven others). Only the currency pairs in regions X1, X3 and X8 are CLS-eligible. Other currency pairs (USD/INR, USD/MYR and USD/PHP) that offer PVP settlement are marked separately. Out of a maximum of 780 unique cross-rates in the matrix, positive turnover data are available for 273 pairs ranging from $1.288 trillion per day for the EUR-USD pair to very small turnover numbers for the more obscure pairs. The disaggregated data allow us to develop more refined estimates of the share of trading that may benefit from risk mitigation through PVP settlement in different segments of the FX market. Tables 3.3 and 3.4 show a sample of these results.

On a global level, turnover among all pairs of the 17 CLS currencies measures 90.46% of global turnover. This estimate is slightly smaller than the 93.7% estimate given earlier based on the sum of trading in all 17 CLS currencies, because it excludes trades involving one non-CLS currency that cannot be settled through CLS Bank. The data show that slightly greater turnover, 92.93%, is CLS-eligible among 11 Asia-Pacific currencies than among the 27 non-Asia-Pacific currencies where the share is 90.93%. One reason for this difference is the vehicle currency role played by the USD against many non-CLS currencies and as well as FX turnover between the EUR, GBP, CHF and others against many non-CLS currencies.

Because of greater time-zone differences, Herstatt risk can be greater between Asia-Pacific currencies and currencies in Europe and North America. Therefore, turnover in these pairs may hold special interest. The BIS data suggest that, for trades between Asia-Pacific currencies and all others, a somewhat smaller share of turnover (89.79%) is in CLS currencies compared with 90.43% for trades between non-Asia-Pacific currencies and all others.[21] However, taking into account that IDR, MYR and PHP trades against the USD can make use of separate PVP arrangements, Asia-Pacific currencies appear to have a larger share of turnover (92.56%) where risk mitigation is available compared with the share (91.59%) for non-Asia-Pacific currencies.

[19] "Payment Systems Report", Bank of Thailand, 2012, p 25. The link became operational on 28 July 2014.

[20] See Committee on Payment and Settlement Systems (2011, p 181). In addition, the Clearing Corporation of India Limited (CCIL) is a third-party member of CLS that offers settlement services in CLS-enabled currencies to participating banks (fourth parties) as a settlement aggregator. Ibid at p 183.

[21] The share is 89.70% for Asia-Pacific currencies versus only non-Asia-Pacific, or X3/(X3+X4+X6+X7) in Graph 3.2.

Overall the BIS data confirm that a large share of global FX turnover flows through currency pairs that are eligible for risk mitigation through CLS or other PVP arrangements. The data also suggest that the share eligible for risk mitigation is slightly larger for trades among Asia-Pacific currency pairs, or pairs involving an Asia-Pacific currency compared with the analogous figures for non-Asia-Pacific currencies. Trades in IDR, MYR and PHP versus the USD account for more than 28% of turnover for non-CLS currencies in Asia-Pacific versus currencies in later time zones. Thus, the separate PVP arrangements by the central banks of Indonesia, Malaysia and the Philippines could, if widely used, play an important role in supplementing the risk mitigation services offered by CLS Bank.

3.e Risks that remain despite CLS and other PVP settlement systems

The figures in Table 3.3 are estimates of the upper bound on the percentage of FX turnover that *could be settled* through CLS or other PVP settlement systems. However, it is difficult to make the linkage between these estimates and (a) the share of turnover that actually utilises risk-mitigating settlement, and (b) the share of turnover that remains subject to settlement risk. Simply because trades *could be settled* using a risk-mitigating system does not mean that counterparties *can* or *will* take the option to use it. And, perhaps surprisingly, even if a trade does not use CLS or another PVP system, the trade may not be subject to settlement risk.

The first part of this explanation is apparent. Only counterparties who are settlement members or third-party members can exercise the option to settle through CLS Bank.[22] However, not utilising CLS need not imply that a trade is subject to settlement risk. Consider a EURUSD trade between Bank A and Company B. If B maintains its EUR and USD accounts within Bank A, there is no need for the bank to transmit funds from one bank to another (so called "on-us" settlement). Alternatively, consider a USDJPY forward contract between Bank A and Hedge Fund C. The bank could be aware that the hedge fund intends to cash settle the forward contract and *not* take delivery. And so there is no need for PVP settlement, and also no settlement risk.[23] In the same fashion, trades between two non-CLS-eligible currencies would not be subject to settlement risk if they were settled internally within a single bank, or subject to cash settlement rather than delivery.

In 2013, CLS Bank started its own survey to assess more accurately the share of FX turnover that members route through CLS and the extent to which other settlement methods are utilised.[24] While a final version of the survey has not been released, it appears based on a preliminary draft of the report that close to 55% of trading activity in CLS-eligible currencies flows through CLS.[25] Most of the remainder benefits from risk mitigation through on-us settlement or bilateral

[22] The central banks in Indonesia, Malaysia and the Philippines have their own systems for vetting access to their PVP systems.

[23] Credit risk between the counterparties still remains. In the forward contract example, the counterparty could elect to cash settle regardless of whether the contract serves a speculative or hedging purpose.

[24] See Clark, "CLS Expansion will be key to EM currency growth", *FX Week*, 19 July 2013.

[25] We thank Dino Kos and Rachael Hoey of CLS for allowing us to review a preliminary version of the report.

netting, leaving a little over 10% subject to gross non-PVP settlement.[26] In this case, 10% of roughly $4.5 trillion, or $450 billion, in daily trading leaves a large potential exposure. For non-CLS currencies, clearly none settle through CLS but, as we have seen, a small amount settles through other PVP systems, much more settles on-us, and close to half benefits from bilateral netting. But this still leaves more than one third of non-CLS currencies to settle through a gross non-PVP process. In this case, one third of roughly $500 billion, or $167 billion, in daily trading involving non-CLS currencies also represents a substantial potential exposure.

Combining these two figures we arrive at $617 billion as a rough estimate of daily FX turnover subject to settlement risk through a non-PVP process. This estimate excludes daily turnover in currency swaps and FX options, estimated at $390 billion in 2013, that are not CLS-eligible products.[27] In total, perhaps as much as $1,000 billion in daily FX turnover may be settled at present without the benefit of some type of risk mitigation.

Looking into where settlement risk remains, among the non-CLS currencies, our own analysis based on Graph 3.2 reveals that among currency pairs with an Asia-Pacific component the USD/CNY rate shows the highest turnover at $112.68 billion/day. And for non-Asia-Pacific pairs, the USD/RUB is the largest at almost $79 billion/day. Early in 2014, press reports predicted that the rouble was likely to become CLS-eligible by year-end.[28] And in 2012, China indicated that it was in the process of developing an advanced payment system that would support PVP of the renminbi against foreign currencies.[29] In a recent interview, David Puth, the Chief Executive Officer of CLS, was quoted as saying that discussions with the jurisdictions of number of other currencies were "well under way".[30] So indications are that additional currencies are under active consideration for the CLS system.[31]

Despite the progress to date and the likely progress ahead, it is important to keep in mind a succinct comparison offered by the Allsopp Report in 1996. The CLS Bank has been engineered to offer a "guaranteed refund system" rather than a "guaranteed receipt system". Thus, in the event that a CLS third-party member fails (eg Lehman Brothers), the trade may be rescinded in advance (leaving the counterparty to make other settlement arrangements). Or, if the trade is not

[26] Presumably some portion of this activity is forward contracts that cash settle. While the initial setup costs for CLS membership could deter some new members, the marginal cost of using CLS is very small. (Banks averse to the initial costs of CLS membership also have the option to become third-party members). In its interim financial report for the six months ending 30 June 2013, CLS reported revenues of £86.8 million. With more than 1.25 million matched trades per day, revenue to CLS is less than $1.00 per trade.

[27] Currency swaps and non-exchange-traded FX options will be subject to risk mitigation through CCP arrangements as required by the Dodd-Frank Act. Those regulations are in the process of being drafted.

[28] See E Szalay, "CLS set to add Russian ruble in November, source says", *FX Week*, 12 February 2014. This has since been deferred.

[29] See Committee on Payment and Settlement Systems, "Payment, clearing and settlement systems in China", 2012, p 44.

[30] See K Alys, "Spotlight on: David Puth, CLS", *FX Week*, 22 October 2012. Brazil, Chile, Thailand, Russia and China were mentioned in the article.

[31] In its "Report on Payment Systems, 2013", the central bank of Hungary discusses a letter of intent to join CLS, and includes estimates of the FX settlement risk exposure in Hungarian banks.

rescinded in time, the settlement member responsible for the third party will be left to meet their CLS obligations. A guaranteed receipt system, such as a regulated futures exchange, would have detailed margin requirements and function like a CCP, which is not the case for CLS Bank.

Finally, as the Allsopp Report also anticipated, a multicurrency settlement mechanism (such as CLS) might also create a new source of systemic risk despite its risk-reducing potential. As the Report phrased it: "a disruption in the settlement of one currency could disrupt the settlement of all other linked currencies. … The possibility of not receiving the currencies they purchased on time could lead participants in guaranteed refund systems to hold back their payments at times of market stress, thereby increasing the total number of failed settlements" (p 25). In naming the CLS Bank as a systemically important financial market utility, the FSOC built on many of the same points. Their report (2012, p 157) noted in part that the "…CLS Bank's expansion will reduce overall risk but also concentrate the risk associated with a potential disruption to or failure of CLS Bank."

4. FX market behaviour during periods of high volatility

Institutional safeguards are likely to be most important during times of rising and high volatility in markets. In the following we briefly review the movement of exchange rates and metrics of FX market liquidity in Asia-Pacific over the past 10–15 years, paying particular attention to market characteristics during periods of high volatility, most notably the global financial crisis of 2008–09 and the "taper tantrum" of 2013. The latter episode of volatility occurred after the Federal Reserve indicated its intention to begin "tapering" the degree of quantitative easing, conditional on economic stabilisation proceeding as expected. We also present some event study analysis to assess the impacts of the tapering announcements in 2013.

4.a Literature on FX market impacts of the GFC and "taper tantrum"

A characteristic of the global financial crisis was the substantial appreciation of the US dollar when the crisis deepened, even in response to negative US-specific macroeconomic shocks which in normal circumstances would have led to US dollar depreciation (Fratzcher (2009)). Not surprisingly, fundamentals played a role in determining which countries' currencies depreciated the most in response to financial stability shocks. In particular, those countries with large current account deficits and fewer FX reserves experienced significantly larger depreciations against the US dollar. However, exposure to the risk appetite of US investors was another important factor. The currencies of countries in which US investors held relatively large portfolio investments consistently depreciated more. Clearly, financial openness and integration increased the vulnerability of countries to external shocks.

Another striking feature in FX markets during the global financial crisis was large and persistent deviations in major markets from covered interest rate parity in major currency pairs. Baba and Packer (2009b) documented that, both in the GFC's early stages in 2007 and even more so in 2008–09, covered interest rate parity did not hold across many currencies pairs. For the most part, these deviations reflected

a shortage of US dollar funding in global markets during the crisis (McGuire and von Peter (2009)).

Another period of volatility in FX markets followed heightened expectations of changes to US monetary policy in 2013 and early 2014. In particular, big depreciations in a large number of emerging market currencies were associated with tapering announcements by Federal Reserve Chair Ben Bernanke (Aizenman et al (2014)). The impact of the tapering news differed according to country fundamentals, but in a manner different from that noted for the GFC: ie the currencies of countries with current account surpluses, high international reserves and low debt burdens depreciated *more* than other currencies. The authors interpret this result as consistent with fragile economies having built up less exposure to financial flows, or "hot money" during earlier periods of relatively high rates in EMEs (and quantitative easing by the Federal Reserve). That said, while the immediate response at the daily frequency was most evident in the exchange rates of more robust economies, by the end of 2013, the currencies of fragile economies had experienced the most depreciation, as markets eventually reflected the adverse global implications of higher rates.

Other studies focusing on the exchange rate depreciation over the entire summer of 2013 also point towards a correlation of local currency depreciation and financial fragility. Eichengreen and Gupta (2013) show a positive relation of depreciation with deterioration of the current account and appreciation of real exchange rates during the earlier three years. The authors also document that the currencies of countries with larger financial markets depreciated more between April and September 2013, indicative that "large markets are more prone to the effects of liquidity retrenchment." On the other hand, more conventional measures of vulnerability such as public debt and budget deficits had little relation to the degree of currency depreciation during the taper tantrum.

4.b FX rate movements

In the following section, we review the bilateral exchange rates of the 12 Asia-Pacific currencies examined in Part 2 versus the US dollar. In the left-hand panels of Annex Graph 1, dramatic depreciation versus the US dollar is observed across a large cross-section of currencies during the peak of the financial crisis in 2008, the most for the Australian and New Zealand dollar at 60%, and 25–50% for the Indian rupee, the Indonesian rupiah, the Korean won and the Philippine peso. Somewhat more modest depreciations were observed for the Malaysian ringgit, the Thai baht, and Singapore dollar. As the Chinese renminbi does not float freely against the US dollar, it was rather unaffected during the crisis. Moves in the Hong Kong dollar, which runs a currency board, were also miniscule by comparison. The Japanese yen, often a safe haven currency, depreciated 10% in early 2008, but otherwise tended to appreciate against the dollar over the period.

By contrast, the depreciation pressure during the 2013 episode of turbulence was much more limited for most Asia-Pacific currencies (Annex Graph 1, right-hand panels). For India and Indonesia, there was indeed depreciation of their currencies on the scale that had been seen during the GFC, by around 20–30% for the two currencies from the high to the lows of 2013. But for the bulk of currencies, including those of Australia, Korea, Malaysia, New Zealand, the Philippines and Thailand, depreciation was much less, and in regimes which allow much less degree

of currency flexibility versus the dollar, such as China and Hong Kong, significant impacts were not detected.

Table 4.1 reports FX rate changes and presents formal tests of significance with regard to the announcement effects of three major Federal Reserve announcements, suggestive either of future tapering or confirming the tapering of its asset purchase programme, on 22 May, 19 June and 18 December 2013.[32] Indeed, all 12 of the currencies depreciated against the dollar on a net basis on the day after the tapering announcements (nine significantly so in a statistical sense), with nine of the 12 currencies having depreciated on each of the three days.

Interestingly, many high-turnover currencies, as measured by the triennial survey, depreciated the most sharply, with statistically significant depreciations ranging in aggregate on tapering announcement dates from lows of 0.03% and 0.24% (the HKD and RMB) to highs of 4.3%, 3.4% and 3.3% for the NZD, KRW and AUD, respectively. Currencies of seven out of 12 jurisdictions experienced a greater than 2.3% depreciation versus the US dollar on aggregate over those three days. The Indonesian rupee and Indian rupiah, which had by far the largest depreciation during the seven months covering the three announcements (May 22–December 18), had rather small reactions (– 1.9% and –0.6%) in total – for the three days after the actual key announcements themselves.

4.c Measures of FX market liquidity

Bid-ask spreads. The relative bid-ask spread is a common measure used to assess liquidity in FX markets (Karnaukh et al (2014)). Here we use daily bid and ask and mid-quote prices from Datastream Thomson Reuters. With similar data, Rime and Schrimpf (2013) document a decline in average bid-ask spread for currencies of emerging market economies and, at least by this metric, convergence in liquidity conditions of EM currencies to those of advanced countries.

Indeed, for many of the EM currencies in Asia-Pacific that we are examining, average bid spreads show a trend decline in reported relative bid-ask spreads over the past 15 years (with the exception of the Malaysian ringgit, where the data are available only from 2004 and started at relatively low levels) (Annex Graph 2, left-hand panels). Reported spreads for the advanced economy currencies of the Japanese yen, Australian and New Zealand dollars showed some decline between in the early 2000s, but have been mostly stable since 2004. Around the global financial crisis, it was principally the Indonesian rupiah that shows a rise in reported spreads that was notable over the 15 year time frame (to nearly 2%, although it should be acknowledged that similarly large rises were apparent in 2004 and 2006 as well.)

Rises in bid-ask spreads over the later period of market turbulence in 2013 were principally in Indonesia and Philippines (Annex Graph 2, right-hand panels).

[32] Nearly all of the daily series are all taken at the Asia close (NDF series were taken from the London close), while the FOMC announcements or subsequent press conferences all happened in the US afternoon, or after the Asia (or European) close. Therefore, information from the Federal Reserve announcements on day t should be captured in the difference between the date t+1 and t rates. Estimates were roughly similar (though less precise) when the difference between day t+2 and day t was considered. Higher-frequency data, which would allow one to abstract from other information that may have been released in the one-day window, were not available to us in this study.

For the rupiah, spreads rose by a factor of nearly four, from 10 basis points to around 40 basis points, while Philippine peso spreads saw a smaller increase of roughly three times to 10 basis points over the later period. Event study evidence does not suggest an outside reaction of spreads after the specific tapering announcements, however, in either of these or the other currencies under investigation (Table 4.2).

Implied volatilities. Implied volatilities, which capture the cost of insurance against sharp moves in exchange rates, rose quite dramatically during the GFC in 2008 for all of the currencies examined (Annex Graph 3, left-hand panels). Implied volatilities also rose during the 2013 period, particularly in the second and third quarters, but not to the peaks of the GFC (Annex Graph 3, right-hand panels). Event study evidence indicates that implied volatilities rose significantly after at least one of the tapering announcements in nine out of the 12 currencies (Table 4.3). In contrast to the depreciation of exchange rates, in which a number of the sharpest moves were concentrated in the advanced economy currencies with high turnover (AUD, NZD), the most pronounced rises in implied volatility tended to be currencies of emerging Asia, in particular the Indonesian rupiah and Philippine peso (3.1% and 2.9%, respectively). However, currencies in regimes which allow less flexibility versus the dollar – the Chinese renminbi and Hong Kong dollar – did not have a significant rises in implied volatility.

Realised volatilities. Realised volatilities have been found to correlate well with other metrics of liquidity, and have the advantage of being available over longer time periods and for more currencies (Karnaukh et al (2014)). Annex Graph 4 (left-hand panels) reports time series for the monthly averages of the absolute value of daily changes to interest. The volatility of most currencies against the dollar hit their peak during the GFC but, by this measure, the Indian rupee clearly suffered its most illiquid period during the 2013–14 bout of market turbulence, with realised volatilities rising well above the 2008–09 period. The Philippine peso, Thai baht and Singapore dollar's realised volatilities also rose considerably in 2013, particularly in the second and third quarters (Annex Graph 4, right-hand panels).

Deviations from covered interest parity. It has been well established in a number of papers (eg Baba and Packer (2009a, 2009b)) that covered interest parity did not hold in a number of markets around the time of the financial crisis in 2008–09. In fact, reflecting well known US dollar shortages, the Federal Reserve arranged swap lines with numerous other central banks to counteract dollar shortages, and deviations subsequently declined as confidence returned. Deviations increased again with the European sovereign crisis, but returned to close to pre-crisis levels for the most part. Some Asia-Pacific currencies also showed deviations from CIP versus the dollar during the crisis (Annex Graph 5), which was attributed more to tight funding conditions than to counterparty risk (Genberg et al (2011)).

However, when we examine the currencies of the Asia that showed significant positive deviations from CIP during the crisis, while there was a statistically significant announcement effect (in aggregate) for one currency (KRW), it was short-lived and very small relative what was observed in 2008–09 (Table 4.4 and Annex Graph 5). The other currencies (JPY, PHP, IDR) that had seen major deviations from CIP during the global financial crisis did not show any such behaviour during the taper tantrum period (Annex Graph 5 and Table 4.4). It would appear that the dollar shortages which characterised the earlier period, when the stability of the entire

global financial system was at stake, were not a factor in the region during the more recent period of volatility.

Forward premium gap. Forward FX rates from onshore markets can at times mislead. In many currency markets, differences between deliverable forward and (offshore) non-deliverable forward (NDF) rates can emerge, reflecting limits to arbitrage, particularly in stressed market conditions (McCauley et al (2014)).

Indeed, the deliverable forward-NDF premia widened sharply for a number of Asia-Pacific currencies during the global financial crisis, when the offshore NDF rate depreciated by more than the onshore forward rate (represented by negative differentials for five currencies, shown in Annex Graph 6, left-hand panels). Though not by as much, the differentials also widened for certain currencies at points during the May–December 2013 taper tantrum period (Annex Graph 6, right-hand panels). Particularly affected were differentials in the Indonesian rupiah and Philippine peso, falling below –4% and –1% at their troughs, respectively, with statistically significant falls in the differential evident around the key announcement dates of the taper tantrum (Table 4.5). The forward premia of the Indian rupee also fell below –1% during the taper tantrum period (though not in response to announcements), but large offshore-onshore differentials were not as evident for the Chinese renminbi and Korean won. The coincidence of (forward) currency depreciation in the NDF market with a widening of negative premium is consistent with the stylised fact found in other studies that the offshore NDF market tends to lead the deliverable market in times of market stress.

It is also worthy of note that daily turnover – for which data are available for the Indonesia rupiah, Indian rupee and Philippine peso during 2013 – increased sharply in the days after each of the three tapering announcements in the case of the Indonesia rupiah and Philippine peso. Excepting China, these are the two currencies among the group in Table 4.5 that have the largest ratio of trading taking place offshore; these are also the currencies where the offshore-onshore forward differentials responded the most to the tapering announcements. An increase in volume at times of market turbulence is consistent with both turnover and prices reacting to the arrival of new public information, as suggested in the findings of Galati (2000).

4.d Market indices

In the following section, we focus on a particular FX trade that is common both among FX investors in the Asia-Pacific, and in currencies of Asia-Pacific jurisdictions: namely, the carry trade. The evidence shows that carry trade investors earned abnormal losses during the days after the announcements of the Federal Reserve's intention to taper asset purchases. Specifically, broad carry trade indices based on G10 currencies and those based on EME currencies on net lost 2.3% and 1.6%, respectively, in the days immediately following the three major taper announcements mentioned earlier, often as much as or more than the individual vulnerable currencies themselves. We shall proceed to examine the stability features of the carry trade for FX markets in the Asia-Pacific.

5. Carry trades in the Asia-Pacific Region and crowdedness

Carry trades have attracted the attention of investment professionals, researchers and government policymakers throughout most of the modern floating exchange rate period. Carry trades in the FX market take long positions in one or more high-yielding (target) currencies financed by short positions in one or more low-yielding (funding) currencies. The strategy is profitable when the target currency does not depreciate by more than the interest differential. Indeed, it is not uncommon for the target currency to appreciate, thereby producing an exchange rate gain for the investor in addition to the yield differential. There is strong evidence that currency carry trades have been profitable for the last 20 years or more.[33] Nevertheless, questions remain as to whether carry trade profits when calculated are largely offset by trading costs, or whether they are simply a reasonable compensation for attendant risks, or instead represent real economic profits in excess of associated risks.[34]

The carry trade is of special interest for the Asia-Pacific region for several reasons. First, for most of the last 20 years, the region has been home to one traditional funding currency (JPY) and several traditional target currencies (AUD, NZD, INR and other EM currencies). Thus, the region may be prone to the macroeconomic and financial market side effects traditionally associated with the building-up and unwinding of carry trade strategies (eg see Cucuru, Vega and Hoek (2010)). Second, at least two rapid unwinds of carry trades have involved Asia-Pacific currencies. In 1998, the JPY (even at that time an important funding currency), depreciated to nearly 146 USDJPY in August but ended the year around 114. Included in that move was a 14% appreciation over the space of two days, October 6–8, the yen's largest two-day move since the beginning of the float in February 1973. In a similar vein, but over a longer time horizon, from 2000 until the summer of 2008, the JPY (still a funding currency) depreciated against the AUD from roughly 60 AUDJPY to over 107 AUDJPY producing substantial gains for carry traders who were long the AUD. However, after the Lehman Brothers bankruptcy in September 2008, carry traders unwound their positions quickly. The AUD dropped below 60 AUDJPY by late October 2008, resulting in losses for carry traders unable to close out their positions fast enough.

Recently some analysts have pointed to the performance of the CNY carry trade against the USD as a funding currency, which has raised concerns in some quarters that another large unwind could be looming.[35] As noted in the previous section, the prospects of earlier or faster than expected Fed tapering contributed to greater volatility in many FX markets; this is in turn may have resulted in a faster and more

[33] See, for example, Gyntelberg and Schrimpf (2011).

[34] Burnside et al (2006) argue that market frictions such as bid-ask spreads and price pressure that are an increasing function of order size are sufficient to greatly reduce the profitability of carry trades and push the marginal Sharpe ratio toward zero. Research by Burnside et al (2010), Brunnermeier, Nagel and Pedersen (2009) and others supports the view that carry trade profits reflect a peso problem or crash risk premium. Mancini, Ranaldo and Wrampelmeyer (2013) find evidence of systematic variation in FX market liquidity that could contribute to carry trade returns. Bilson (1981) produced the first rigorous, out-of-sample test of a carry trading strategy and concluded that the performance was too good to be consistent with credible risk premiums.

[35] See B Hafeez (2013).

damaging unwind of carry positions. Risk can be compounded because carry positions are easily levered and the overall size of aggregate positions is difficult to judge beforehand. Beyond the risks that fall on private investors, Curcuru, Vega and Hoek (2010) point out that risks associated with excessive exchange rate and asset price volatility as well as increased stress on the banking system stemming from loan defaults impact the broader economy, which makes the carry trade a concern for financial regulators and policymakers.

5.a Carry trade returns and risks

By construction, a carry trade targets investment in a high-interest rate currency financed by borrowing in a low-interest rate currency. When the high interest rate reflects a scarcity of capital and high real rate of return and the low interest rate reflects an abundance of capital and low real rate of return, carry trades serve a useful economic purpose in helping to equilibrate rates of return and promote a more efficient allocation of capital. On the other hand, when only a nominal interest rate difference is observed, uncovered interest parity (UIP) implies that there is no incentive for capital flows because depreciation of the high-interest rate currency will fully offset the interest differential. In practice, most analysts base carry trade signals on the nominal interest rate differential, and the change in this as well as the exchange rate will determine the profitability of the carry trade in the investor's base currency.

Graph 5.1 illustrates the cumulative return on a simple carry trade strategy with equally weighted long positions in the three highest-yielding G-10 currencies financed by equally weighted short positions in three lowest-yielding G10 currencies and held over the 1989–2013 period. Over the 24-year sample period, this stylised strategy would have produced an average annual excess return (above the risk-free rate) of 5.9% with annualised volatility of 9.3% which implies a Sharpe ratio exceeding 0.6.[36] Graph 5.2 shows the cumulative return for an analogous carry trading strategy for a portfolio of EM currencies over a shorter sample period, 2001–13. Rosenberg (2014) notes that the sample period does not cover an earlier period when periodic currency crises hit EM countries, but that it could fairly represent a period when global investors took greater awareness of EM carry trades. Over the 13-year sample period, this EM carry trade strategy would have produced an average annual excess return of 10.7% with annualised volatility of 11.4%, which implies a Sharpe ratio of 1.1. The results are striking but Rosenberg (2014) cautions that insufficient liquidity in various EM currencies as well as capital flow restrictions and regulations might have limited investor's ability to undertake these trades in sizeable amounts.

Both Graphs 5.1 and 5.2 illustrate a pattern of cumulative returns that generally moves upwards over time, but is punctuated occasionally by short periods of large losses.[37] Following Brunnermeier, Nagel and Pedersen (2009), it can be useful to briefly sketch the macroeconomic setting that enables this pattern of returns to

[36] For comparison, the Sharpe ratio for a buy-and-hold strategy on the S&P 500 stock index has averaged about 0.3.

[37] The imagery sometimes used is that carry trades are like "picking up nickels in front of a steam roller", or that carry trades "go up by the stairs, and down by the elevator."

develop. To begin, once an interest differential is observed, investors will not react immediately. Contrary to UIP theory, carry trade investors are exposed to a variety of risks, such as exchange rate risk and liquidity risk. Given risk aversion, these factors are likely to retard the rate at which investors pursue carry trades and the ultimate size of their positions. Over time, as carry trade profits are realised, other investors may be attracted and early investors may have had both the inclination and time to arrange financing to leverage their positions. Even if policymakers observe carry trade positions mounting, they may be reluctant to adjust interest rates (presumably set to meet domestic economic objectives) that would reduce the carry or affect exchange rate expectations. And so the cycle of carry favouring the target currency and greater investor confidence continues. At some point, a shock occurs – possibly a change in the expected path of interest rates, or of exchange rates, or in investor access to credit needed to roll over their positions – that leads some investors to begin unwinding their positions. Depending on the nature of the shock, the more apparent the shock is and the greater its impact on more investors, the more likely it is that many investors will attempt to unwind more of their positions at the same time, thus precipitating a rush for the exits, a large drop in the exchange rate, and sudden large losses for carry trade investors.

The Australian dollar-Japanese yen experience from 2002–08 provides a textbook illustration of both the time pattern of carry trade returns and their distribution. As shown in Graph 5.3a, the three-month nominal interest rate differential between AUD and JPY hovered around 5% at the start of this period before moving higher. Even on a risk-adjusted basis (see Graph 5.3b), carry returns were significant and also trended upward over the period. Risk reversal prices, representing the price of out-of-the-money calls on JPY versus similar calls on AUD, were positive, indicating that market expectations favoured a yen appreciation. Nevertheless, the AUD appreciated gradually over the period until the summer of 2007. The AUDJPY dropped from 103 in mid-July 2008 to about 85 just prior to the Lehman Brothers bankruptcy on September 15. Within six weeks, the rate had fallen below 60 AUDJPY.

5.b Evidence of carry trade activity and warning signs

Related literature. While there is abundant evidence on the historic patterns of carry trade risk and return, there is less agreement on how sizeable and important carry trade activity may be in financial markets, or how to measure it. Galati, Heath and McGuire (2007) examine a number of indicators to gauge the magnitude of carry trade activity. Data on bank positions and cross-border flows in known funding and target currencies are consistent with greater activity in these currencies. However, the authors acknowledge that it is difficult to determine whether these positions are explicitly related to carry trades.

Tracking the net open positions of non-commercial traders in currency futures contracts is another approach in wide use by professional analysts. This approach assumes that commercial traders are predominantly hedgers while non-commercial traders reflect the speculative component of the market. However, while a futures exchange can easily classify traders as commercial or non-commercial, it is possible that some commercial accounts use futures contracts to engage in currency speculation. In addition, the currency futures market is a small share of global FX trading and so an indicator based on futures contracts may not be representative of the overall market. Acknowledging these limitations, Galati, Heath and McGuire

(2007) provide evidence that net long non-commercial open positions in several target currencies tended to build along with risk-adjusted returns on carry, and that funding currencies displayed a complementary net short open position. The authors offer additional supportive evidence, based on turnover data in the broader FX market, that shows a positive correlation between turnover and the carry-to-risk ratio for target currencies.

In a related paper, Curcuru, Vega and Hoek (2010) propose a more direct approach for gauging the importance of carry trades based on exchange-traded funds (ETFs) and exchange-traded notes (ETNs) whose returns are directly linked to carry trade strategies. By itself, the introduction of securities linked to carry trades demonstrates the wider interest in and greater availability of financial products linked to currency carry trades. The authors note that the volume of outstanding shares for one ETF tended to grow along with the carry-to-risk ratio but that, as products intended for retail investors, ETFs and ETNs might not be representative of the larger institutional market. Based on this information, together with data for net open positions of non-commercial traders in currency futures contracts as well as BIS data and US Treasury International Capital (TIC) data on cross-border capital flows, the authors are not able to find "convincing evidence that carry trade strategies were adopted on a widespread and substantial basis" over the period leading up to and just subsequent to the GFC.

In his survey of carry trading, Rosenberg (2014) lends support to this view with the possible explanation that FX managers "appear to place a great deal more emphasis on risk management than on return enhancement, so much so that they appear to prefer leaving money on the table rather than pursuing risky strategies such as FX carry trades that could leave their portfolios exposed to potentially large downside moves." To support this interpretation, Rosenberg observes that an index of FX fund manager performance is weakly correlated to carry returns and that the returns for FX managers on the whole display much less volatility and lack the characteristic left skew of carry trade returns more generally.

Carry returns and style analysis: methodology. Carry-trade investments represent only one of a number of different currency investment strategies. In the following we review a method for examining the prevalence of carry trading strategies which is based upon comparing the pattern of returns for carry with the pattern of returns for professional investors, while taking into account the possibility of alternative investment "styles".

The approach, developed in a series of papers by Pojarliev and Levich (2008, 2010, 2011), relies on a simple factor model that expresses returns on a currency fund as a linear function of a several indices that serve as proxies for currency investment strategies such as carry, trend following/momentum investing, and value. Each of these indices, also known as style factors, represents an investable index that follows a well-specified, dynamic strategy. Analogous to the carry trade which owns high-yielding currencies financed by short positions in low-yielding currencies, the trend strategy owns currencies with a positive trend financed by short positions in currencies with a negative trend, and the value strategy owns the most undervalued currencies financed by short positions in the most overvalued currencies. Pojarliev and Levich use a currency volatility index as a fourth factor to

capture the overall risk level. The model has the form:

$$R_t = \alpha + \sum_i \beta_i F_{i,t} + \varepsilon_t \quad (1)$$

where

R is the excess return generated by the currency manager, defined as the total return (R_t^*) less the periodic risk-free rate ($R_{F,t}$)

α is a measure of active manager skill,

F is a beta factor, that requires a systematic risk premium in the market,

β is a coefficient or factor loading that measures the sensitivity of the manager's returns to the factor, and

ε is a random error term.

Do "global macro" investors pursue carry? While the dependent variable in this analysis is usually the time series of returns of funds or groups of funds that specialise in currency investments, the group that we first consider below are so-called global macro fund managers, many of whom make explicit reference to currency strategies in their stated investment mandates. Global macro funds have the benefit of representing a larger pool of capital, nearly $200 billion or a little over 8% of all assets under management in the hedge fund industry in 2014 according to Hedge Fund Research. On the other hand, global macro funds pursue a variety of strategies that are not entirely pure currency plays, and so their connection to carry and other currency strategies may be more likely to fluctuate over time.

To explore the possible reliance on currency carry trades by global macro funds, we regress the returns on the HFRI Macro Total Index against the DB Carry Index using monthly data over the period January 2000–August 2014. We estimate a set of rolling regressions based on 12, 18 and 24 months and estimate both univariate and multivariate regressions that include indices of trend-following and value styles of currency investing as discussed above. For the 18-month window with 151 observation periods, we find that the beta coefficient on carry is significant in roughly one quarter of the periods. When significant, the coefficient on carry ranges from about 0.25 to 0.55, while the R-squared ranges from 0.26 to 0.71. The size of the coefficient and high R-squared suggest that carry can be an important strategy for global macro funds, whose earnings can depend heavily on returns to the strategy. At the same time, the coefficients variability over time also suggests that as a group, a large proportion of managers may enter or exit a strategy at about the same time, enough so to affect the estimate for the Macro Total Index.

Dedicated currency funds. The second group of investors we consider are dedicated currency funds with mandates framed almost exclusively in terms of currency strategies. The dependent variable in the regressions of Table 5.1 is the return on the Barclay Currency Traders Index (BCTI), which represents the return on managed programmes that trade primarily in currency futures and forward markets. We expect carry to be a strategy pursued by a large number of funds that comprise this index. Dedicated currency traders, as a group, however are far smaller in terms of assets under management than the "global macro" fund grouping considered above. In 2014, BarclayHedge estimated that managed currency funds represented just short of $20 billion or about 6% of assets under management in the managed futures industry. This market share is down from 11.4% in 2007 prior to the GFC.

Estimates from Pojarliev and Levich (2008) of the style factor coefficients are shown in the first three rows of Table 5.1, using data over the period 1990–2006. The results strongly implied that the three common currency investment strategies – carry, trend and value – are significant and collectively explain more than 60% of the variation in monthly returns for the BCTI over the period 1990–2006. Positive coefficients on carry and trend indicate that managers on average held positive exposure to those strategies; while the negative coefficient on value suggests that currency manager returns have generally been associated with bets against value and holding long (short) positions in overvalued (undervalued) currencies.

When the sample is divided into pre-2000 versus afterwards (2000–06), the point estimates on the coefficients suggest that managers raised their exposure to carry in the later period and lowered their exposures to trend and value. Recall that the second period is one where the underlying data indicated a very favourable carry-to-risk ratio for the AUD and NZD among others. Additional estimates of the style factor coefficients reported in Pojarliev and Levich (2012) using alternative carry and value indices confirm these results for subperiods extending through 2010.

In the fourth row of Table 5.1, we also present results for the same variables for the more recent period 2011–14, so as to coincide with periods of later regression analysis. The coefficients on carry and trend are statistically significant (carry at the 90% level), but the coefficients are lower, suggesting that exposure to carry and other style factors may not have been as important as during previous periods.

Analysis at the currency fund manager level. The analysis can also be pursued at the currency fund manager level. Pojarliev and Levich (2010) estimate equation (1) for each of 80 professional currency fund managers listed on the DB Select platform. The platform is operated by Deutsche Bank and allows customers to make investments in individual funds and observe prices and return on a daily basis with returns audited and confirmed by an independent third party.[38] This data set permits the estimation of style factor coefficients for individual managers and groups of managers. In addition, because the data set includes observations on managers who delisted from the platform, the authors are able to track the performance of funds that survive until the end of the sample ("live funds") versus those that cease to report ("dead funds").

The results for three synthetic portfolios are displayed in the first three rows of Table 5.2. The first portfolio is a "fund of funds" that invests an equal amount in each manager listed on the platform at time *t*, a second fund including only managers that remain "live" at the end of the sample (26 March 2008) and a third fund that includes only managers that are "dead" by the end of the sample. The first fund of funds is investable while the other two are not, but help us inspect any differences in strategy between funds that ultimately live or die out. These results show that the three style factors are again significant and collectively explain a large proportion, some 53%, of the variation in currency investment returns for the "fund of funds" that includes all managers. Notably, the portfolio of "live" managers has a slightly higher coefficient on carry, an equally large R^2, and a point estimate of excess performance (alpha) that is positive. By comparison, the portfolio of "dead"

[38] This data set is unique in that regard as many hedge fund data sets are built from self-reported data that are unaudited and prone to a variety of biases.

managers held a contrarian position on carry (as indicated by the significant negative coefficient) and did not hold a contrarian position on value in comparison to the "live" managers. These differences were costly as the "dead" managers produced significant negative alpha of 6.4 basis points per week. The decision to bet against carry too early and pursue a strategy less associated with the style factors (suggested by the smaller R^2) most likely contributed to the decision to delist from the platform.[39]

In the final row of Table 5.2, we report the most recent results of an investable fund of funds based on 32 currency fund managers returns listed on the Citi Access platform operated by Citibank (the DB data were not available for this later period). These data cover the period August 2011 through May 2014. In contrast to the BCTI regressions for the later period, all the style factors are highly significant, and together with volatility, explain a large portion (72%) of the variation in currency investment returns for the fund of funds.

Assessing the "crowdedness" of currency investment strategies. The increasing importance of the fund management industry has led a number of economists to focus on how correlation of asset manager choices might increase fluctuations in financial markets (Feroli et al (2014)). The abundance of currency fund managers in the data set discussed above suggests a new approach to measuring herding, or "crowdedness", in currency investment strategies (Pojarliev and Levich (2011)). The key metric is based on the net proportion of currency managers who hold positions that are significantly related to an underlying style factor. Let $a_{F,t}$ be the percentage of funds with significant positive exposure to style *F*, and let $b_{F,t}$ be the percentage of funds with significant negative (or contrarian) exposure to style *F*. Then $C_{F,t} = a_{F,t} - b_{F,t}$ defines the crowdedness measure of style *F* at time *t*.

Market participants have long instinctively appreciated that crowded trades can be both bad for returns (as prices have likely been bid up away from their economic fundamentals level) and especially risky if many investors were to attempt to unwind their positions simultaneously. Pedersen (2009) develops a formal model that demonstrates how crowding in financial markets generates a second endogenous risk from "being trampled by falling prices, margin calls, and vanishing capital" that creates another layer of risk on top of the economic risk of the position. In Pedersen's words, crowding creates "a negative externality that increases the aggregate risk".

In a study covering all funds on the DB Select platform from April 2005 to June 2010, Pojarliev and Levich (2011) find that crowdedness varied considerably over the sample period. For example, carry crowdedness varied from –7% to +32%. Trend crowdedness varied from –3% to +34% and value crowdedness varied from –28% to +12%. Prior high returns on a strategy also can lead to an increase in crowdedness while periods of low or no returns induces funds to close down or migrate to another strategy. Thus, crowding develops both by the entry of new funds and a

[39] It is worth recalling that in mid-1992 George Soros famously made a contrarian carry bet by shorting the high-interest rate Italian lira and British pound and taking a long position in the Deutsche mark. Shortly thereafter authorities previously resisting the depreciation of the lira and the pound allowed their currencies to depreciate against the mark and Soros reportedly made upwards of $1 billion on the trade. A decision to delist from the DB Select platform could be the result of numerous factors and does not imply that the manager or the fund ceased operations.

shift by discretionary fund managers to those strategies that seem to be producing the best returns.

The relation between crowdedness and returns is highlighted for the specific case of the carry trade in Graph 5.4. As the returns on carry advanced through 2006 and into 2007, carry crowdedness, after being near zero in the early part of the sample, moved upward to 28%. Crowdedness retreated along with the performance of carry into early 2008, and both turned negative after the Lehman Brothers bankruptcy in fall 2008. Although carry returns recovered in 2009 and fund managers began to crowd back into carry, carry returns fell and fund managers quickly exited the carry trade after the onset of the European sovereign crisis in 2010.

For this paper we prepared updated crowdedness estimates running through May 2014. As data from the DB Select platform were not available, for the most recent period we relied on the previously mentioned sample of 32 currency fund managers listed on the Citi Access platform operated by Citibank. These data cover the period 31 August 2011 through 28 May 2014 and provide us with 119 rolling 26-week windows to calculate the number of managers with returns significantly related to a carry return index.

Similar to other results, we find that over this period a variable and sometimes large fraction of managers earned returns linked to carry. The proportion of funds following carry (as represented by the DB G10 Carry Index) ranged from 10% to more than 60% as shown in Graph 5.5. Unlike the pattern observed earlier, where carry returns seemed to attract a greater crowd of investors, between Q2 2012 and Q2 2013 the carry index advanced almost 20% but our measure of crowdedness seemed to be unaffected or possibly it declined slightly. And from Q3 2013 to the end of the sample, the carry index was essentially flat, delivering no returns, but carry crowdedness fell from over 60% to 15% in about three months. Given that the crowdedness measure depends on regression estimates over the prior 26 weeks, investment decisions made starting in April 2013 began to influence crowdedness estimates in October. The data are consistent with the possibility that the first announcements of tapering made in May and June 2013 led some currency managers to trim or exit carry trade positions, so that by early 2014 carry crowdedness had become significantly lower. Importantly, this relatively fast exit from carry was not accompanied by a decline in carry performance, suggesting that carry positions, at least during this period, could be liquidated without a large market price impact.

6. Summary and conclusions

In this paper, we have explored the development and functioning of the foreign exchange markets in Asia and the Pacific from a variety of perspectives.

From the perspective of sheer size, at $5.3 trillion per day global FX turnover represents a staggering figure. Global turnover in FX has expanded more than fourfold in the dozen years between 2001 and the latest 2013 BIS Triennial Survey. Turnover for Asia-Pacific currencies has kept pace and in many cases shown a higher rate of growth since 2010 than for currencies from other regions. Offshore trading is another prominent and growing trend, and once again Asia-Pacific

currencies have demonstrated higher offshore growth vis-à-vis both advanced economy and emerging market currencies. While many Asia-Pacific currencies stand out in these trends, the Chinese renminbi is noteworthy for exceptionally high rates of turnover growth. The RMB is now the second most actively traded EM currency (behind the Mexican peso) and the ninth most actively traded currency in the world.

In a parallel trend, non-deliverable forward contracts have become more important both as a vehicle for hedging and speculative purposes, but also as a means of price discovery when the alternative delivered forward contract is constrained. And finally, the rising importance of non-dealer financial institutions points to a growing cadre of counterparties that may pose growing risks for traditional FX market-makers.

With such enormous daily turnover and diverse counterparties, robust operating and risk management systems are essential to safeguard the narrow FX market and the broader financial system. Surprisingly, although FX is a critical element of the global economy, the market is not subject to significant regulatory oversight. Moreover, while the Dodd-Frank Act imposes CCP margin requirements and marking to market on most derivative positions, outright FX forwards and swaps, which together accounted for 55% of global FX turnover in 2013, are exempt from the CCP mandate. This decision hinges on several factors – FX forwards tend to be very short-maturity contracts, while FX swaps require both parties to physically exchange the full amount of currency at fixed terms known at the outset of the contract, and the CLS Bank virtually eliminates settlement risk from FX trading.

The CLS Bank is the most critical FX market innovation over the last 20 years and it has had a profound impact on safeguarding the market and mitigating the risks of trading. While, by some measures, the reach of the CLS Bank may appear limited – only 17 CLS-enabled currencies and fewer than 100 settlement members – the 17 CLS-enabled currencies account for more than 90% of all global FX turnover, and access to CLS extends to more than 10,000 third-party members. Our analysis reveals that Asia-Pacific countries and currencies are well represented in the CLS system, and along with several alternative PVP systems, the region has access to PVP settlement on a par with countries in the rest of the world.

In practice, there are no precise estimates of what fraction of global FX turnover benefits from risk mitigation by using the CLS Bank or alternative PVP settlement systems available in several other Asia-Pacific countries. Preliminary results from a survey by CLS of its members suggest that roughly 55% of global turnover may be settled through CLS. However, much of the remaining turnover may be settled "on us" within a single bank (and not subject to settlement risk) or benefit through bilateral netting, which reduces the amounts at risk relative to the gross turnover figures. Our estimates suggest that possibly $450 billion of daily turnover in CLS currencies and another $167 billion in daily turnover for non-CLS currencies may be subject to gross non-PVP settlement risks. Clearly, the $617 billion of daily FX turnover settled through non-PVP systems represents a substantial risk, and underscores why countries generally and the Asia-Pacific region in particular would benefit by having more currencies become CLS-enabled or tradable under other PVP systems.

The "taper tantrum" announcements in 2013 offer an opportunity to examine how Asia-Pacific currencies have reacted to news that, owing to the continuing central importance of the US economy and US monetary policy, could impact financial markets and economies elsewhere. Our analysis focused on the impact of

tapering announcements on FX rates, on market liquidity (as proxied by bid-ask spreads), on volatility, on deviations from covered interest parity, and on the gap between onshore forward rates and their offshore, NDF counterpart rates. In the case of both exchange rates and implied volatilities, we find that Asia-Pacific currencies responded quickly to tapering announcements, but with some surprising variation. The currencies of countries with larger turnover and better fundamentals tended to react more immediately, while implied volatilities tended to rise more for the other currencies. Over the entire period, depreciation was also more evident for the latter group of currencies. In contrast to the global finance crisis, deviations from covered interest parity were minimal; neither did bid-ask spreads noticeably move. For two of the five currencies for which NDF market data were available, price discovery appears to take place first in the overseas market, leading to significant onshore-NDF premia.

Finally, we examined currency carry trades as a well known investment strategy that at times has seemed to present a disruptive element in cross-border currency flows and an additional source of instability at times of financial stress. The carry trade has been an attractive investment strategy over the last 20–30 years, both in its own right (in terms of a high return compared with its own risk) and also as a strategy to pair with other investment strategies in currency or other asset classes. Most previous studies have found it difficult to estimate how intensely carry strategies are used. An exception is prior research by Pojarliev and Levich (2011), who trace the number of professional currency managers whose returns significantly track the returns on carry and other currency investment strategies. In this paper, we extend that analysis and find that, indeed, many currency managers as well as global macro hedge fund managers have taken positions so that their funds produce returns that track a currency carry index. While, in earlier periods, currency managers seemed prone to herding into carry when it was performing well and then unwinding their positions in near unison when returns turned negative, the recent experience does not show evidence of herding in response to positive carry returns. And there is some evidence to suggest that the tapering announcements led to a comparatively orderly withdrawal from carry, without causing any apparent market disruptions.

The common thread across all of these various perspectives is that the development and functioning of FX markets in the Asia-Pacific region seems to be proceeding at a slightly faster pace than other regions, but that operational safeguards such as access to CLS and PVP settlement as well as other risk-mitigating measures are on a par with those of other regions or perhaps slightly ahead of them. Although we document interesting cross-country differences in the market response to several recent US monetary policy-related announcements of exchange rates and related volatilities, on the whole there were few signs of the illiquidity in markets of the sort that characterised the global financial crisis. Similarly, professional investors have moved into and out of carry, but there is no evidence over the last several years of herding or rapid unwinds that have been observed in previous cycles.

While these developments lend confidence, vulnerability remains present because currencies within the region are a popular vehicle for global carry trades and other investment strategies, and all currencies respond when the jurisdiction of the key global currency (ie the US dollar) considers a change in monetary policy. It is worth keeping in mind that the post-GFC period has witnessed a general decline in currency volatility as well as a general reduction in interest rates worldwide. Should

monetary policies and economic performance begin to diverge more than in the recent past, currency volatility and expected rate movements may return. Continuing to promote risk-mitigating systems such as CLS Bank and alternative PVP arrangements and tracking the crowdedness of certain currency strategies such as the carry trade that are prone to unusual risks would seem to be advisable policy recommendations; they should promote the integrity and resilience of the global FX market and the related markets that depend on it.

Currency distribution of global foreign exchange market turnover, developed markets

Table 2.1

	Net-net basis,[1] percentage share of average daily turnover in April[2]					Growth
	2001	2004	2007	2010	2013	2010–13
US dollar	89.9	88.0	85.6	84.9	87.0	38.0
Euro	37.9	37.4	37.0	39.1	33.4	15.1
Japanese yen	23.5	20.8	17.2	19.0	23.0	63.3
Australian dollar	4.3	6.0	6.6	7.6	8.6	53.2
Swiss franc	6.0	6.0	6.8	6.3	5.2	10.0
Canadian dollar	4.5	4.2	4.3	5.3	4.6	16.3
New Zealand dollar	0.6	1.1	1.9	1.6	2.0	65.6
Other developed markets	18.2	20.9	20.5	17.0	15.8	25.3
Emerging markets	8.6	9.0	12.5	14.8	18.8	71.4
Others	6.5	6.5	7.5	4.6	1.6	…
Total	**200.0**	**200.0**	**200.0**	**200.0**	**200.0**	**34.6**

[1] Adjusted for local and cross-border inter-dealer double-counting (ie "net-net" basis). [2] Because two currencies are involved in each transaction, the sum of the percentage shares of individual currencies totals 200% instead of 100%.

Source: BIS Triennial Central Bank Survey.

Currency distribution of global foreign exchange market turnover, emerging markets

Table 2.2

	Net-net basis,[1] percentage share of average daily turnover in April[2]					Growth
	2001	2004	2007	2010	2013	2013
Mexican peso	0.8	1.1	1.3	1.3	2.5	170.9
Chinese renminbi	0.0	0.1	0.5	0.9	2.2	249.0
Russian rouble	0.3	0.6	0.7	0.9	1.6	138.2
Hong Kong dollar	2.2	1.8	2.7	2.4	1.4	–17.6
Singapore dollar	1.1	0.9	1.2	1.4	1.4	32.5
Turkish lira	0.0	0.1	0.2	0.7	1.3	140.1
Korean won	0.8	1.1	1.2	1.5	1.2	6.5
South African rand	0.9	0.7	0.9	0.7	1.1	107.8
Brazilian real	0.5	0.3	0.4	0.7	1.1	117.4
Indian rupee	0.2	0.3	0.7	1.0	1.0	39.8
Indonesian rupiah	0.0	0.1	0.1	0.2	0.2	50.2
Malaysian ringgit	0.1	0.1	0.1	0.3	0.4	94.6
Thai baht	0.2	0.2	0.2	0.2	0.3	123.4
Philippine peso	0.0	0.0	0.1	0.2	0.1	16.2
Other emerging markets	1.4	1.6	2.2	2.6	2.9	49.6
Others	6.5	6.5	7.5	4.6	1.6	…
Total	**200.0**	**200.0**	**200.0**	**200.0**	**200.0**	**34.6**

[1] Adjusted for local and cross-border inter-dealer double-counting (ie "net-net" basis). [2] Because two currencies are involved in each transaction, the sum of the percentage shares of individual currencies totals 200% instead of 100%.

Source: BIS Triennial Central Bank Survey.

Offshore trading of emerging market currencies, 2013

Daily average in April,[1] share in total – onshore and offshore – OTC FX market turnover Table 2.3

	Offshore turnover	Offshore share in global turnover	Intra-regional share[2]	Share of regional financial centres[3]	UK	US	Euro zone	Other	% change since 2007[4]
	USD bn	In per cent							
Advanced economies	7,607.0	79.2	…	…	45.3	20.6	5.7	…	8.54
Japanese yen	*1,024.1*	*83.2*	…	…	*44.7*	*21.1*	*3.8*	…	*14.9*
Australian dollar	*395.5*	*85.7*	…	…	*42.1*	*19.6*	*5.0*	…	*18.1*
New Zealand dollar	*97.8*	*93.4*	…	…	*36.9*	*24.0*	*3.2*	…	*9.4*
Emerging market currencies	678.7	67.4	12.6	…	29.9	16.4	4.6	3.9	22.9
Emerging Asian currencies	277.2	59.2	26.6	25.3	18.8	5.8	2.6	2.8	19.4
Chinese renminbi	*86.1*	*72.0*	*45.5*	*43.7*	*18.0*	*8.9*	*1.6*	*1.2*	*56.1*
Hong Kong dollar	*40.7*	*52.6*	*10.7*	*8.1*	*22.9*	*15.5*	*5.1*	*5.0*	*1.0*
Singapore dollar	*48.8*	*65.4*	*12.6*	*11.4*	*27.8*	*7.1*	*3.7*	*5.8*	*15.6*
Korean won	*27.4*	*42.7*	*21.2*	*21.1*	*11.3*	*8.5*	*1.5*	*1.6*	*14.2*
Indian rupee	*28.0*	*53.0*	*27.0*	*26.9*	*15.1*	*7.0*	*1.1*	*1.5*	*30.3*
Indonesia rupiah	*6.2*	*68.5*	*40.2*	*31.5*	*17.4*	*4.7*	*2.0*	*1.9*	*23.2*
Malaysian ringgit	*13.8*	*64.6*	*36.4*	*36.3*	*19.8*	*4.9*	*1.6*	*2.0*	*39.6*
Thai baht	*7.7*	*44.8*	*19.7*	*19.2*	*13.4*	*6.6*	*3.6*	*3.2*	*25.9*
Philippine peso	*5.1*	*65.5*	*35.3*	*35.0*	*18.2*	*8.5*	*3.8*	*1.7*	*23.7*

[1] Adjusted for local and cross-border inter-dealer double-counting (ie "net-net" basis). [2] Intraregional is defined as all offshore trades within the respective emerging market region. [3] Hong Kong SAR and Singapore. [4] Annualised change.

Sources: BIS Triennial Central Bank Survey; authors' calculations.

OTC FX market turnover in the Pacific regions – by counterparty

Daily average in April,[1] in billions of US dollars

Table 2.4

	Spot			FX derivatives		
	Reporting dealers	Other FIs	Non-FIs	Reporting dealers	Other FIs	Non-FIs
Emerging market	119.300	64.807	52.691	302.829	169.846	62.813
Emerging Asia	90.476	40.344	33.792	249.668	115.294	44.319
China	5.498	7.747	8.739	8.932	6.790	3.030
Hong Kong SAR	19.217	9.335	6.483	92.211	50.458	10.815
India	6.652	4.198	2.563	8.945	2.562	3.289
Indonesia	0.783	0.525	1.594	0.745	0.427	0.213
Korea	11.645	3.510	2.692	17.703	3.533	2.099
Malaysia	1.866	1.601	0.463	1.955	1.428	1.726
Philippines	0.949	0.133	0.213	1.480	0.294	0.154
Singapore	42.074	12.612	9.514	113.756	48.655	21.280
Thailand	1.793	0.681	1.529	3.941	1.146	1.712
Developed market	556.059	1,117.883	135.417	1091.781	1456.900	214.221
Australia	18.831	12.114	2.914	54.912	31.067	8.151
Japan	54.433	18.439	40.314	87.103	38.925	22.850
New Zealand	0.369	0.607	0.862	3.425	2.446	0.901

[1] Adjusted for local and cross-border inter-dealer double-counting (ie "net-net" basis).

Sources: BIS Triennial Central Bank Survey; authors calculations.

CLS-enabled currencies as of September 2014 and turnover as of April 2013 Table 3.1

	Currency	Turnover(%)[1]	Rank in BIS Triennial Central Bank Survey 2013
1	US dollars	87.0	1
2	Euro	33.4	2
3	Japanese yen	23.0	3
4	Pound sterling	11.8	4
5	Australian dollar	8.6	5
6	Swiss franc	5.2	6
7	Canadian dollar	4.6	7
8	Mexican peso	2.5	8
9	New Zealand dollar	2.0	10
10	Swedish krona	1.8	11
11	Hong Kong dollar	1.4	13
12	Norwegian krone	1.4	14
13	Singapore dollar	1.4	15
14	Korean won	1.2	17
15	South African rand	1.1	18
16	Danish krone	0.8	21
17	Israeli new shekel	0.2	29

[1] Percentage shares of average daily turnover in April 2013.

Source: BIS Triennial Central Bank Survey.

The CLS community in the Asia-Pacific and other countries

Table 3.2

	Asia-Pacific	Other countries	Total
Countries/currencies	6	11	17
	(35.2%)	(64.8%)	(100.0%)
Countries with shareholders	5	18	23
	(21.7%)	(78.3%)	(100.0%)
Shareholders, by country	15	61	76
	(19.7%)	(80.3%)	(100.0%)
Settlement members[1]	18	46	64
	(28.1%)	(71.9%)	(100.0%)
Third-party members, by BIC name	774	10,865	11,639
	(6.7%)	(93.3%)	(100.0%)
Memo:			
BIS Triennial Central Bank Survey 2013			
Number of countries	13	40	53
	(24.5%)	(75.5%)	(100.0%)
FX turnover by country[2] (in trillions of US dollars)	$1,407	$5,264	$6,671
	(21.1%)	(78.9%)	(100.0%)
FX turnover by currency[3] (in trillions of US dollars)	$1,133	$4,212	$5,345
	(21.2%)	(78.8%)	(100.0%)

Note: CLS data are as of June 2014.

[1] Include two user members, one from the Asia-Pacific and one from elsewhere. [2] For 54 countries; net-gross basis. [3] For 53 countries; net-net basis.

Sources: Private correspondence with CLS; CLS bank website; BIS Triennial Central Bank Survey.

Share of FX turnover eligible for CLS and other PVP settlement

Table 3.3

	CLS bank	Other PVP arrangements	Total
All global FX trading[1]	90.46%	1.15%	91.61%
Among Asia-Pacific pairs only	92.93%	…	…
Among non-Asia-Pacific pairs	90.93%	…	…
Asia-Pacific vs any currency	89.79%	2.78%	92.56%
Non-Asia-Pacific vs any currency	90.43%	1.16%	91.59%

[1] Based on 40 individual currencies in the 2013 BIS Triennial Central Bank Survey and data on trading in 273 unique currency pairs. Eligible trading for CLS covers 17 currencies and 136 unique currency pairs including six Asia-Pacific currencies and 11 non-Asia-Pacific. See notes to Graph 3.2 for additional details.

Sources: BIS Triennial Central Bank Survey; authors' calculations.

Turnover among CLS-enabled currency pairs and non-CLS pairs as of April 2013[1]

Table 3.4

Turnover among		Turnover		Percent of total
		Millions per day	Region in Graph 3.2	
Two CLS currencies	Both Asia-Pacific	52,903	X8	1.05%
	One Asia-Pacific and one non-Asia-Pacific	1,826,111	X3	36.10%
	Both non-Asia-Pacific	2,696,529	X1	53.31%
	Sub-total		4,575,543	90.46%
One CLS and one non-CLS currency	Both Asia-Pacific	4,027	X9	0.08%
	One Asia-Pacific and one non-Asia-Pacific	209,738	X4 + X6	4.15%
	Both non-Asia-Pacific	269,023	X2	5.32%
	Sub-total		482,789	9.54%
	Total	5,058,331	5,058,331	100.00%

The CLS currencies in Asia-Pacific region are AUD, HKD, JPY, KRW, NZD and SGD. The CLS currencies in non-Asia-Pacific region are CAD, CHF, DKK, EUR, GBP, ILS, MXN, NOK, SEK, USD and ZAR. The non-CLS currencies in Asia-Pacific region are CNY, INR, TWD, MYR, THB, IDR and PHP. The non-CLS currencies in non-Asia-Pacific region are ARS, BGN, BHD, BRL, CLP, COP, CZK, HUF, LTL, LVL, PEN, PLN, RON, RUB, TRY and SAR.

[1] No turnover data are available with both legs of a transaction involving a non-CLS currency (regions X5, X7 and X10). See notes to Graph 3.2 for additional details. The figures in this table exclude $285 billion of global turnover that are classified as other or residual and cannot be assigned to a specific currency pair in Graph 3.2.

Sources: BIS Triennial Central Bank Survey; authors' calculations.

Changes to bilateral exchange rate,[1] in percentage points

Table 4.1

	CNY	INR	IDR	KRW	MYR	PHP	SGD	THB	AUD	JPY	NZD	HKD
22 May 2013	–0.07	–0.14	–0.06	**–1.30**	–0.43	**–1.20**	–0.02	–0.43	0.27	**2.04**	0.38	–0.02
19 Jun 2013	–0.15	**–1.69**	–0.18	**–1.30**	**–1.47**	**–1.32**	**–1.68**	**–1.46**	**–3.70**	**–3.14**	**–3.97**	0.01
18 Dec 2013	–0.02	–0.21	–0.35	**–0.83**	–0.55	–0.39	**–0.61**	–0.51	–0.34	–0.98	–0.78	–0.01
SUM[2]	–0.24	**–1.94**	–0.59	**–3.43**	**–2.45**	**–2.91**	**–2.31**	**–2.40**	**–3.27**	**–1.11**	**–4.30**	–0.03
22 May – 18 Dec[3]	0.83	–10.58	–20.0	5.07	–7.71	–7.35	–0.21	–8.21	–8.52	–0.70	1.10	0.10

[1] Against the US dollar, a positive number indicates an appreciation of the local currency; one-day change. Numbers in bold significantly different from zero at 95% confidence level. [2] The sum of one-day changes after three "taper" announcement days, 22 May, 19 Jun, 18 Dec 2013. [3] Change between 22 May and 19 December 2013.

Sources: Datastream; authors' calculations.

Changes to relative bid-ask spreads,[1] in basis points

Table 4.2

	CNY	INR	IDR	KRW	MYR	PHP	SGD	THB	AUD	JPY	NZD	HKD
22 May 2013	0.00	0.45	0.00	–0.04	–0.04	–0.03	0.79	**13.3**	0.01	0.06	–0.06	0.13
19 Jun 2013	–2.29	–0.03	5.03	0.84	–0.45	–0.06	–0.09	–3.45	0.27	–0.10	–1.02	0.13
18 Dec 2013	0.33	0.00	–4.18	0.92	–3.11	–1.14	–0.03	3.02	–0.01	0.93	0.03	0.00
SUM[2]	–1.97	0.42	0.84	1.72	–3.60	–1.23	0.66	12.90	0.27	0.89	–1.04	0.26

[1] Relative bid-ask spreads are expressed in basis points against the mid-quote; indicative quotes against the US dollar; one-day change. Numbers in bold significantly different from zero at 95% confidence level. [2] The sum of one-day changes after three "taper" announcement days, 22 May, 19 Jun, 18 Dec 2013.

Sources: Datastream; authors' calculations.

Changes to one-month implied volatility,[1] in percentage points

Table 4.3

	CNY	INR	IDR	KRW	MYR	PHP	SGD	THB	AUD	JPY	NZD	HKD
22 May 2013	0.13	0.54	0.38	**0.88**	**0.74**	**1.95**	**0.71**	–0.02	0.15	**1.00**	0.30	0.00
19 Jun 2013	0.10	**1.09**	**3.00**	**1.63**	**1.56**	**1.26**	**1.38**	–0.12	**1.60**	0.30	**1.55**	0.00
18 Dec 2013	–0.03	–0.74	–0.25	–0.06	–0.47	–0.26	0.01	–0.30	**–0.85**	–0.80	**–0.95**	0.00
SUM[2]	0.20	0.89	**3.13**	**2.45**	**1.82**	**2.94**	**2.11**	–0.44	0.90	0.50	0.90	0.00

[1] At the money against the US dollar, in percentage point, a positive number indicates an increase of volatility; one-day change. Numbers in bold significantly different from zero at 95% confidence level. [2] The sum of one-day changes after three "taper" announcement days, 22 May, 19 Jun, 18 Dec 2013.

Sources: JPMorgan Chase; authors' calculations.

Change of deviation from covered interest parity[1], in delta unit

Table 4.4

	CNY	INR	IDR	KRW	MYR	PHP	SGD	THB	AUD	JPY	NZD	HKD
22 May 2013	0.05	0.14	0.11	0.11	0.02	–0.01	–0.01	0.03	0.05	0.01	–0.01	0.00
19 Jun 2013	0.22	–0.01	0.03	**0.16**	0.28	–0.05	**–0.03**	**0.09**	–0.02	0.00	0.10	**–0.08**
18 Dec 2013	0.12	0.07	–0.05	–0.02	0.05	**0.60**	–0.01	–0.04	0.07	0.01	0.09	0.00
SUM[2]	0.39	0.21	0.09	**0.25**	0.35	0.55	**–0.05**	0.08	0.10	0.02	0.18	**–0.07**

[1] Computed as the difference between the three-month FX swap-implied US dollar interest rate and three-month US dollar Libor, in per cent; the former is derived from the covered interest parity condition based on the domestic three-month interest rates; one-day change. Numbers in bold significantly different from zero at 95% confidence level. [2] The sum of one-day changes after three "taper" announcement days, 22 May, 19 Jun, 18 Dec 2013.

Sources: Bloomberg, Datastream, authors' calculations.

Changes to onshore less offshore foreign exchange forward premia[1]

Table 4.5

	CNY	INR	IDR	KRW	MYR	PHP
22 May 2013	–0.05	–0.07	–0.07	0.43	–0.09	0.21
19 June 2013	–0.11	0.22	**–2.25**	**–1.40**	–0.13	**–1.96**
18 December 2013	–0.03	–0.13	–0.15	0.22	–0.07	–0.15
SUM[2]	–0.19	–0.02	**–2.47**	–0.74	–0.29	**–1.90**

[1] The forward premium gaps are calculated as the difference between onshore forward and offshore NDF as a percentage of the spot price; two-day change. Numbers in bold significantly different from zero at 95% confidence level. [2] The sum of one-day changes after three "taper" announcement days, 22 May, 19 Jun, 18 Dec 2013.

Sources: Bloomberg; authors' calculations.

Excess currency index returns as a function of four factors

Table 5.1

Dependent variable: excess currency return[1]	Alpha	Beta[2]				R^2
		Carry	Trend	Value	Volatility	
Jan 1990–Dec 2006	–9 bps	**0.70**	**1.28**	**–1.01**	0.04	0.68
	(–0.72)	(3.30)	(17.44)	(–2.25)	(0.43)	
Jan 1990–Dec 2000	–16 bps	**0.74**	**1.44**	**–1.38**	–0.04	0.68
	(–0.72)	(2.78)	(14.91)	(–2.44)	(–0.38)	
Jan 2001–Dec 2006	–11 bps	**1.03**	**0.77**	–0.64	0.33	0.77
	(–1.00)	(3.99)	(9.71)	(–1.01)	(3.09)	
Jan 2011–Jul 2014	0.1 bps	0.11	**0.15**	0.03	**0.003**	0.42
	(0.87)	(1.69)	(3.05)	(0.44)	(2.99)	

T-values in parentheses. Numbers in bold significantly different from zero at 95% confidence level.

[1] Barclays Currency Traders Index. [2] Regressors for carry, trend, value and volatility are Citibank Beta1 G10 Carry Index, AFX Index, Citibank Beta1 G10 PPP Index and implied volatility respectively. For sample period Jan 2011–Jul 2014, regressors for carry and value are Deutsche Bank G10 Harvest Index and Deutsche Bank FX PPP Index respectively.

Sources: Pojarliev and Levich (2008); authors' calculations.

Excess currency returns for individual managers as a function of four factors

Table 5.2

	Alpha	Beta				R^2
		Carry	Trend	Value	Volatility	
Investable FoF DB platform[1] (2005 – 2008)	0.1 bps	**0.14**	**0.40**	**–0.08**	0.12	0.534
	(0.31)	(6.03)	(10.88)	(–3.85)	(1.53)	
"Live" FoF	2.7 bps	**0.19**	**0.45**	**–0.10**	0.15	0.550
	(1.16)	(7.21)	(10.70)	(–4.25)	(1.74)	
"Dead" FoF	**–6.4 bps**	**–0.06**	**0.23**	0.02	–0.01	0.183
	(–2.31)	(–2.12)	(4.57)	(0.75)	(–0.15)	
Investable FoF Citi platform[2] (2011 – 2014)	0.1 bps	**0.27**	**0.33**	**0.34**	**0.006**	0.719
	(0.96)	(3.09)	(4.44)	(2.67)	(3.24)	

T-values in parentheses. Numbers in bold significantly different from zero at 95% confidence level.

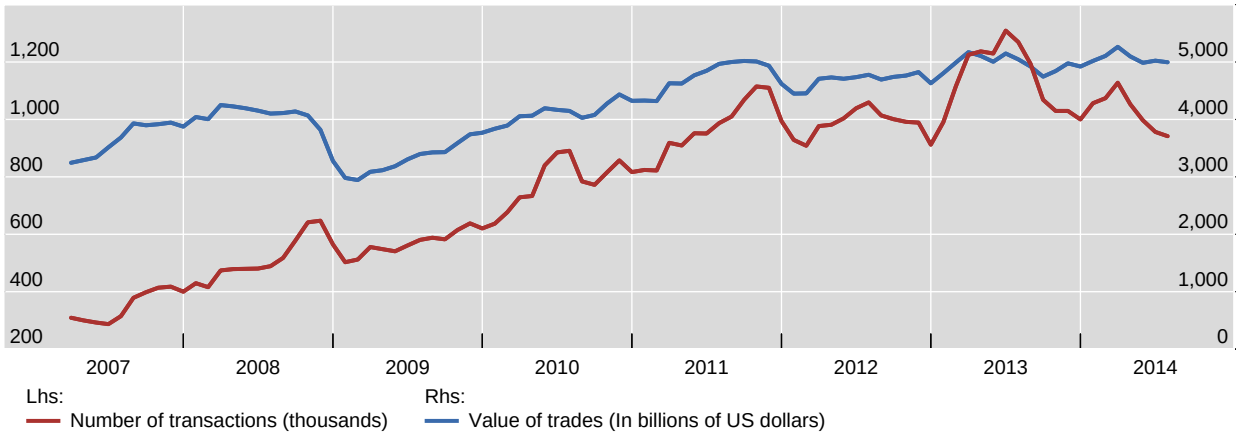
[1] All funds on the DB Select platform, and those that are live or dead as of 3/26/2008. Based on 156 weekly returns, 6 April 2005 to 26 March 2008. [2] All funds on the Citi Access platform, monthly data.

Sources: Pojarliev and Levich (2010); authors' calculations.

CLS bank, volume of transactions and value of trades

Three-month moving average of daily data

Graph 3.1

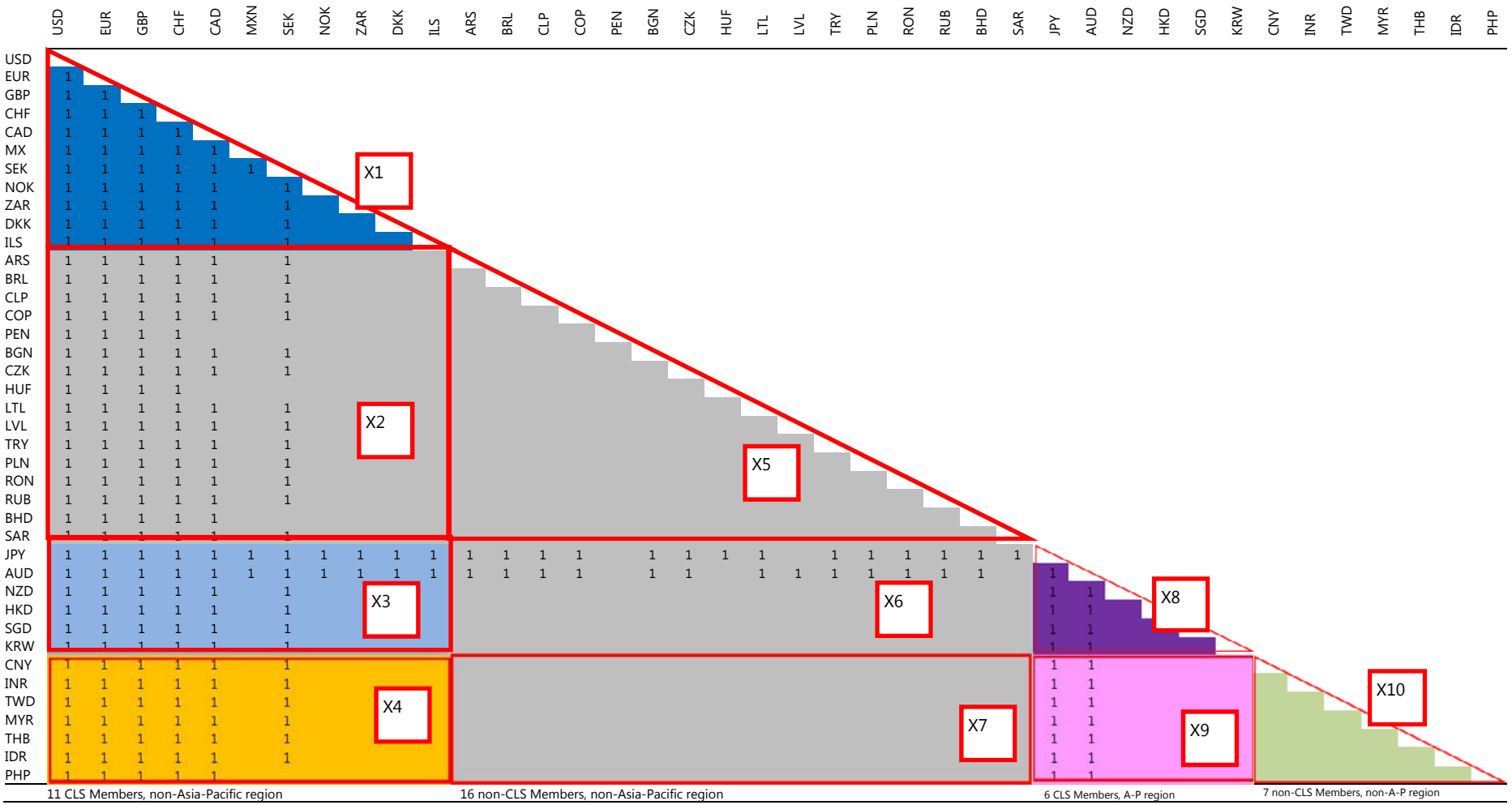


Note: Data reflect matched trades that were entered into on date *t* rather than settled trades that were entered into at some earlier time for settlement on date *t*.

Sources: CLS; authors' calculations.

40 x 40 matrix of all currency pairs with turnover data in the BIS 2013 Triennial Survey

Graph 3.2



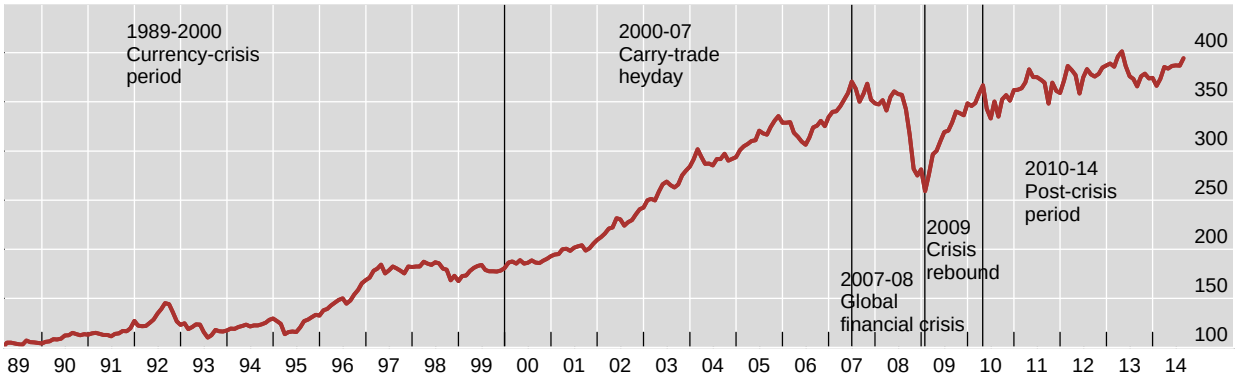
Note for Graph 3.2: The 2013 BIS Survey has positive turnover data for all cells marked with "1". Regions X1, X3 and X8 designate all pairs of CLS-enabled currencies. All other regions are currency pairs that cannot settle through CLS. Trades between the INR or MYR or IDR and the USD are eligible for PVP settlement through the RENTAS system or the HKMA.

Q1) % trades, any pair, enabled for CLS:	(X1 +X3 +X8)/sum(X1, ... X10)
Q2) % trades of AP/AP enabled for CLS:	X8/(X8 +X9 +X10)
Q3) % trades of NAP/NAP enabled for CLS:	X1/(X1 +X2 + X5)
Q4) % trades of AP/(AP or NAP) enabled for CLS:	(X3 + X8)/(X3 + X4 + sum[X6....X10])
Q5) % trades of NAP/(AP or NAP) enabled for CLS:	(X1 + X3)/sum [X1,...X7]

Add INR, MYR and IDR volume to Q1, Q4 and Q5 numerator to measure % enabled for CLS or PVP

Cumulative total return of a G10 3×3 carry trade basket, February 1980–August 2014

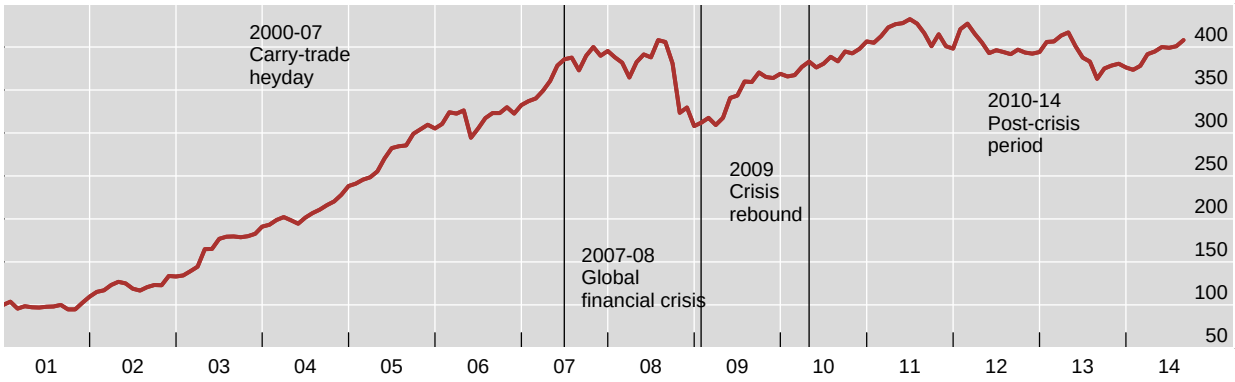
February 1989 = 100 Graph 5.1



Source: Bloomberg.

Cumulative total return of an EM 3×3 carry trade basket, December 2000–August 2014

December 2000 = 100 Graph 5.2

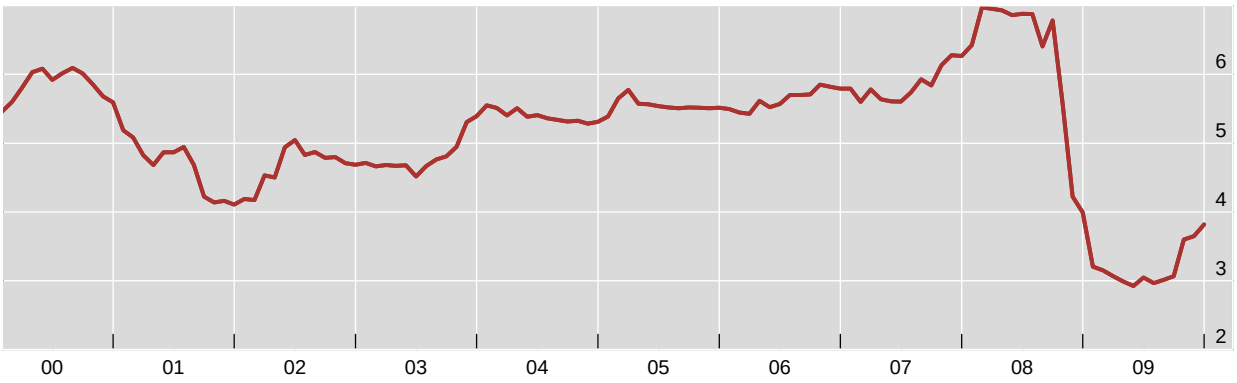


Source: Bloomberg.

AUD-JPY interest differential[1]

In per cent

Graph 5.3a

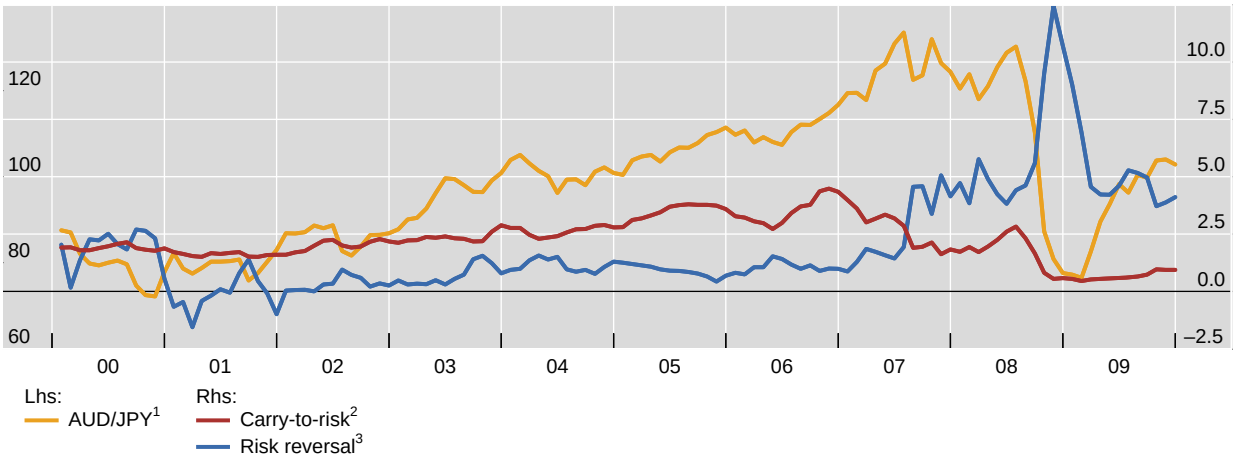


[1] Three-month LIBOR interest rate differential between Australian dollar and Japanese yen, end of month.

Sources: Bloomberg; authors' calculations.

Exchange rate and carry trade attractiveness

Graph 5.3b

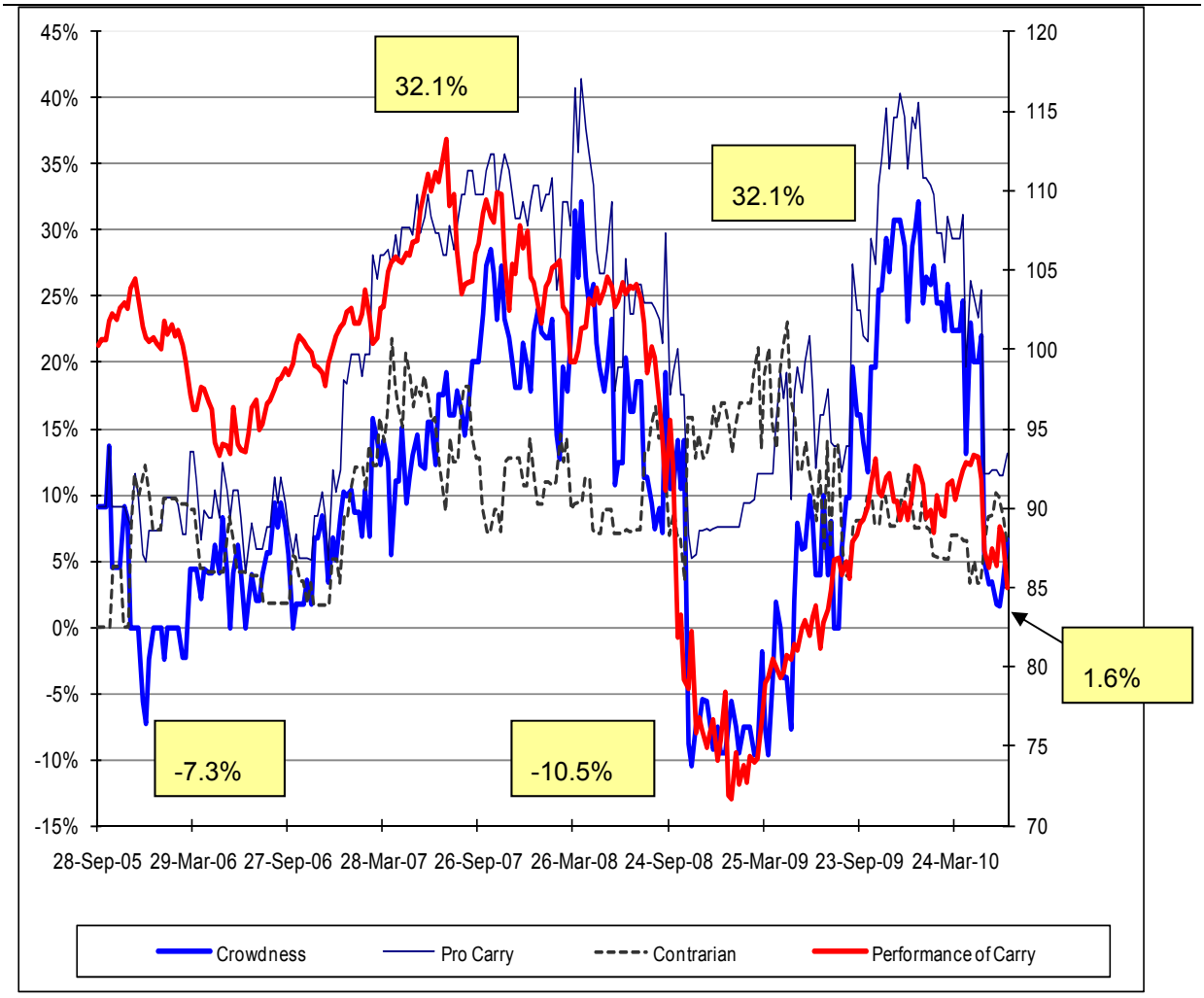


[1] 2002–06 = 100. [2] Defined as the three-month interest rate differential divided by the implied volatility derived from three-month at-the-money exchange rate options; quintuple scale (eg the number 2 represents a ratio of 0.4). [3] 25 delta; a positive value indicates a willingness to pay more to hedge against a yen appreciation.

Sources: Bloomberg; JPMorgan Chase; authors' calculations.

Carry crowdedness

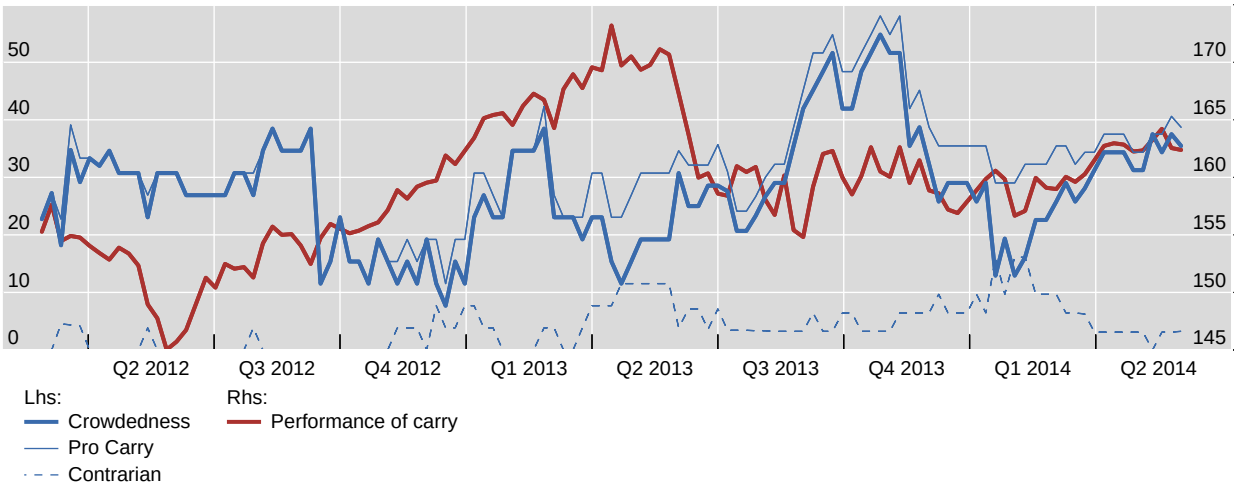
Graph 5.4



Source: Pojarliev and Levich (2011).

Carry crowdedness

Graph 5.5

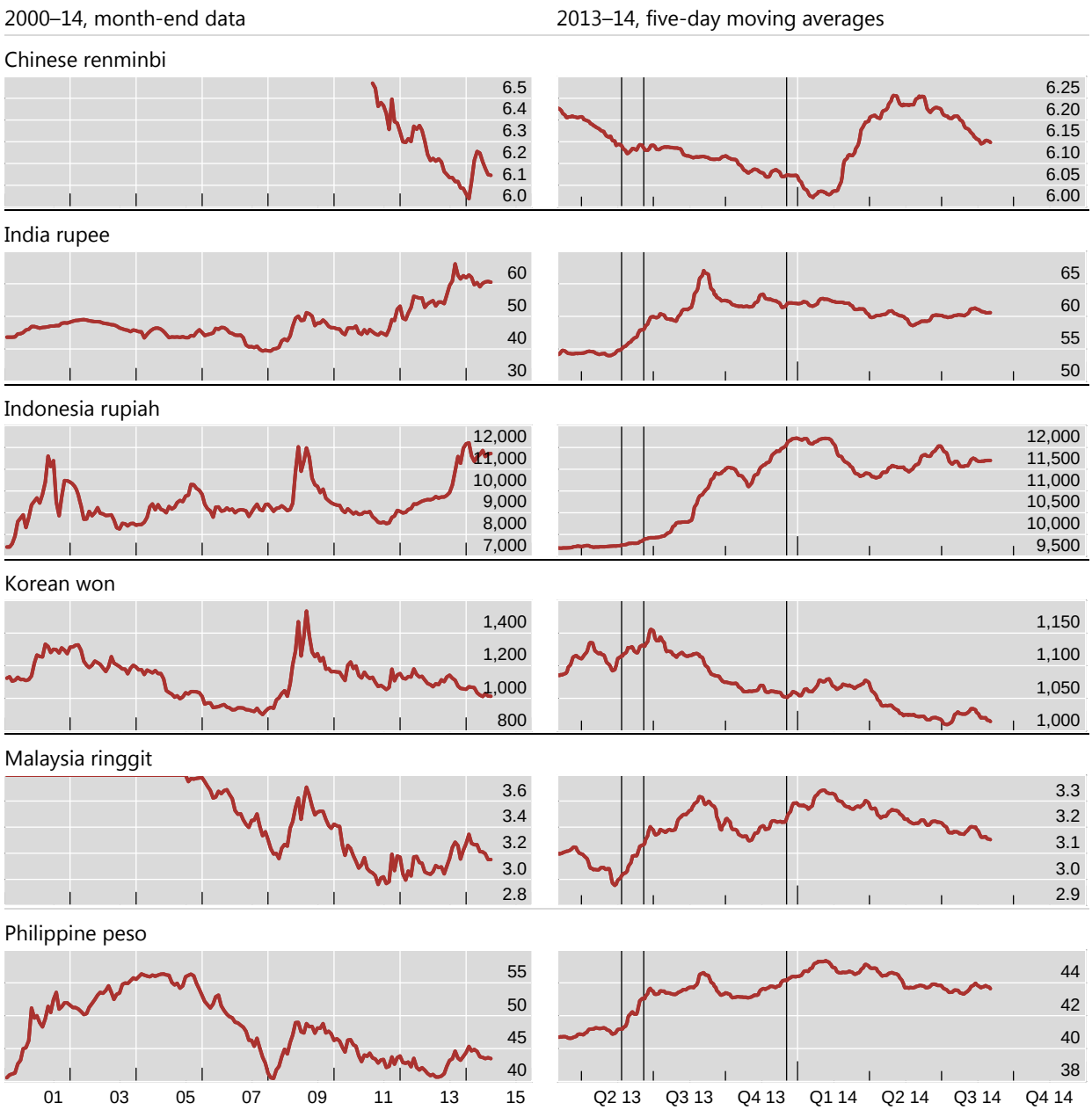


[1] Carry crowdedness is defined as the percentage of managers with significant style betas for carry less the percentage of managers with significant negative style betas against carry, where the DB G10 Carry Index is used as a proxy for carry trade returns. The first measure for crowdedness is estimated as of 2/22/2012 with 26 weekly observations from 8/31/2011 until 2/22/2012. The last measure of crowdedness is estimated as of 5/28/2014 with 26 weekly observations from 12/4/2013 until 5/28/2014. The sample contains 119 rolling windows.

Source: Bloomberg.

Bilateral exchange rate, per US dollar[1]

Annex Graph 1



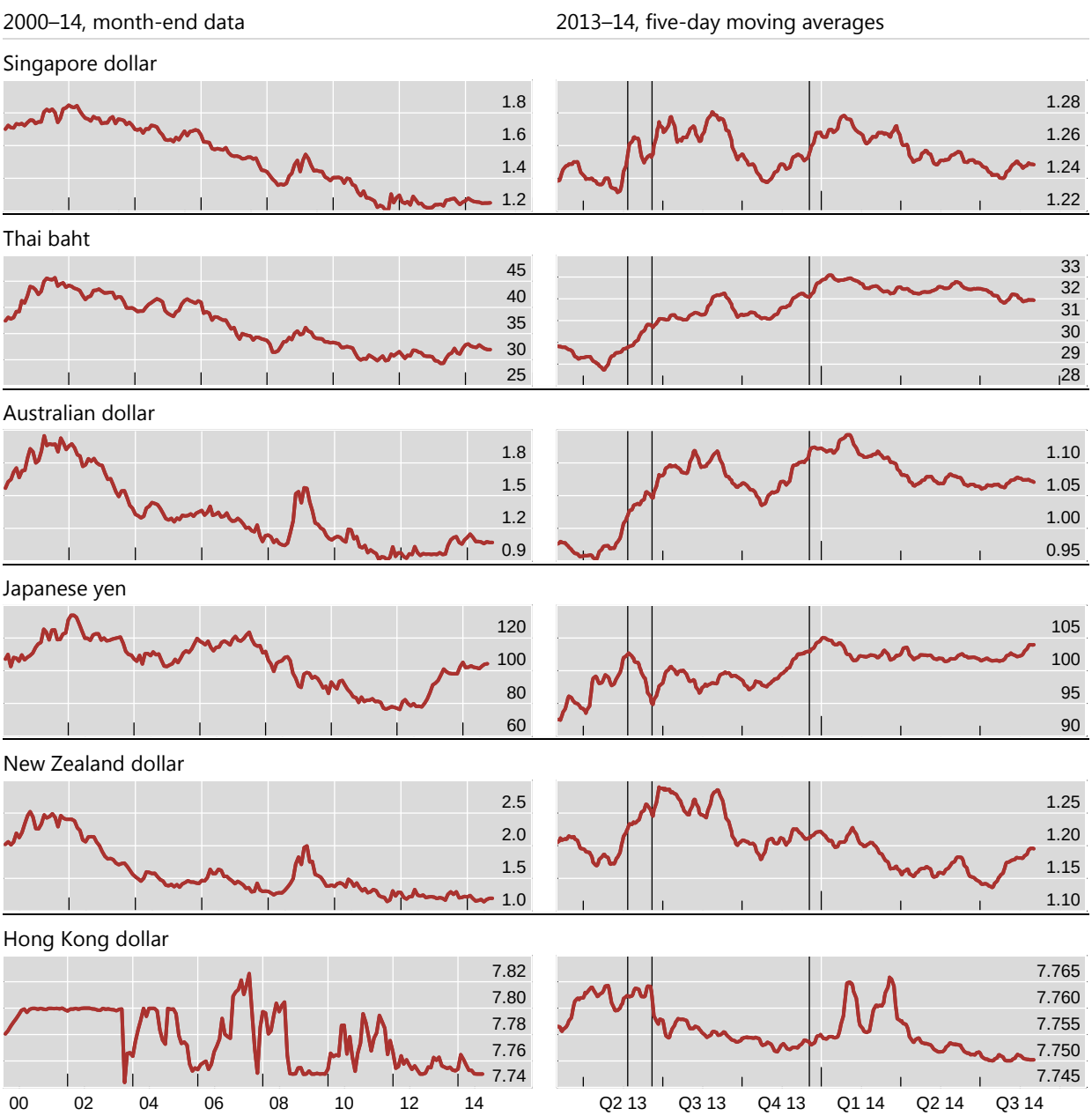
The three vertical lines indicate 22 May, 19 June and 18 December 2013.

[1] An increase indicates a depreciation of local currency.

Sources: Datastream, WM/Reuters; authors' calculations.

Bilateral exchange rate, per US dollar[1] (cont)

Annex Graph 1



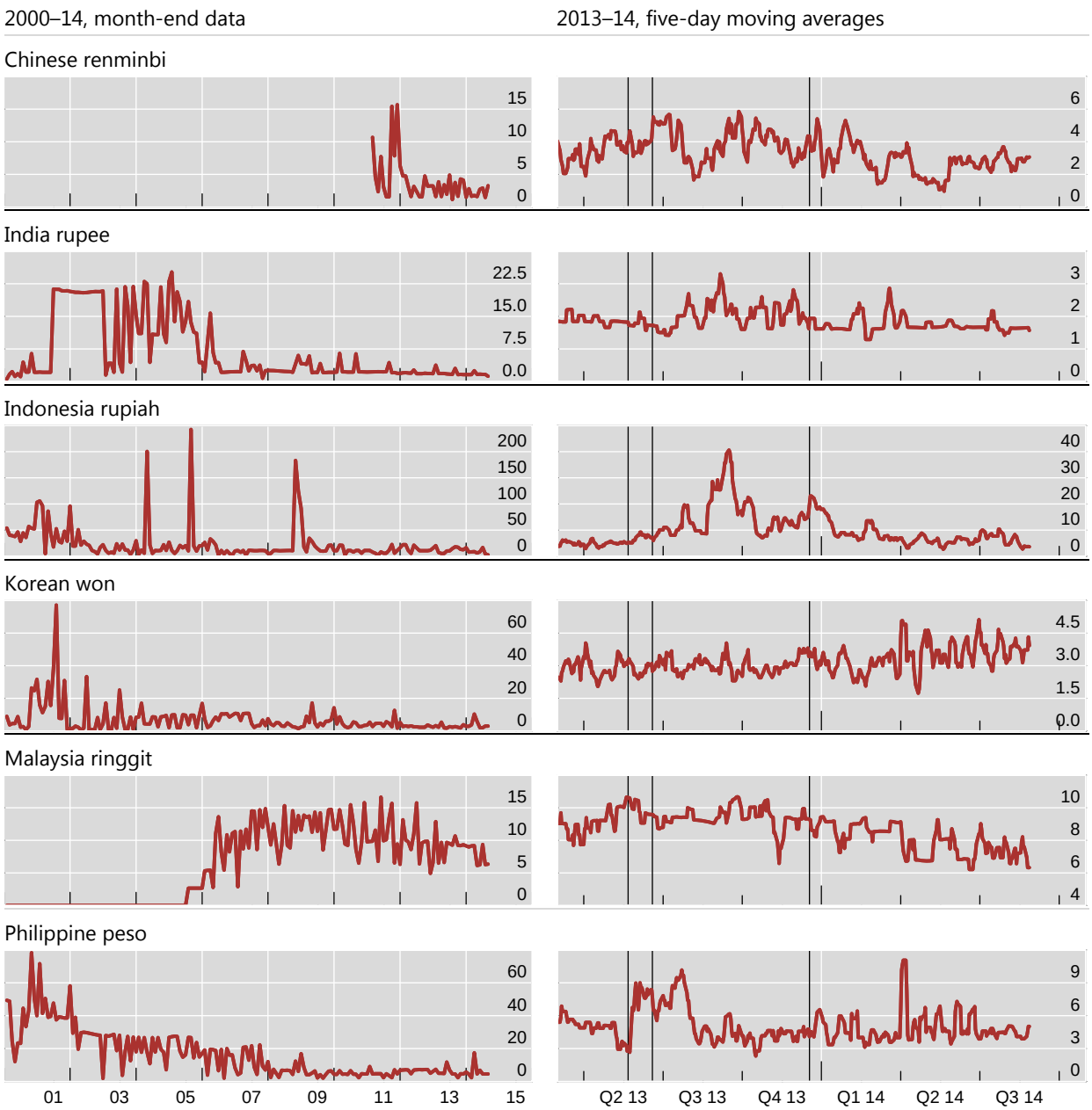
The three vertical lines indicate 22 May, 19 June and 18 December 2013.

[1] An increase indicates a depreciation of local currency.

Sources: Datastream, WM/Reuters; authors' calculations.

Relative bid-ask spreads, basis points[1]

Annex Graph 2



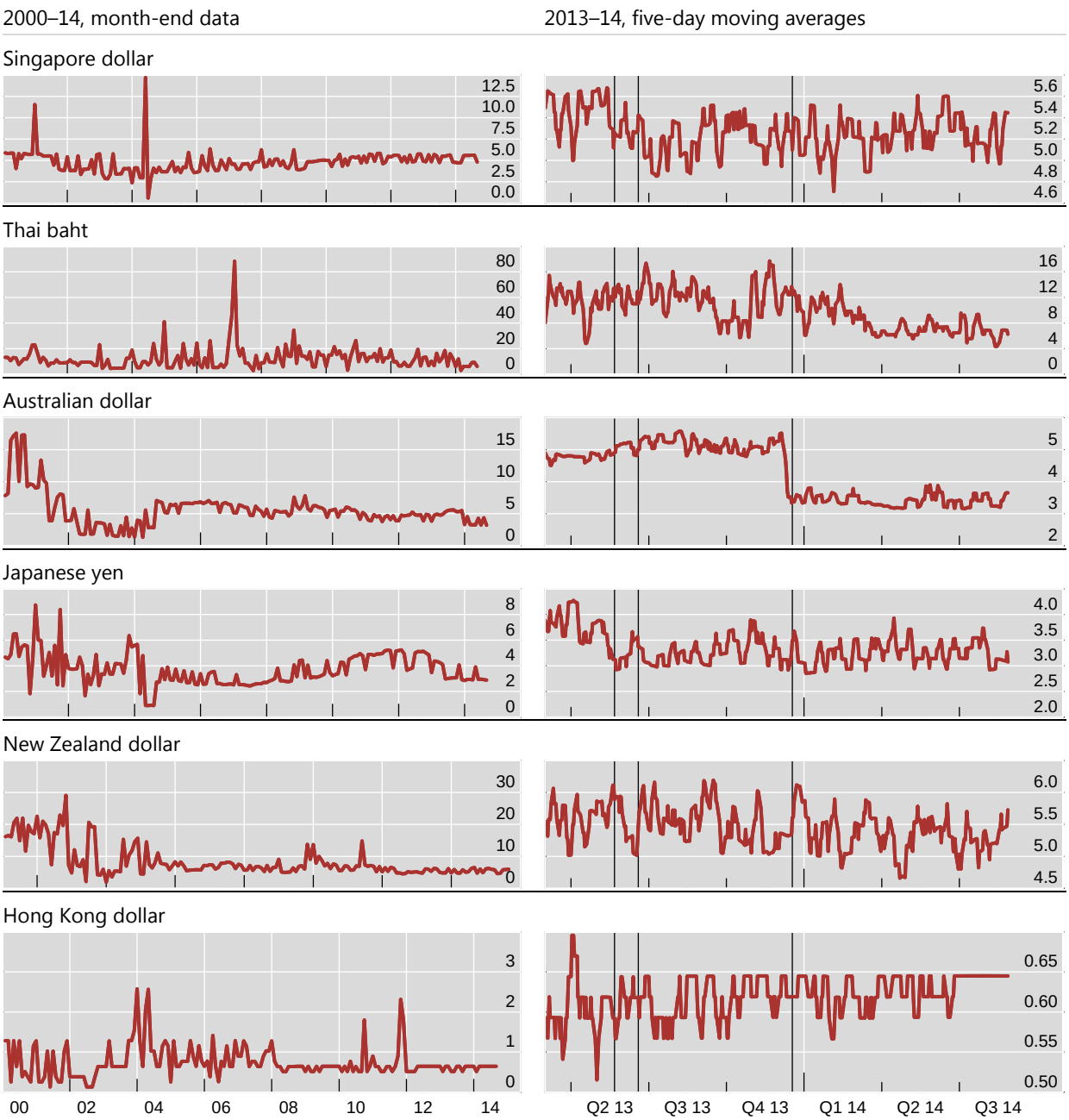
The three vertical lines indicate 22 May, 19 June and 18 December 2013.

[1] Relative bid-ask spreads are expressed in basis points against the mid-quote; indicative quotes against the US dollar.

Sources: Datastream, WM/Reuters; authors' calculations.

Relative bid-ask spreads, basis points[1] (cont)

Annex Graph 2



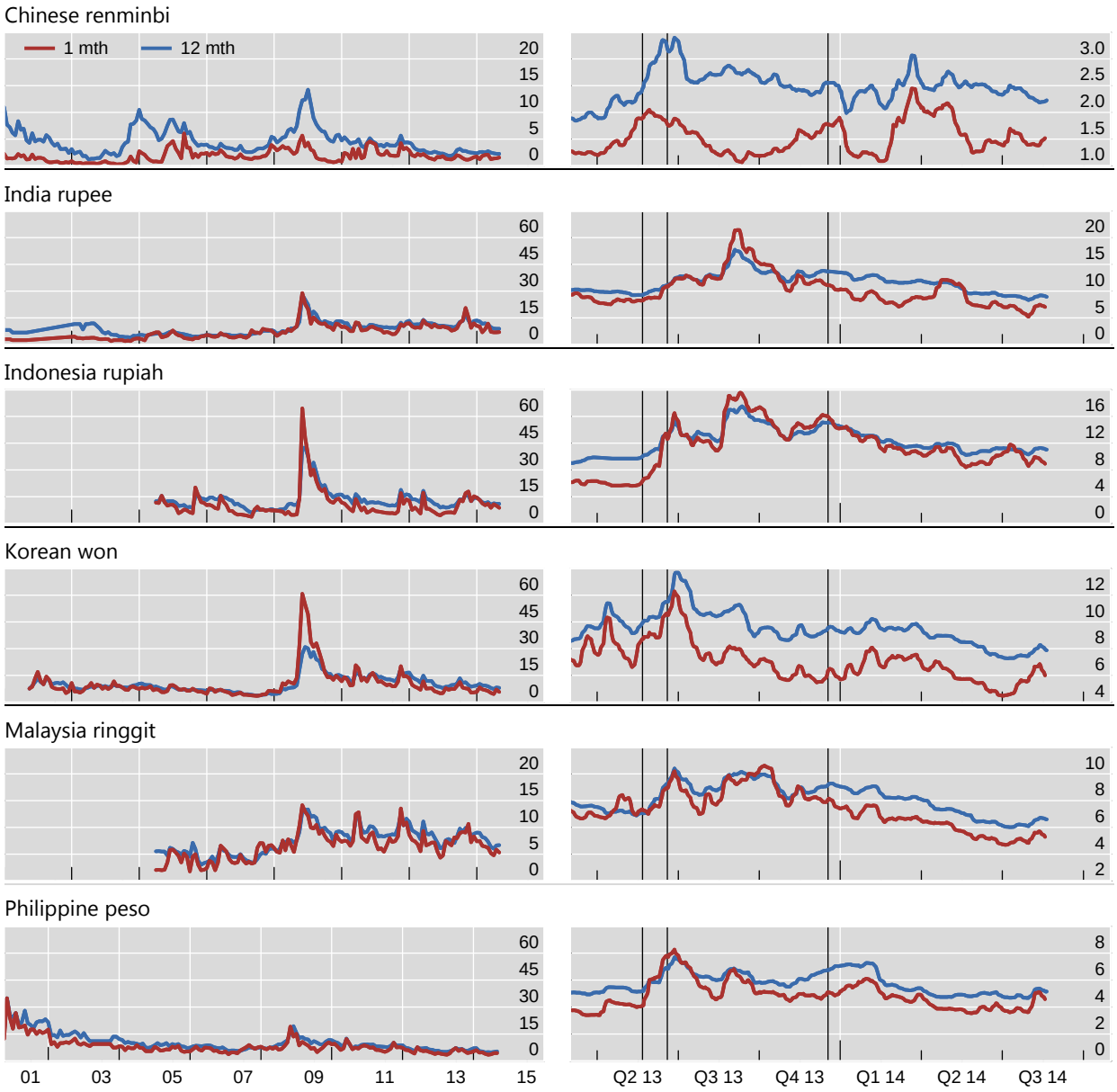
The three vertical lines indicate 22 May, 19 June and 18 December 2013.

[1] Relative bid-ask spreads are expressed in basis points against the mid-quote; indicative quotes against the US dollar.

Sources: Datastream, WM/Reuters; authors' calculations.

Implied volatility

Against the US dollar, at the money, in per cent — Annex Graph 3



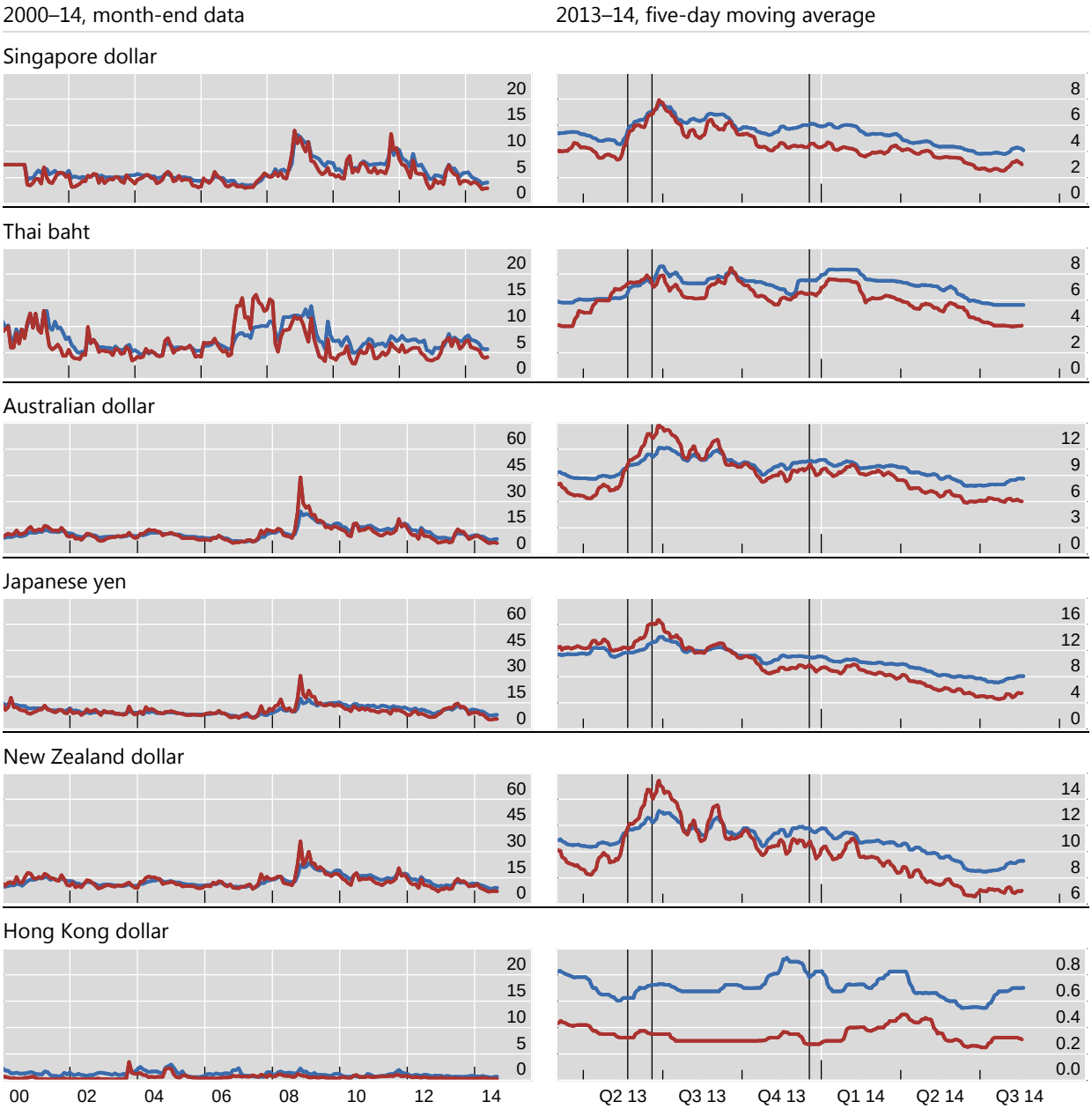
The three vertical lines indicate 22 May, 19 June and 18 December 2013.

Source: JPMorgan Chase.

Implied volatility (cont)

Against the US dollar, at the money, in per cent

Annex Graph 3

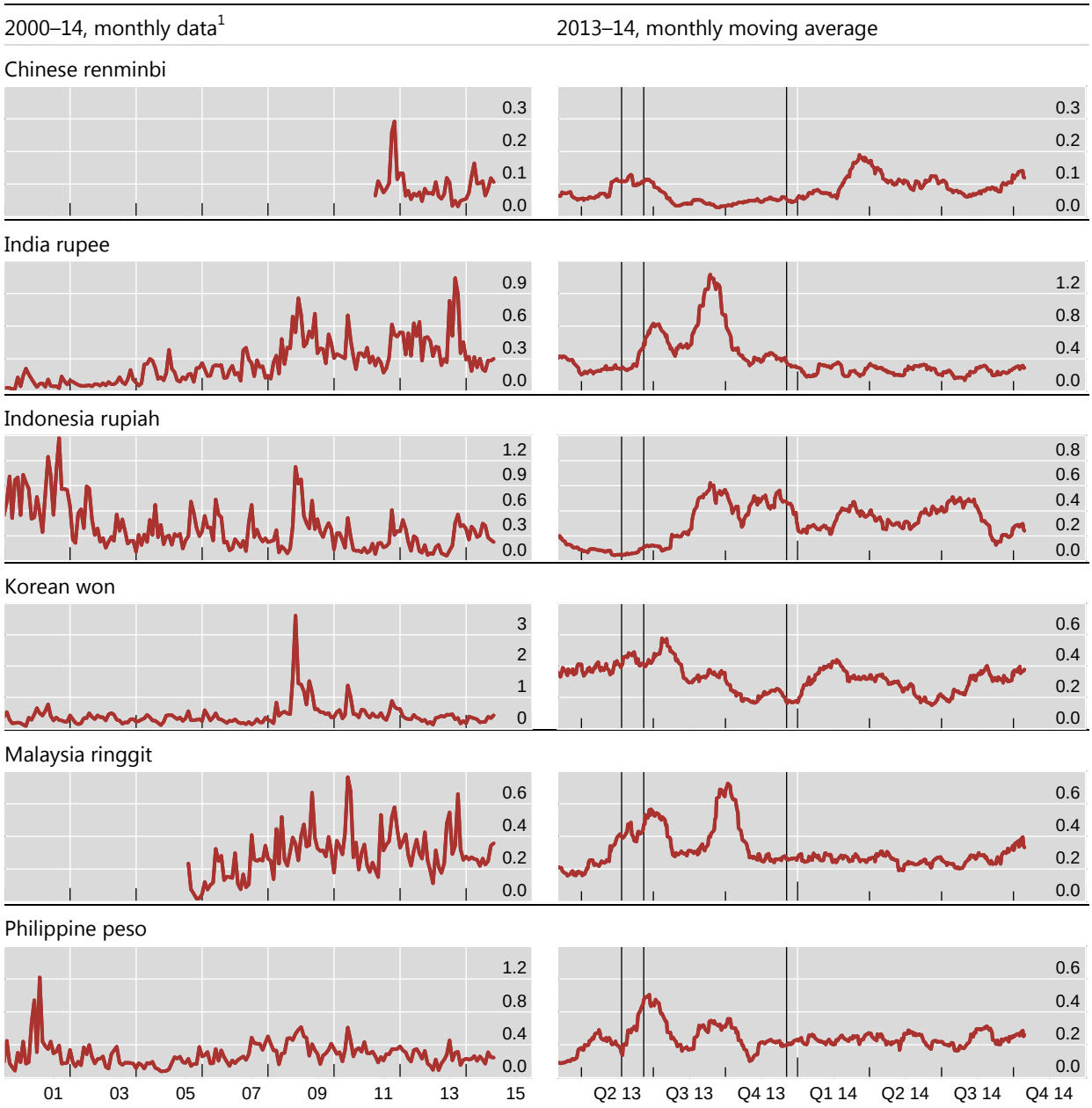


The three vertical lines indicate 22 May, 19 June and 18 December 2013.

Source: JPMorgan Chase.

Realised volatility

Against the US dollar, in percent — Annex Graph 4



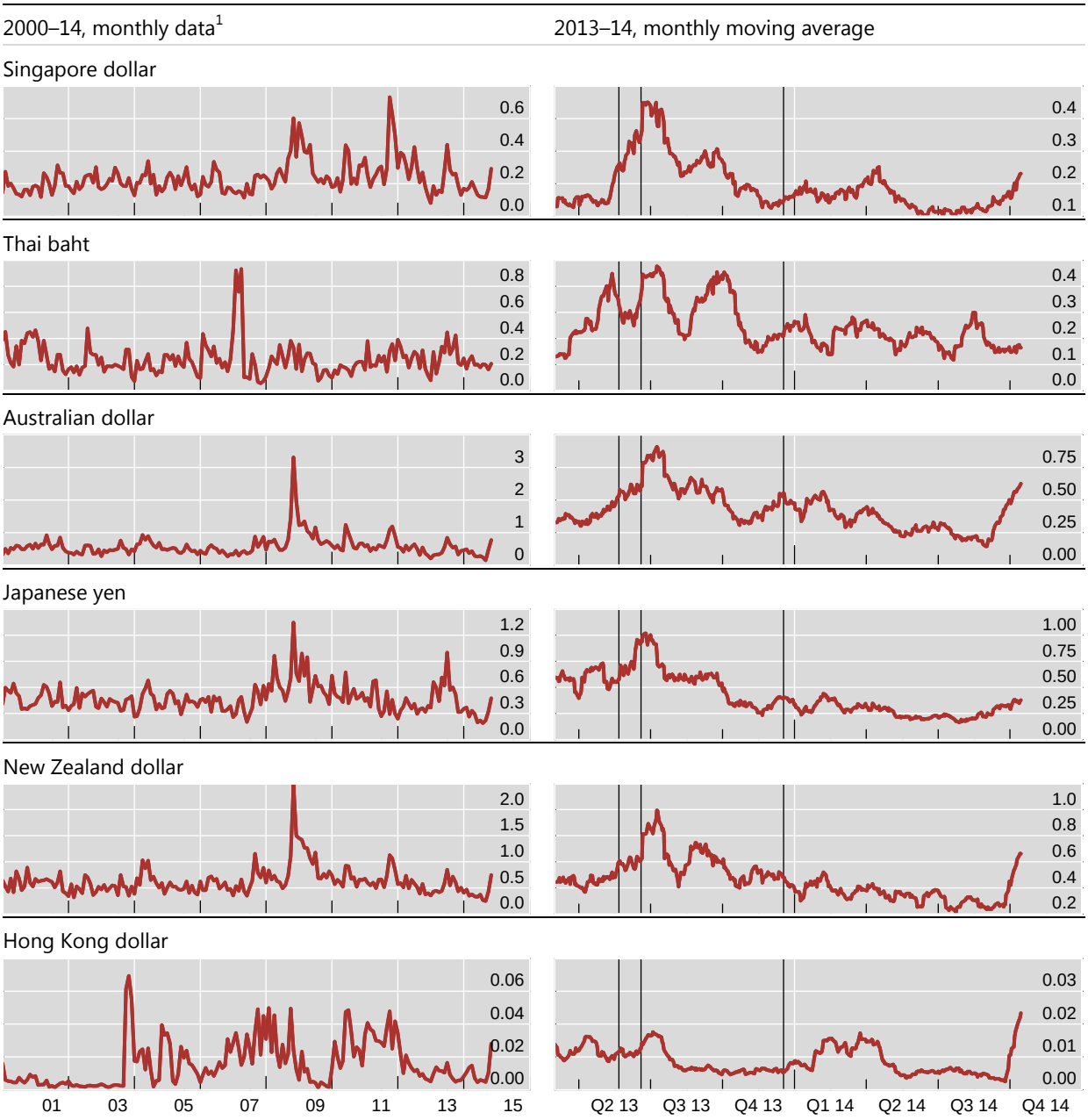
[1] Computed as the monthly averages of daily absolute returns.

Sources: Datastream, WM/Reuters; authors' calculations.

Realised volatility (cont)

Against the US dollar, in percent

Annex Graph 4



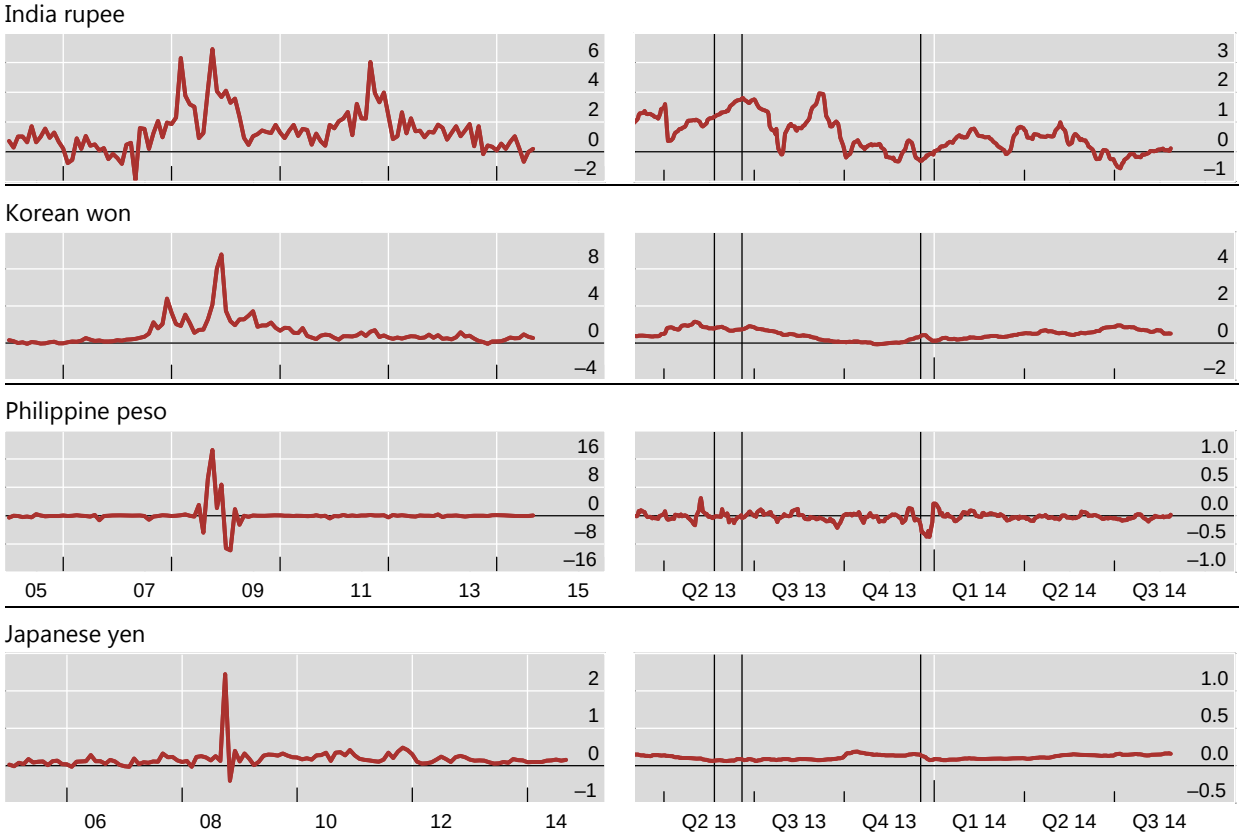
[1] Computed as the monthly averages of daily absolute returns.

Sources: Datastream, WM/Reuters; authors' calculations.

Deviations from covered interest parity

Annex Graph 5

2000–14, month-end data[1] | 2013–14, five-day moving average[2]

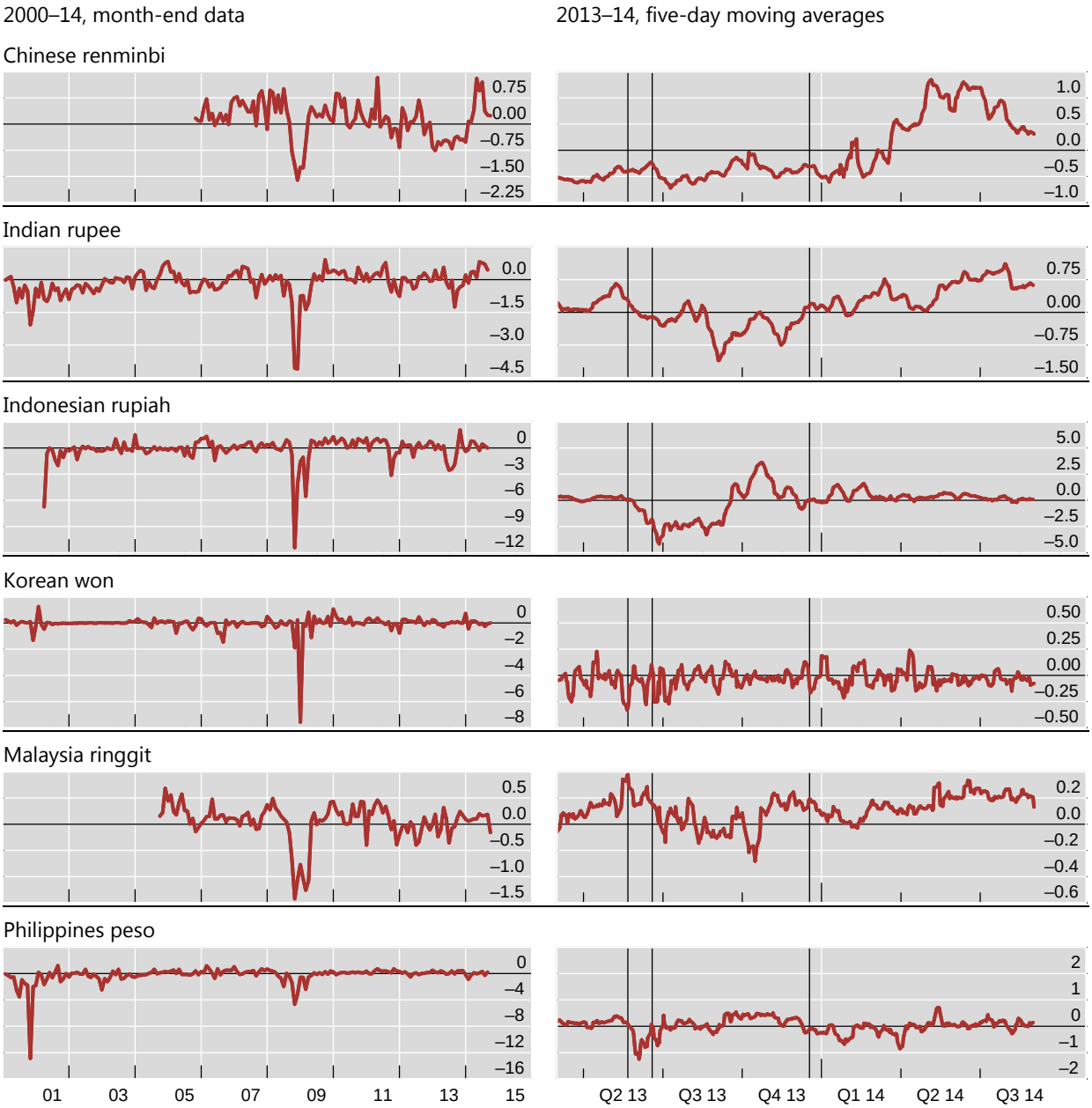


[1] Computed as the difference between the three-month FX swap-implied US dollar interest rate and three-month US dollar Libor, in per cent, end of month. The former is derived from the covered interest parity condition based on the following domestic three-month interest rates.

Sources: Bloomberg, Datastream, authors' calculations.

Onshore less offshore foreign exchange forward premia[1]

As a % of spot price, for three-month contracts — Annex Graph 6



The three vertical lines indicate 22 May, 19 June and 18 December 2013.

[1] The forward premia are calculated as the difference between onshore forward and offshore NDF rates as a percentage of the spot price.

Sources: Bloomberg; authors' calculations.

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Comments on Levich and Packer: "Development and functioning of FX markets in Asia and the Pacific"

Takatoshi Ito[1]

The Levich and Packer paper covers a wide range of issues surrounding the foreign exchange markets, with emphasis on the Asian countries. Section 2 outlines how Asian currencies have been transacted in financial markets, using the BIS Triennial Survey. Section 3 focuses on CLS Bank, which is based on a payment-versus-payment (PVP) model. However, the authors point out that, having eliminated Herstatt risk, CLS has itself become a too-big-to-fail institution. Section 4 describes foreign exchange market developments after the global financial crisis of 2008–09. Section 5 focuses on the carry trade strategy and asks whether it is a winning strategy. The paper will interest a wide range of readers, from academics to policymakers and market practitioners.

In Section 2, it is shown that major Asia-Pacific currencies, such as the Japanese yen, Australian dollar, and New Zealand dollar, have increased their shares in global turnovers of currencies according to the BIS Triennial Survey. One interesting fact, still under-appreciated, is that the renminbi is a fast-growing currency in terms of turnover statistics. Its share increased from 0.1% in 2004 to 2.2% in 2014. Although the volume is still low, the increase is very fast. The currency's offshore turnover volume is, at USD 86.1 billion, the largest among Asian emerging market currencies. Looking forward, the renminbi will increase its share in turnover and other measures for international currencies.

Section 3 deals with risks in foreign exchange transactions. One of the best known is so-called Herstatt risk. For the settlement of any foreign exchange transaction, two banks have to send or receive two different currencies. As central banks are not open 24 hours a day, it is difficult, if not impossible, to make the two payments simultaneously. When Bank Herstatt failed in 1974, some of the transactions failed. In order to eliminate this risk, CLS Bank was established in 1997 and started operations in 2002. It is the sole global multicurrency settlement system and is based on a unique, continuously operating PVP system, with a guaranteed refund system (in the case of a failed transaction of the other leg).

Currently, there are 17 CLS-eligible currencies and some 90.46% of global FX turnover goes through CLS. However, settlement risk continues to obtain in some currency pairs involving emerging market currencies, such as the renminbi, Russian rouble, Thai baht, and Brazilian real. There is a plan to cover those currencies in the future. However, the huge success of CLS comes at a price. As CLS has lowered settlement risk significantly, CLS has itself become a source of systemic risk as a financial institution that is too big to fail. This development in settlement risk is not widely known among academics, even among financial experts. This chapter is a good summary of CLS's institutional development.

[1] Columbia University.

Section 4 shows the contrast in currency movements between the period after the global financial crisis and the period after the May 2013 "taper tantrum" following the hint that QE3 would end in the United States. In the wake of the global financial crisis, downward pressure was exerted on currencies associated with large current account deficits, smaller foreign exchange reserves, and with larger US investments prior to the crisis. Wide-spread violations of covered interest rate parity were observed. In the wake of the taper tantrum, by contrast, the downward pressure was felt by currencies associated with larger current account surpluses, high foreign exchange reserves and low debt. This was quite a turnabout.

According to the authors, many papers have interpreted this result as consistent with fragile economies having built up less exposure to financial flows, or "hot money" during earlier periods of relatively high rates in EMEs (and quantitative easing by the Federal Reserve). They also cite Eichengreen and Gupta (2003) to the effect that the currencies of countries with larger financial markets depreciated more between April and September 2013, which is indicative that "large markets are more prone to the effects of liquidity retrenchment".

I am not convinced by this explanation. A more careful analysis of the difference between the two episodes is called for. The global financial crisis originated in the United States, and thus prompted panicky deleveraging by US and European financial institutions. It was interesting that the Japanese yen and the Swiss franc appreciated sharply in the wake of the crisis. Capital outflows from emerging markets were also based on the perceived risk of the emerging market economies – typical of a crisis contagion. By contrast, in 2013, capital outflows from emerging markets were based more on the interest rate differential. Even with their strong fundamentals, the low-interest countries – typically sound economies – were the ones that experienced capital outflows.

The investigation of carry trades in Section 5 is interesting. It is well known in the recent literature that investing in high-interest-rate currencies while borrowing in low-interest-rate currencies yields excess returns – violating the uncovered interest rate parity relationship. However, the result is sensitive to the sample period, and volatility may be high. Graphs 5.1 and 5.2 show the cumulative returns of the carry trade strategies in G10 and EM currencies, respectively. Although large excess returns were produced, these returns seem to be smaller (no increase in cumulative returns) after 2007. This may reflect the interest rate differential between the advanced countries and EM countries, which narrowed in the wake of the global financial crisis.

Table 5.2, summarising the profitability (excess returns) of four factors – carry, trend, value, and volatility – among individual managers shows an interesting result. Those who made losses and exited from the market had large negative excess returns in alpha and in the carry trade component. The difference between "live" fund managers and "dead" fund managers is striking. So it is not just the strategy but how well it is executed that is the key for success.

Japan is a home base for carry trades. Japan's huge foreign reserves, amounting to USD 1.2 trillion, can be regarded as a form of carry trade. The Ministry of Finance issues short-term government securities (T-bills) in yen to obtain yen liquidity, and then intervenes in the market to obtain US dollars, when it wishes to slow down the yen's appreciation. The foreign reserves, mostly in the form of US T-bills and T-bonds, have accumulated while Japanese T-bills are rolled over on the liability side.

Hence, this is essentially a carry trade and one that has produced profits, according to Ito (2003).

Many Japanese retail investors are also known to be carry traders. Those who invest in high-interest rate currencies, taking on exposure to the risk of the yen's appreciation, are nicknamed "Mrs Watanabe". Japanese securities firms market high-interest rate bonds denominated in foreign currencies, such as those of Australia and New Zealand, to such retail investors. Indeed, these "uridashi" bonds are so popular that demand for them has soared. As a result, the high-interest rate currencies have appreciated. In December 2005, the RBNZ and Treasury of NZ visited Japan to discourage the marketing of "uridashi" bonds. In January, there was a debate between Finance Minister Michael Cullen, defending the mission to Japan, and Mr John Key, who was critical that pressure was being put on Japan.

Is Mrs Watanabe a naïve investor, ignorant of currency risks? Not necessarily so. First, for carry trades to produce excess returns, uncovered interest rate parity has to be violated, and many papers have now demonstrated that this violation occurs. Second, many Mrs Watanabes are retired workers or their widow(er)s. Their time preference is very high. Large interest payments in the next 10 years, even with a risk of losing principal value, are likely to be more highly valued by 75 year-old investors. For them, carry trades are akin to a reverse mortgage.

The authors argue that returns on carry trades have declined, and they attribute this to market overcrowding. When more traders, lured by success of other traders, adopt the same strategy, or carry trade, then returns will inevitably decline. The first movers, or the innovators, reap the profits, but the followers do not. This is interesting in principle, but the claim seems difficult to actually substantiate.

Markets are evolving all the time, and trading strategies are also advancing. Increasingly, market transactions are driven by algorithmic trading. It's possible that, rather than the humans crowding each other out, it is the rise of the machines that is crowding out the humans.

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Exchange rates, expected returns and risk: what can we learn from Asia-Pacific currencies?

Anella Munro[1]

Abstract

This paper employs a risk-augmented asset price model of the exchange rate to compare the risk and return characteristics of a range of Asia-Pacific USD currency pairs. The Asia-Pacific currencies include a full range of exchange rate regimes, so provide a broad perspective of exchange rate behaviour. The results suggest that more managed exchange rates are associated with higher variance of the relative "bond premium" (the difference between observed interest rates and the underlying risk-free rate), lower variance of the "currency premium" (currency-specific premia and/or long-run fundamentals), and a slightly higher degree of risk-sharing. The results point to a role for risk and risk sharing in monetary policy trilemma trade-offs.

Keywords: exchange rate, asset price, currency risk, monetary policy trilemma, Asia-Pacific

JEL codes: F31, G12

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1. Introduction

Exchange rate behaviour is important for our understanding of cross-border financial linkages. In theory, uncovered interest parity (UIP) links exchange rates and relative interest returns. UIP is a workhorse in models used to assess optimal monetary policy in open economies. In a modern open-economy model, that parity condition also defines the monetary policy trade-offs between interest rate management and exchange rate management, akin to the trilemma trade-offs of Mundell (1983).[2] However, the standard empirical test of UIP fails systematically across currency pairs and across time periods.[3]

The standard test of UIP treats risk as exogenous because short-term interest rates are assumed to be risk-free. In practice, even highly rated government bills or central bank rates, can reflect a considerable "specialness premium" (Krishnamurthy and Vissing-Jorgensen (2012)), and any interest rate with a maturity greater than zero reflects a term premium, and from the foreign investor's point of view, currency revaluation risk (Lustig and Verdelhan (2007)). Munro (2014) derives a structural asset price model with risk adjustments, and shows, analytically, that the exchange rate and relative returns reflect common premia. Those common premia can severely bias the estimated exchange rate-interest rate relationship, if not accounted for.

This paper uses that structural framework to compare the risk and return properties of Asia-Pacific exchange rates and interest returns. The currencies examined in Munro (2013) were advanced country floating exchange rate currencies. Here that sample is extended to include six additional Asian currencies: the Hong Kong dollar (HKD), the Korean won (KRW), the Malaysian ringgit (MYR), the Philippine peso (PHP), the Singapore dollar (SGD) and the Thai baht (THB). The wider sample includes emerging market currencies, and is considerably more diverse in terms of exchange rate regimes. It includes more actively managed exchange rates, and the HKD provides a useful boundary case of a fixed exchange rate system (see Table 1).

The results for the additional Asian currencies both confirm the earlier results and provide a new perspective. As in Munro (2014),[4] a structural decomposition implies that, if risk is not accounted for, the estimated relationship between exchange rates and relative returns is severely biased. That bias is estimated to be even more severe for the more managed Asian exchange rate regimes.

The additional Asian currencies also provide a new perspective. The volatility of the relative bond premium – the spread between relative interest rate payoffs and relative risk-free interest rates, that is the source of reduced-form estimation bias, is larger for the additional Asian currencies. However, there appears to be a trade-off.

[2] In a financially open economy, we can either control the exchange rate or have independent monetary policy, but not both. See Obstfeld et al (2005) for an empirical overview.

[3] See Bilson (1981) and Fama (1984). For literature reviews, see Engel (2013), Engel (2012), Engel (1996), and Flood and Rose (1996).

[4] Munro 2014) examines eight advanced-country USD exchange rates: he Australian dollar (AUD), the Canadian dollar (CAD), the Swiss franc (CHF), the euro (EUR), the British pound (GBP) the Japanese yen (JPY), the New Zealand dollar (NZD) and the Swedish krona (SEK).

Larger bond premium volatility tends to be associated with lower volatility of the "currency premium" – an exchange rate premium that includes measures of risk and long-run exchange rate fundamentals, and with slightly greater risk-sharing. Those trade-offs are related to the IMF de facto classification of exchange rate arrangements (Habermeier et al (2009)), and are correlated with the reserves to GDP – an indicator of foreign exchange market intervention capacity. Those correlations suggest a role for risk and risk-sharing in trilemma trade-offs.

The model used in the paper is derived in Munro (2014), and builds on Engel and West (2010) and Lustig and Verdelhan (2007). The model is a structural two-equation, partial equilibrium model. The first equation is Engel and West (2010)'s asset price equation, augmented with explicit risk adjustments. The second expresses the difference between home and foreign interest payoffs in terms of risk adjustments, following Lustig and Verdelhan (2007). By accounting explicitly for risk, the structural model reveals an estimation bias problem in the reduced-form relationship between exchange rates and relative interest returns. The idea that the exchange rate risk premium is correlated with expected returns goes back at least to Fama (1984).

Burnside (2012) and Sarno et al (2012) show that measures of risk that help to price equities or bonds are not helpful in pricing exchange rates. Furthermore, non-traditional measures of risk that help to price exchange rates are unhelpful in pricing equity and bond markets. The unobserved bond and currency premia derived from the structural model are consistent with that empirical regularity.

This paper also relates to the literature on the monetary policy trilemma, or "impossible trinity". The trilemma (Mundell (1983)) is based on the Mundell-Fleming model,[5] which is inconsistent with UIP because it does not account for expectations (Wren-Lewis (2013), Dornbusch (1976a)), and does not account for risk. Both are central to the model employed here. In a modern, open-economy model, interest parity implies trade-offs similar to those in Mundell's trilemma (Obstfeld et al (2005)). In a financially open economy, taking the expected foreign interest rate path as given, policymakers can control either the domestic interest rate or the exchange rate, but not both. Arbitrage in vast foreign exchange markets and fixed-income markets determines the other. Therefore, policymakers face a trade-off between interest rate stabilisation and exchange rate stabilisation.

Monetary policy trade-offs are also affected by expectations about future interest rates and by risk. Central banks typically control the overnight interest rate, while the exchange rate reflects the entire expected future paths of home and foreign interest rates. Monetary policy influences expectations about the future interest rate path, but that influence is constrained by the economic outlook (Bernanke (2013)), and payoffs further into the future also reflect increasing risk premia. The results here link monetary policy trade-offs to risk and risk sharing.

Empirical assessments of the trilemma support the idea that additional exchange rate management reduces interest rate independence (for example, Obstfeld et al (2005) and Aizenman et al (2010)). The results here suggest that some Asian countries have achieved, to varying degrees, lower exchange rate variance through additional exchange rate management, and have given up a corresponding

[5] See Fleming (1962) and Mundell (1962).

degree of interest rate control. That is, countries are not necessarily limited to the "corners" of the trilemma (Klein and Shambaugh (2013)). The results imply that the trade-off between exchange rate stabilisation and interest rate stabilisation is mainly a trade-off between the risk premium components of interest rates and the exchange rate.

The next section describes the risk-augmented asset price model of the exchange rate employed in this paper. Section 3 describes the empirical approach used. Section 4 presents the structural decompositions and relates the results to exchange rate regimes. Section 5 concludes.

2. The asset price model of the exchange rate

The asset price model used for the empirical analysis is derived in Munro (2014). It is a partial-equilibrium, structural asset price model based on two equations. The first equation is an exchange rate asset price equation, as in Engel and West (2010). It expresses the log of the real exchange rate, q_t (the value of the foreign currency in terms of home currency), as its expected long-run equilibrium value, $E_t\overline{q}_t$, net of the sum of expected relative real interest returns, R_t, and the sum of expected excess returns to holding foreign currency:[6]

$$q_t = -R_t - \Lambda_t + E_t\overline{q}_t \tag{1}$$

where, the sum of expected future relative interest payoffs $R_t = E_t\sum_{k=0}^{\infty} r^d_{t+k}$ is an undiscounted sum of future home-foreign short-term interest differentials, r^d_t. The "level" excess return, $\Lambda_t = E_t\sum_{k=0}^{\infty}\lambda_{t+k}$, is the sum of expected one-period excess returns to holding foreign currency $\lambda_t \equiv E_t(q_{t+1}) - q_t - r^d_t$. The expected long-run equilibrium exchange rate $E_t\overline{q}_t$ reflects factors such as the terms of trade and relative productivity (Benigno and Thoenissen (2003)).

Abstracting from risk, if the home interest rate is expected to rise relative to the foreign rate, the no-arbitrage condition (UIP) requires an immediate appreciation of the home currency (Dornbusch (1976b)) so that it can depreciate over the period of relatively high home returns. The initial appreciation eliminates all future excess returns, while the subsequent depreciation offsets the higher interest payoffs, period by period, so there is no excess return to holding the home or foreign asset.

The short-term interest rate is often assumed to be risk-free. Government bills or central bank rates are often assumed to be risk-free because their credit default risk and liquidity risk are relatively low. However, government bills reflect different sovereign ratings and can reflect "specialness" premia associated with investment

[6] This asset price form of the UIP condition has been examined in real terms (Engel and West (2010)) and in nominal terms (Engel and West (2010), Nason and Rogers (2008) and Kano (2014)). It is derived from the home investor's Euler equations for home bonds and foreign bonds.

mandates and collateral value (Krishnamurthy and Vissing-Jorgensen (2012)). Interest rates with a maturity greater than zero also reflect interest rate risk and term premia, and from the foreign investor's point of view, currency revaluation risk (Lustig and Verdelhan (2007)).

Lustig and Verdelhan (2007) show that the observed short-term home-foreign interest differential, r_t^d, can be expressed as:

$$r_t^d = (r_t^f - r_t^{*f}) - [cov_t(m_{t+1}, r_t) - cov_t(m_{t+1}^*, r_t^*)] \quad (2)$$

where the unobserved home risk-free interest rate, r_t^f, is defined by the home investor's willingness to give up a unit of consumption today to consume $(1 + r_t^f)$ units of consumption next period.[7] Similarly, r_t^{*f} is the unobserved foreign risk-free rate, defined by the foreign investor's consumption discount factor. m_t is the log of the stochastic discount factor M_t defined by:

$$M_{t+1} = E_t \beta U'_{C,t+1} / U'_{C,t} = \frac{1}{1+r_t^f}$$

where, β is the subjective discount factor and $U'_{c,t}$ is the marginal utility of consumption.

The covariance terms in (2) are consumption risk adjustments. They increase yields on bonds that perform poorly in bad times, and reduce the yields on bonds that perform well in bad times, such as those denominated in reserve currencies. Lustig and Verdelhan show that, with complete risk-sharing (risk-free rates are equal and the interest differential reflects only risk premia), the second covariance term includes exchange rate revaluation risk. Empirically, they also show that high interest currencies depreciate, on average, when consumption growth is low.

The second equation in the structural asset price model is a forward-looking version of equation (2). It expresses expected relative interest returns, R_t, as the difference between expected home and foreign risk-free rates and a "bond premium" Λ_t^R that reflects consumption risk adjustments:

$$R_t = R_t^f - \Lambda_t^R \quad (3)$$

where $R_t^f = E_t \sum_{j=1}^{N} (r_{t+j-1}^f - r_{t+j-1}^{f*})$ and $\Lambda_t^R = E_t \sum_{j=1}^{N} \lambda_{t+j-1}^R$.

Interpreting Λ_t in terms of consumption risk-adjustments, Munro (2014) shows that equation (1) can be written as:

$$q_t = -R_t - \Lambda_t^R - \Lambda_t^{FX} \quad (4)$$

[7] Depending on the formulation of the utility function, the risk-free rate is lower when people save more because they are patient, are averse to varying consumption across time (inter-temporal substitution), are averse to varying consumption across states (risk aversion) or if consumption growth is expected to be volatile (precautionary savings). See Cochrane (2001).

where $\Lambda_t^{FX} = \Lambda_t - \Lambda_t^R - E_t\overline{q}_t$ reflects a currency-specific premium, that reflects incomplete risk-sharing, and long-run fundamentals, such as relative productivity and the terms of trade. Despite the role of fundamentals, for convenience, here, we will refer to Λ_t^{FX} as the "currency premium".

Expected interest returns, R_t and the exchange rate excess return, Λ_t reflect common risk premia. If we assume that returns are risk-free, and estimate equation (4):[8]

$$\Delta q_t = -\alpha \Delta R_t \underbrace{-\Delta\Lambda_t + (E_{t+1}\overline{q}_t - E_t q_t)}_{\text{unobservables, } \varepsilon_{t+1}} \quad (5)$$

then our estimate of the parameter, α, will be biased:

$$\hat{\alpha} = \alpha + \frac{cov(-\Delta R_t, \varepsilon_{t+1})}{var(\Delta R_t)}$$

In the limit of complete risk-sharing,[9] consumption is perfectly correlated across countries, home and foreign risk-free rates are equal, and $m_t = m_t^*$. In that case, the risk-free interest rate differential is zero, and we should expect to estimate $\hat{\alpha} = 1 + \frac{cov_t(\Lambda_t^R, -\Lambda_t^R)}{var(\Lambda_t^R)} = 0$. In the complete risk-sharing case, there is complete disconnect in the reduced-form relationship between expected short-term interest returns and changes in exchange rates. There is also disconnect between measures of risk that price domestic asset markets and measures of risk that price the exchange rate (Sarno et al (2012), Burnside (2012)).

3. Empirical approach

3.1 Structural decomposition

To compare the risk and return characteristics of Asia-Pacific currencies, I first estimate the reduced-form relationship between exchange rates and expected returns (equation 5). Then I estimate the structural model defined by equations (3) and (4). The structural model decomposes the exchange rate and relative returns into three unobserved components – expected relative risk-free returns, R_t^f, the bond premium, Λ_t^R and the currency premium, Λ_t^{FX}, using q_t and R_t as observables.[10]

[8] Engel and West (2007) examine the unconditional correlation between q_t and R_t in differences to ensure stationarity.

[9] Complete risk-sharing is rejected in empirical studies (Backus and Smith (1993)). Kose et al (2003) find that, on average, consumption did not become more correlated across countries in the 1990s, despite financial integration.

[10] Another potential empirical approach is instrumental variables. For example, the residual of equation (5) can be used as an instrument for the bond premium in equation (3). Thanks to Hugo Vega for suggesting this.

The variables q_t, R_t and $\Lambda_t = (q_t - R_t)$ test as integrated for most currency pairs (Table 2). Therefore, the model is estimated in differences.[11]

$$\Delta q_t = -\Delta R_t - \Delta\Lambda_t^R - \Delta\Lambda_t^{FX} \quad (6)$$

$$\Delta R = \Delta R_t^f - \Delta\Lambda_t^R \quad (7)$$

Intuitively, variation in q_t and R_t is attributed to three unobserved components: negative co-movement between q_t and R_t is attributed to R_t^f; other variation in R_t is attributed to the bond premium, Λ_t^R; and other exchange rate fluctuations are attributed to the currency premium Λ_t^{FX}.

The implied bias in the reduced-form equation (5) is the ratio of the variance of changes in the bond premium to the variance of ΔR_t. Since variances must be positive, the parameter, α, will be biased downwards from its risk-free value of one, consistent with the weak unconditional correlation between Δq_t and ΔR_t in Engel and West (2010) and Table 3.

Applying this framework to a broad set of currencies, including emerging market currencies and more managed exchange rate regimes, allows us to compare, across currency regimes, the properties of the unobserved components, R_t^f, Λ_t^R and Λ_t^{FX}, from the structural decomposition,.

3.2 Forecasts of real interest rate returns

To estimate the model (6) and (7) we need measures of q_t and R_t. Real exchange rates are constructed as nominal rates times relative consumer prices. For R_t, we need a forecast of future relative interest returns.[12]

The interest rate swap market provides a useful market-based measure of expected future short-term (Libor or equivalent) nominal returns. The swap rate is the rate the market is willing to pay (receive) in exchange for floating-rate interest payments (receipts). When participants agree on a fixed rate, it should provide a good forecast of future floating rate payments. The risk component of swap rates is generally low compared to bonds of the same maturity. No principal is exchanged, collateral may be posted against out-of-the-money positions, and the counterparties are often similarly rated banks (see Duffie and Singleton (1997)). However, they still reflect other premia such as term premia, interest rate risk and currency revaluation risk.

[11] Estimating in differences should also make estimates less sensitive to structural change. See Munro (2014) for robustness.

[12] Engel and West (2005, 2010) forecast future economic fundamentals, such as relative interest payoffs using AR(1) and VAR(2) models.

The N -period interest-rate swap provides a forecast of the discounted sum of future short-term nominal floating Libor interest rates:

$$(1+i_t^{PV})^N = E_t \prod_{k=1}^{N} \beta^k (1+i_{t+k-1})$$

taking logs,

$$N i_t^{PV} \approx E_t \sum_{k=1}^{N} \beta^k i_{t+k}$$

These discounted, 10-year forecasts not quite the infinite, undiscounted sum we would like, but it is a market-based forecast of short-term interest returns over a long horizon, based on transacted prices.[13] Zero-coupon swaps would provide an undiscounted forecast of future short-term rates, but are not readily available for the additional six currencies.[14]

Expected relative real returns, R_t, are defined as expected relative nominal returns net of expected relative inflation:

$$\begin{aligned} R_t &= \sum_{k=0}^{119} (i_{t+k} - i^*_{t+k}) - E_t \sum_{k=1}^{120} (\pi_{t+k} - \pi^*_{t+k}) \\ &\approx 120(i_t^{sw10} - i_t^{*sw10}) - \frac{(\rho_\pi)^2 (1-\rho_\pi^{120})}{1-\rho_\pi} (\pi_{t-1} - \pi^*_{t-1}) \end{aligned} \tag{8}$$

where home and foreign 10-year nominal swap rates i_t^{sw10} and i_t^{*sw10} (% per month) are multiplied by 120 months to proxy a 120 month sum of returns. The expected 10-year sum of future relative inflation is proxied by an N -period AR1 forecast, based on observed $t-1$ inflation.[15] The AR(1) coefficient for inflation is estimated jointly with other parameters.

3.3 Estimation, data and prior distributions

The model is estimated for the original eight US dollar (USD) currency pairs examined in Munro (2014), and six additional Asian USD currency pairs (see Table 1). For each USD currency pair, the model is estimated using demeaned observed data for the CPI-based real exchange rate, q_t, the 10-year swap

[13] Those forecasts are the basis for a vast volume of transactions: the Bank for International Settlements (2013) reports that the notional amount of interest rate swaps outstanding globally in December 2012 was $490 trillion.

[14] The Euler equations for home and foreign bonds, from which UIP is derived, are discounted sums. The relative price is undiscounted. Plain vanilla swap rates are highly correlated with zero coupon swaps, so plain vanilla swaps should provide a good proxy for movements in expected returns in our framework that relies on sign restrictions. Munro (2014) shows the results using zero-coupon and plain-vanilla swaps to be qualitatively similar. Kano (2014) argues that the appropriate discount rate is well below one.

[15] Break-even inflation rates, derived from inflation-indexed bonds, might provide a better measure of expected inflation. In practice, inflation-indexed bonds are only systematically issued in a few jurisdictions, markets are often not very liquid and data samples are short.

differential, and relative annual CPI inflation $(\pi_t^{12} - \pi_t^{12*})$. The "home" currency is always the USD. The start date of the sample is limited by the available period for swap data on Bloomberg. The end of the sample is March 2014. Exchange rate and interest rate data are end-month. Data sources are shown in Appendix A.

The real exchange rates and forecasts of relative returns, R_t, are shown in Graph 1a for the original eight currencies and Graph 1b for the six additional Asian currencies. Descriptive statistics for q_t, R_t and Λ_t are shown in Table 3.

The model is estimated using Bayesian techniques.[16] In a first step, the mode of the posterior distribution is estimated by maximising the posterior function, that combines the prior information on the parameters with the likelihood of the data. In a second step, the Metropolis-Hastings algorithm is used to sample the posterior space and build the posterior distributions. The posterior distributions are from a Metropolis-Hastings chain, of which the first third is discarded. Acceptance rates are about 30%. Convergence is established using chi-squared statistics comparing the means of the beginning and end of the retained section of the Markov chain (Geweke (1992)). Dispersed priors restrict shock variances to be positive (Table 4).

For estimation, the full model also includes an expression for the forecast of expected real returns R_t (equation 8), accounting identities that relate levels and differences, and an AR(1) process for the evolution of annual inflation $(\pi_t^{12} - \pi_t^{12*})$.

4. Results

4.1 Posterior estimates

Table 4 reports the reduced-form estimates (top panel) and the structural estimates (bottom panel) for the 14 currency pairs. The posterior estimates of the parameters and shock standard deviations are well identified in the sense that the posterior distributions are distinct from the prior distributions as shown in Graph 2.

The estimates of α in equation (5) suggest a weak relationship between exchange rates and expected returns. The parameter α is consistently estimated to be well below one, consistent with the correlations reported in Engel and West (2010). The average estimate of α for the six additional Asian currencies (HKD, KRW, MYR, PHP, SGD and THB) is near zero. That is low compared a theoretical value of one,[17] and lower than the average reduced-form estimate of 0.44 for the original eight currency pairs.[18] How can we understand the weaker estimates for the

[16] See An and Schorfheide (2007) for a description of this methodology. The estimation is implemented in Dynare (Adjemian et al (2011)).

[17] The theoretical value for α may be greater than unity because we ignore interest rate differentials beyond 10-years and because we use a discounted sum of expected returns by using plain vanilla swaps rather than zero coupon swaps.

[18] This is higher than the 0.35 baseline estimate reported in Munro (2014) because the explanatory variable, R_t, is a smaller, discounted sum constructed from plain vanilla swaps rather than zero coupon swaps.

additional Asian currencies? While capital controls may play a role for some currencies, for others, such as the HKD, capital markets are very open.

From the perspective of the structural model (equations 6 and 7), the reduced-form estimate of α, is biased downward from one if observed interest returns are not risk-free. The downward bias is increasing in the volatility of the bond premium and falling in the volatility of R_t (bias $= -var(\Delta\Lambda_t^R) / var(\Delta R_t)$). The structural decomposition attributes the low reduced-form estimates to two factors. The main factor is the variance of the bond premium. The average standard deviation of changes in the bond premium for the six additional Asian currencies, at 2.9% is about double the average 1.4% for the original eight currency pairs.

The second factor that contributes to low reduced-form estimates is the variance of changes in relative risk-free returns. The average standard deviation of relative risk-free returns is slightly smaller for the additional Asian currencies, at 0.9%, compared to 1.2% for the eight original currency pairs. The lower variance of relative risk-free returns increases the reduced-form estimation bias by reducing the variance of R_t, the denominator in the bias equation.

The estimated volatility of relative risk-free returns is particularly low for the HKD and CAD, helping to explain the low reduced-form estimates of α for those currencies. The low variance of relative risk-free returns is interesting in terms of the higher implied degree of risk-sharing. As countries become more financially integrated, we expect consumption growth to be increasingly correlated, so that risk-free rates, defined by consumption discount factors, converge. The low estimated volatility of relative risk-free returns for the CAD and HKD relative to the USD suggest that the degree of financial market completeness increases with a common currency (Hong Kong SAR) or with a high degree of economic integration (Canada).

Together, the higher degree of risk-sharing (lower variance of the relative risk-free returns) and the larger relative bond premium imply severely biased estimates of α for the six additional Asian currencies. The implied reduced-form estimation bias is shown in the right hand column in the bottom section of Table 4. For the additional Asian currencies, the reduced-form estimation bias implied by the structural model averages –0.92, compared to –0.58 for the original eight currency pairs.

4.2 Variance decomposition

When observed interest rates are assumed to be risk-free, all of the variance of relative returns is attributed to relative risk-free rates (Table 5 top panel, last two columns). When risk is accounted for, the relative bond premium accounts for 55% of the variance in expected relative returns, on average (Table 5 bottom panel). For the additional six Asian currencies, the relative bond premium accounts for an average 88% of the variance of changes in expected relative returns.

When risk is accounted for, risk-free returns account for a considerably higher share of exchange rate variance. Relative risk-free returns account for an average 19% of exchange rate variance, compared to 5% in the reduced-form equation (Table 5, first three columns). For the additional six Asian countries, relative risk-free returns account for an average 24% of exchange rate variance, compared to 4% in the reduced-form equation. The contribution of relative risk-free returns to

exchange rate variance is highest for the HKD at nearly 50%. Overall, even though UIP is assumed to hold in the structural decomposition, movements in the currency premium (risk and changes in expected long-run fundamentals) account for about three quarters of exchange rate variance, on average.

4.3 Unobserved components and exchange rate regimes

While the estimated bond premium volatility tends to be higher for the additional Asian currencies, there appears to be a trade-off. The volatility of the currency premium for those currencies (except the Korean won) is correspondingly smaller, and the volatility of relative risk-free returns is slightly smaller. Graph 3 illustrates those trade-offs.

In Graph 3, the currencies are ordered according to the ratio of the currency premium volatility to bond premium volatility. That ordering loosely groups the currencies according to IMF de facto exchange rate regimes.[19] At the right, the Hong Kong dollar (currency board, dark colour) has the highest currency premium to bond premium variance. The currencies classified as partly managed (medium colour) tend to lie towards the right. Currencies that are classified in the most freely floating category (lighter colour) over the whole 2000–12 period (see Table 1) tend toward the left, and have smaller relative bond premium volatility relative to currency premium volatility.

Another potential indicator of the exchange rate regime is the ratio of foreign currency reserves to GDP. The reserves to GDP ratio is an indicator of foreign exchange market intervention capacity. For more managed currencies a substantial stock of reserves is required to credibly stabilise exchange rates in the event of downward pressure on the currency. For countries with floating exchange rates, there is less reason to incur the carry cost of holding a large stock of reserves. Reserves tend to be expensive to hold because the tendency of reserve currencies to appreciate in bad times, when the marginal utility of consumption rises, lowers the yield on reserve currencies (Lustig and Verdelhan (2007)).

Graph 4 plots the standard deviations of the risk and risk-free components against reserves/GDP. For these 14 currencies, countries with greater foreign exchange market intervention capacity tend to have more volatile bond premia and less volatile currency premia. For the latter, the slope coefficient of -1.8% is significant to the 1% level. The slope coefficient for the bond premium is a little smaller in magnitude at 1.2%. It is not significant, unless the PHP outlier is removed, in which case, the slope coefficient is little changed, but is significant to the 1% level and the R^2 statistic increases from 0.12 to 0.57.

The standard deviation of innovations in relative risk-free rates declines slightly with reserves/GDP. The slope coefficient, at -0.40%, is relatively small and is significant to the 5% level. If the CAD is excluded, on the basis that close geography and trade integration might play a role in that case, the slope coefficient is still relatively small at -0.47, and is significant to the 1% level.

[19] There is no perfect measure of exchange rate regime and popular measures of regime are not highly correlated. See Klein and Shambaugh (2010) for a summary of the literature.

4.4 The trilemma and trade-offs

For a financially open economy, Mundell's trilemma is usually stated as a trade-off between capital mobility, a stable exchange rate, and the ability to conduct an independent monetary policy (Graph 5, top panel). Of those three, we can only achieve two. Mundell's monetary policy trilemma is based on the Mundell-Fleming model.[20] However, that model is inconsistent with UIP, because it abstracts from expectations (Wren-Lewis (2013), Dornbusch (1976a)), and abstracts from risk. Both are central to the model used here.

In a modern open-economy model, monetary policy trade-offs, akin to those of Mundell, can be stated simply in terms of interest parity (Obstfeld et al (2005)). As illustrated in the centre panel of Graph 5, with an open financial account, arbitrage is active and UIP links the exchange rate with expected relative returns. Taking the expected path of the foreign interest rate as given, the home policymaker can either stabilise the exchange rate or control the home interest rate path, but not both. Arbitrage in vast foreign exchange and fixed income markets pins down the other. When the trilemma is framed in terms of arbitrage, independent monetary policy has been replaced with stabilisation of the domestic interest rate path.[21]

The trade-off is not so simple when we consider expectations about future interest rates and risk, which also matter for the exchange rate. Central banks typically control an overnight interest rate, while the exchange rate reflects the entire expected future paths of home and foreign interest rates. The influence of short-term rates on longer-term rates, through the expectations hypothesis, is constrained by economic conditions (Bernanke (2013)).[22] Moreover, term premia are increasingly important for less certain payoffs further into the future.

The trade-off between volatility of the bond premium, the currency premium and, to a lesser extent, risk-free returns, and the correlation of those trade-offs with measures of the exchange rate regime (Graphs 3 and 4), suggest a role for risk and risk sharing in understanding monetary policy trade-offs (Graph 5, bottom panel). Exchange rate stabilisation is associated with lower currency premium variance, but with higher relative bond premium variance. That is, observed interest rates are further from the underlying risk-free rate.

The idea that the currency premium is less volatile in a managed exchange rate regime makes sense. If foreign exchange market intervention achieves the purpose of stabilising the exchange rate relative to the base country, then the less volatile exchange rate translates into a smaller currency premium. The larger "currency

[20] See Mundell (1962) and Fleming (1962).

[21] This formulation of the trilemma is helpful in understanding Singapore's monetary system. The objective of the Monetary Authority of Singapore is stated in terms of an inflation target, suggesting independent monetary policy, but is achieved through an intermediate exchange rate target with foreign exchange market intervention as the primary instrument. For a financially open economy, that combination appears to contradict Mundell's trilemma. While a managed exchange rate implies giving up control over the home interest rate path, there is no reason that the exchange rate target cannot be varied as a function of home inflation. In the Singaporean case, imports account for a large share of the CPI basket, so the exchange rate has a strong effect on inflation.

[22] Future interest rates may be influenced through unconventional policies such as forward guidance and bond purchases. In addition, prudential policies may influence the supply/demand for credit.

premium" in floating exchange rate currencies may also reflect more variable long-run fundamentals that affect the choice of the exchange rate regime, ex ante.

Conversely, in floating exchange rate countries, monetary policy appears to stabilise the bond premium – the distance between observed interest rates and the underlying risk-free rate. That is consistent with the idea that optimal monetary policy, in a floating exchange rate regime, sets interest rates close to the underlying risk-free rate (Woodford (2003), Broadbent (2014)).

Asian countries appear to have achieved a varied degree of additional exchange rate management but to have given up a corresponding degree of interest rate control. That result supports the idea that countries may not be limited to "corner" solutions of the trilemma (Klein and Shambaugh (2013)).

4.5 Derived risk premia, capital flows and the VIX index

Through the lens of the risk-augmented asset price model, we have interpreted Λ_t^R as a bond premium and Λ_t^{FX} as a currency premium plus long-run fundamentals. However, we cannot rule out a role for the supply and demand effects of cross-border capital flows. Empirically, cross-currency flows are large and volatile,[23] so may have significant short-term effects on prices,[24] and reflect a variety of factors including, risk, portfolio shifts, "carry trade", safe-haven flows and central bank intervention.

Cerutti et al (2014) and Rey (2013) link the VIX index[25] to the global financial cycle and cross-border flows. Table 6 shows correlations between changes in the VIX index and changes in the exchange rates and the unobserved components. When the VIX index rises, non-reserve currencies depreciate (first column). Through the lens of the risk-adjusted model, non-reserve currencies depreciate because their currency premium rises relative to the USD.[26]

For some currencies, the foreign bond premium also rises relative to the USD when VIX rises, but that effect is generally weaker, is less consistent across currency pairs, and has little effect on the currency – only risk-adjusted returns matter for the exchange rate.

In practice, risk premia and capital flows are often closely related. Empirically, stress events are often associated with large capital flows. Uncertainty or a rise in

[23] For advanced countries, gross current account credits and debits typically account for less than 1% of foreign exchange market turnover reported in the BIS Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity.

[24] Evans and Lyons (2002, 2006) show that flows through foreign currency markets have strong explanatory power for exchange rate movements.

[25] The VIX index is the implied volatility of the S&P 500 equity index.

[26] Changes in VIX tend to be dominated by periods of elevated uncertainty and safe haven flows. Speculative positioning in the International Money Market (IMM) of the Chicago Merchantile Exchange is perhaps more indicative of cross-border capital flows in normal times. In contrast to the correlations for changes in VIX, Munro (2014) shows that, when IMM positioning in a currency increases relative to the USD, that currency appreciates because the foreign bond premium falls and foreign risk-free returns rise relative to US risk-free returns. Those correlations do not inform on causality. IMM positioning is not reported for the additional Asian currencies.

risk may generate safe haven flows, or a retreat from risky assets; and expectation of flows in/out of asset markets, in turn, affect the risk of holding assets in those markets. In principle, assets can be repriced without actual flows (Fama (1965)), so a lasting role for flows implies some sort of limit to capital free arbitrage (Shleifer and Vishny (1997)).

5. Conclusions

This paper examined the risk and return properties of exchange rates and expected relative interest returns, for a diverse group of currencies, including nine Asia Pacific currencies. Extending the analysis of Munro (2014) to include six additional Asian currencies both confirms the original results and provide a new perspective.

When risk is not accounted for, the relationship between exchange rates and expected returns is estimated to be weak, and even weaker for the additional six Asian USD currency pairs. That weaker reduced-form relationship for more managed currencies can be understood in terms of a larger wedge between the underlying risk-free rate and the observed interest rate. That wedge – the bond premium – is a source of reduced-form estimation bias. When risk is accounted for, relative risk-free returns account for about 20% of exchange rate variance, on average, compared to about 5% when interest rates are assumed to be risk-free. Overall, even when UIP holds, the bulk of exchange rate variation is attributed to currency-specific premia, linked to incomplete risk sharing, and to short-term changes in expected long-run fundamentals.

The additional Asian currencies provide a new perspective. There appears to be a trade-off between bond premium volatility and volatility of the currency premium or fundamentals. That trade-off is significantly related to measures of the exchange rate regime. Countries with more managed exchange rates have more volatile bond premia and correspondingly less volatile currency premia or long-run fundamentals. To a lesser extent, more managed currencies' risk-free rates move more closely with US risk-free rates. Asia-Pacific currencies span a full range of exchange rate regimes and risk premium trade-offs. The paper supports the idea that countries are not limited to the corners of the trilemma, and points to a role for risk and risk-sharing in monetary policy trilemma trade-offs.

IMF de facto exchange rate classification 2000–12

Table 1

	2000	2002	2004	2006	2008	2010	2012
Additional six Asian currencies							
HKD	CB	CB	CB	CB	CB	CB	CB
MYR	P	P	P	MF	MF	MF	MF
SGD	MF	MF	MF	MF	MF	MF	MF
THB	FF	MF	MF	MF	MF	F	F
PHP	FF	FF	FF	FF	FF	F	F
KRW	FF	FF	FF	FF	FF	F	F
Original currency pairs							
CHF	FF	FF	FF	FF	FF	FF	MF
AUD	FF	FF	FF	FF	FF	FF	FF
CAD	FF	FF	FF	FF	FF	FF	FF
EUR	FF	FF	FF	FF	FF	FF	FF
GBP	FF	FF	FF	FF	FF	FF	FF
JPY	FF	FF	FF	FF	FF	FF	FF
NZD	FF	FF	FF	FF	FF	FF	FF
SEK	FF	FF	FF	FF	FF	FF	FF

Source: International Monetary Fund, Annual Report, various issues. The IMF classification system was revised in 2009 (see https://www.imf.org/external/pubs/cat/longres.aspx?sk=23311.0.).

Note: CB=currency board, P=other pegged arrangement, MF=managed float, F=floating with some intervention, FF=freely floating. HKD=Hong Kong dollar, MYR=Malaysian ringgit, SGD=Singapore dollar, THB=Thai baht, PHP=Phillipine peso, KRW=Korean won, AUD=Australian dollar, CAD=Canadian dollar, CHF=Swiss franc, EUR=euro, GBP=British pound, JPY=Japanese yen, NZD=New Zealand dollar, SEK=Swedish krona. All currencies are measured against the US dollar.

Unit root tests

Table 2

	Real exchange rate, q_t			Forecast returns, R_t			$\Lambda_t = -(q_t + R_t)$		
	Statistic	lag		statistic	lag		statistic	lag	
					Levels				
AUD	–2.8	0	*	–2.0	0		–2.1	0	
CAD	–2.6	0		–2.2	0		–2.0	0	
CHF	–3.5	0	***	–2.3	0		–2.3	0	
EUR	–2.2	0		–2.2	0		–2.2	0	
GBP	–2.9	0	*	–2.3	0		–2.4	0	
JPY	–2.1	0		–2.6	0		–2.8	0	*
NZD	–3.9	0	***	–2.3	0		–2.1	0	
SEK	–2.8	0	*	–2.0	0		–2.2	0	
KRW	–2.5	2		–2.4	0		–2.3	0	
HKD	–3.3	0	**	–1.5	1		–3.8	0	***
SGD	–2.5	0		–2.6	0		–3.5	0	***
MYR	–3.4	0	**	–2.0	0		–3.0	0	**
PHP	–3.1	0	**	–3.4	0	**	–3.0	0	**
THB	–3.4	0	**	–3.6	0	***	–3.3	0	**
					Differences				
AUD	–14.8	0	***	–15.4	0	***	–15.5	0	***
CAD	–16.7	0	***	–15.7	0	***	–16.4	0	***
CHF	–16.0	0	***	–13.4	1	***	–16.0	0	***
EUR	–13.9	0	***	–14.9	0	***	–13.5	0	***
GBP	–15.0	0	***	–13.6	1	***	–15.4	0	***
JPY	–15.5	0	***	–14.5	1	***	–17.0	0	***
NZD	–6.6	2	***	–13.1	1	***	–15.2	0	***
SEK	–15.3	0	***	–15.6	0	***	–15.8	0	***
KRW	–13.1	0	***	–12.9	1	***	–12.8	0	***
HKD	–13.2	0	***	–15.1	0	***	–15.4	0	***
SGD	–15.4	0	***	–13.9	0	***	–14.5	0	***
MYR	–11.4	0	***	–12.1	0	***	–10.1	1	***
PHP	–13.1	0	***	–13.7	0	***	–13.9	0	***
THB	–11.6	0	***	–14.6	0	***	–15.1	0	***

Notes: Dickey and Fuller (1979) test using the Schwarz/Bayesian Information Criterion to select lag length. Maximum lag of 2. *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level. See Table 1 for abbreviations.

Estimated standard deviations and correlations of q, R, and Λ

Table 3

		Levels						Differences				
		q	R		Λ			q	R		Λ	
AUD	q	22.16	–0.79	***	–0.96	***	Δq	3.58	–0.32	***	–0.89	***
	R		7.74		0.58	***	ΔR		1.62		–0.14	**
	Λ				16.74		$\Delta\Lambda$				3.43	
CAD	q	14.22	–0.05		–0.94	***	Δq	2.42	–0.05		–0.88	***
	R		4.90		–0.28	***	ΔR		1.27		–0.43	***
	Λ				14.79		$\Delta\Lambda$				2.68	
CHF	q	14.34	–0.58	***	–0.91	***	Δq	3.21	–0.21	***	–0.84	***
	R		6.02		0.19	***	ΔR		1.84		–0.35	***
	Λ				11.91		$\Delta\Lambda$				3.34	
EUR	q	14.94	–0.38	***	–0.94	***	Δq	3.16	–0.31	***	–0.87	***
	R		5.06		0.04		ΔR		1.60		–0.20	***
	Λ				13.84		$\Delta\Lambda$				3.07	
GBP	q	7.88	–0.27	***	–0.82	***	Δq	2.38	–0.24	***	–0.77	***
	R		4.77		–0.33	***	ΔR		1.68		–0.43	***
	Λ				8.04		$\Delta\Lambda$				2.57	
JPY	q	14.17	–0.13	**	–0.82	***	Δq	3.18	–0.19	***	–0.78	***
	R		9.14		–0.46	***	ΔR		2.24		–0.47	***
	Λ				15.86		$\Delta\Lambda$				3.53	
NZD	q	21.50	–0.59	***	–0.98	***	Δq	3.83	–0.29	***	–0.88	***
	R		5.04		0.41	***	ΔR		1.87		–0.21	***
	Λ				18.95		$\Delta\Lambda$				3.75	
SEK	q	13.24	–0.51	***	–0.75	***	Δq	3.30	–0.25	***	–0.84	***
	R		8.93		–0.19	***	ΔR		1.91		–0.32	***
	Λ				11.59		$\Delta\Lambda$				3.38	
KRW	q	17.69	0.29	***	–0.97	***	Δq	3.57	0.06		–0.84	***
	R		5.39		–0.53	***	ΔR		2.43		–0.59	***
	Λ				19.94		$\Delta\Lambda$				4.44	
HKD	q	11.81	–0.75	***	–0.75	***	Δq	0.84	–0.12	*	–0.22	***
	R		7.88		0.12	**	ΔR		2.46		–0.94	***
	Λ				7.88		$\Delta\Lambda$				2.50	
SGD	q	12.76	–0.57	***	–0.87	***	Δq	1.95	–0.12	*	–0.59	***
	R		6.37		0.08		ΔR		2.29		–0.73	***
	Λ				10.55		$\Delta\Lambda$				2.82	
MYR	q	8.56	–0.65	***	–0.54	***	Δq	1.84	0.05		–0.68	***
	R		7.51		–0.29	***	ΔR		2.08		–0.76	***
	Λ				6.82		$\Delta\Lambda$				2.85	
PHP	q	16.99	0.84	***	–0.94	***	Δq	2.05	0.44	***	–0.67	***
	R		25.52		–0.97	***	ΔR		5.65		–0.96	***
	Λ				40.85		$\Delta\Lambda$				6.81	
THB	q	15.16	–0.24	***	–0.92	***	Δq	1.82	–0.02		–0.52	***
	R		5.89		–0.15	**	ΔR		2.86		–0.84	***
	Λ				14.89		$\Delta\Lambda$				3.36	
averages	q	14.67	–0.31		–0.87		Δq	2.65	–0.11		–0.73	
	R		7.87		–0.13		ΔR		2.27		–0.53	
	Λ				15.19		$\Delta\Lambda$				3.47	

Notes: Following Table 1 in Engel and West (2010), diagonal elements are standard deviations; off-diagonal elements are correlations. Expected relative returns, R_t, is the 10-year interest rate swap differential, net of an AR(1) relative inflation forecast. $\Lambda_t \equiv -(q_t + R_t)$.

*** indicates significance to the 1% level; ** to the 5% level, and * to the 10% level. See Table 1 for abbreviations.

Prior and posterior estimates

(Forecasts of expected returns from plain-vanilla interest rate swaps) Table 4

	α	σ^{R^f}	σ^{Λ^R}	$\sigma^{\Lambda^{FX}}$	ρ^{π}	σ^{π}	$\hat{\alpha}$ Bias
Distribution	N	γ^{-1}	γ^{-1}	γ^{-1}	β	γ^{-1}	
Prior mean	1	0.020	0.020	0.020	0.8	0.0003	$\frac{var(\Delta\Lambda_t^R)}{var(\Delta R_t)}$
Prior stdev	0.5	0.50	0.50	0.50	0.1	0.0050	
Reduced form model (Risk treated as exogenous $\Lambda^R = 0$)							
AUD	0.71	0.016	–	0.034	0.88	0.00048	
CAD	0.12	0.013	–	0.024	0.89	0.00029	
CHF	0.40	0.019	–	0.031	0.89	0.00028	
EUR	0.64	0.016	–	0.030	0.89	0.00030	
GBP	0.35	0.017	–	0.023	0.93	0.00033	
JPY	0.27	0.022	–	0.031	0.92	0.00037	
NZD	0.61	0.019	–	0.037	0.87	0.00045	
SEK	0.42	0.019	–	0.032	0.91	0.00035	
KRW	–0.08	0.024	–	0.036	0.87	0.00044	
HKD	0.04	0.025	–	0.009	0.92	0.00073	
SGD	0.10	0.023	–	0.019	0.91	0.00051	
MYR	–0.03	0.021	–	0.019	0.85	0.00055	
PHP	–0.16	0.056	–	0.019	0.91	0.00061	
THB	0.01	0.029	–	0.018	0.87	0.00046	
Avg. Orig8	0.44	0.018	–	0.030	0.90	0.00036	
Avg.Asian6	–0.02	0.030	–	0.020	0.89	0.00055	
Structural decomposition							
AUD	1	0.013	0.011	0.033	0.89	0.00048	–0.42
CAD	1	0.008	0.011	0.024	0.89	0.00028	–0.70
CHF	1	0.012	0.014	0.030	0.89	0.00029	–0.59
EUR	1	0.012	0.011	0.029	0.89	0.00030	–0.45
GBP	1	0.011	0.014	0.022	0.93	0.00033	–0.65
JPY	1	0.012	0.019	0.029	0.92	0.00037	–0.72
NZD	1	0.014	0.013	0.036	0.87	0.00045	–0.48
SEK	1	0.013	0.015	0.031	0.91	0.00035	–0.59
KRW	1	0.010	0.023	0.035	0.87	0.00044	–0.87
HKD	1	0.006	0.024	0.007	0.92	0.00073	–0.94
SGD	1	0.010	0.021	0.017	0.91	0.00051	–0.84
MYR	1	0.009	0.020	0.017	0.85	0.00055	–0.90
PHP	1	0.009	0.058	0.019	0.91	0.00062	–1.05
THB	1	0.010	0.027	0.016	0.87	0.00046	–0.91
Avg.Orig.8	1	0.012	0.014	0.029	0.90	0.00036	–0.58
Avg.Asian6	1	0.009	0.029	0.019	0.89	0.00055	–0.92

Notes: The posterior mode is the maximum of posterior distribution. The standard asset price model is subject to the restriction $\alpha > 0$ and Bayesian priors. α is the exchange rate response to expected interest returns. $\rho\pi$ is the AR(1) coefficient for relative inflation. σ_{R^f}, σ_R, σ_{FX} and σ_π are the standard deviations of the innovations in risk-free relative returns, the bond premium, the currency premium and of relative inflation respectively. See Table 1 for abbreviations.

Unconditional variance decomposition

Table 5

variable →	Exchange rate			Expected returns	
innovation →	relative risk-free returns	common bond premium	idiosyncratic currency premium	relative risk-free returns	common bond premium
	Reduced-form model (Risk treated as exogenous $\Lambda^R = 0$)				
AUD	10.59	–	89.41	100	–
CAD	0.44	–	99.56	100	–
CHF	5.20	–	94.80	100	–
EUR	10.66	–	89.34	100	–
GBP	6.09	–	93.91	100	–
JPY	3.55	–	96.45	100	–
NZD	8.72	–	91.28	100	–
SEK	6.10	–	93.90	100	–
KRW	0.29	–	99.71	100	–
HKD	1.42	–	98.58	100	–
SGD	1.39	–	98.61	100	–
MYR	0.09	–	99.91	100	–
PHP	18.29	–	81.71	100	–
THB	0.04	–	99.96	100	–
Average	5.21	–	94.80	100	–
	Structural decomposition				
AUD	13.43	–	86.57	60.50	39.50
CAD	10.21	–	89.79	35.27	64.73
CHF	14.42	–	85.58	42.49	57.51
EUR	15.84	–	84.16	56.93	43.07
GBP	20.16	–	79.84	38.61	61.39
JPY	15.24	–	84.76	30.39	69.61
NZD	13.19	–	86.81	53.35	46.65
SEK	15.38	–	84.62	43.37	56.63
KRW	8.13	–	91.87	17.15	82.85
HKD	46.87	–	53.13	6.58	93.42
SGD	25.22	–	74.78	18.61	81.39
MYR	21.52	–	78.48	17.52	82.48
PHP	16.73	–	83.27	2.20	97.80
THB	27.69	–	72.31	11.75	88.25
Average	18.86	–	81.14	31.05	68.95

Note: for this random walk model, the unconditional variance decomposition and forecast error variance decomposition are identical. See Table 1 for abbreviations.

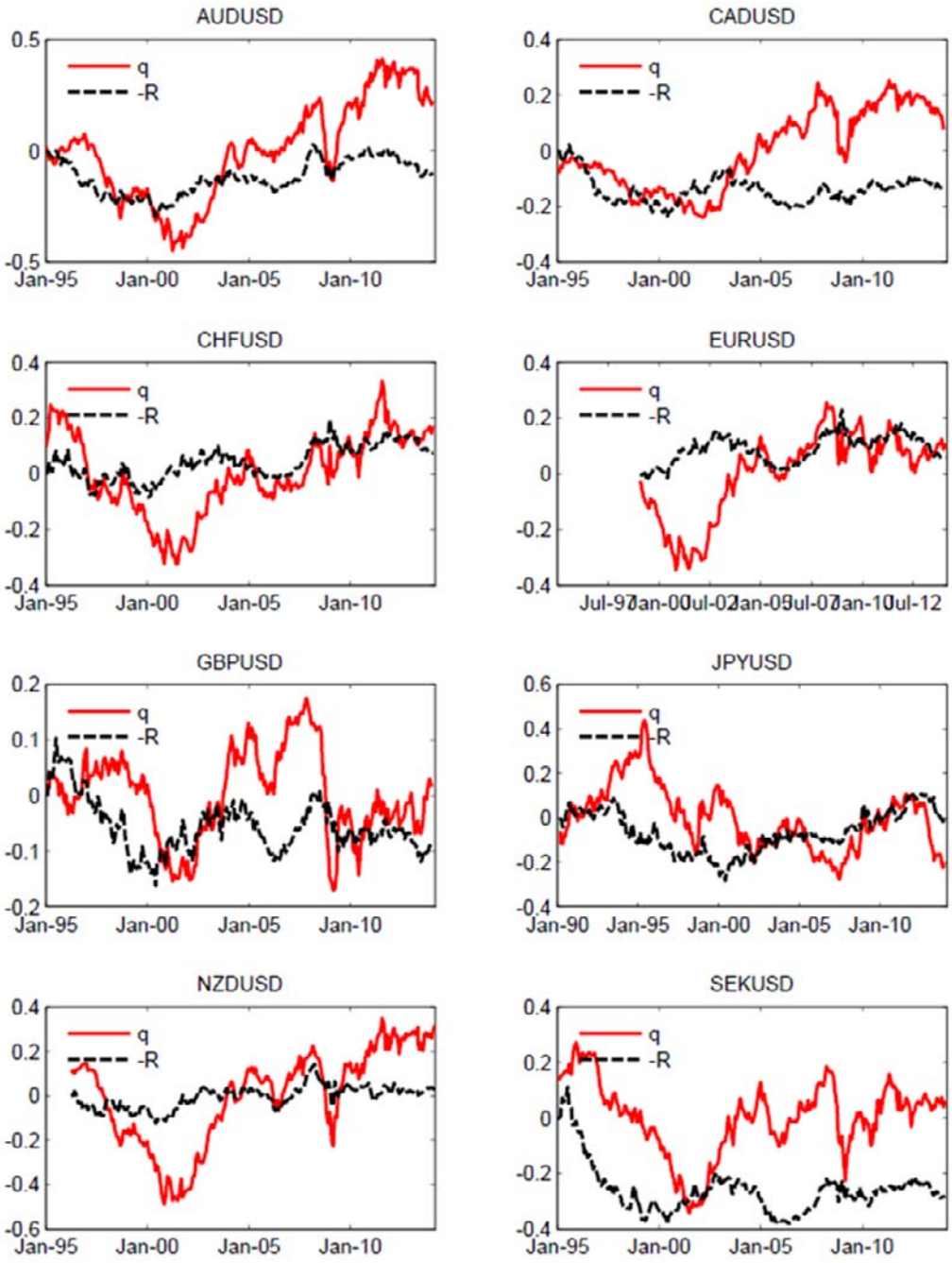
Correlations of innovations with changes in VIX

Table 6

	Δq_t		ΔR_t^f		$\Delta\Lambda^R$		$\Delta\Lambda^{FX}$	
AUD	–0.50	***	0.09		0.17		0.53	***
CAD	–0.43	***	0.07		0.18		0.45	***
CHF	–0.13	**	0.01		0.07		0.14	**
EUR	–0.36	***	0.10		0.11		0.37	***
GBP	–0.06		–0.04		0.10		0.08	
JPY	0.06		–0.06		0.03		–0.05	
NZD	–0.39	***	0.04		0.18		0.43	***
SEK	–0.32	***	0.12	*	0.07	*	0.33	***
KRW	–0.41	***	0.14	*	0.14	*	0.42	***
HKD	–0.09		0.07		0.08		0.10	
SGD	–0.32	***	0.25	***	0.04	***	0.32	***
MYR	–0.42	***	0.26	***	0.19	***	0.43	***
PHP	–0.27	***	0.19	***	0.31	***	0.28	***
THB	–0.23	***	0.12		0.19		0.25	***
average	–0.28		0.10		0.13		0.29	
Reserve currencies: CHF, EUR, GBP, JPY, HKD	–0.11		0.02		0.08		0.13	
Other currencies	–0.37		0.14		0.16		0.38	

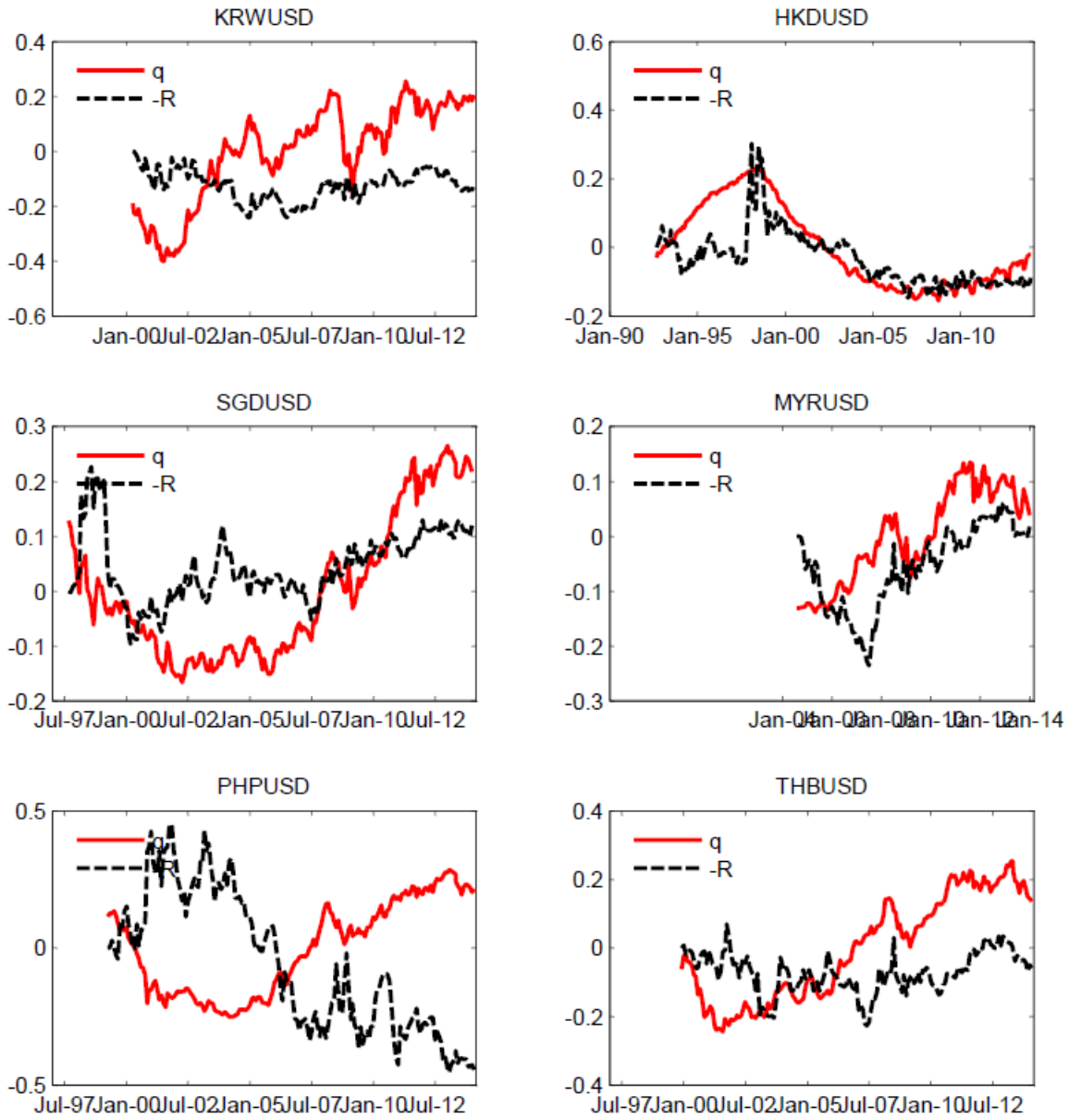
The VIX index is the implied volatility of S&P 500 options, and is commonly used as a measure of risk aversion. A rise in the exchange rate is a depreciation of the USD. Relative risk-free returns are US minus foreign. A rise in VIX is correlated with appreciation of the USD relative to non-reserve currencies because the foreign currency premium rises. For some currencies, the "bond premium" also rises significantly, but that result is less consistent across currencies and weaker, except for the PHP and THB. *** indicates significance to the 1% level; ** indicates significance to the 5% level, * indicates significance to the 10% level. See Table 1 for abbreviations.

Real exchange rates and forecast sums of future relative returns Graph 1a



Real exchange rates (q_t, red lines) are % deviation from sample mean. Dashed black lines show expected relative returns ($-R_t$) constructed as 120 times the 10-year nominal swap differential (monthly rate), net of an AR(1) forecast of the relative inflation paths.

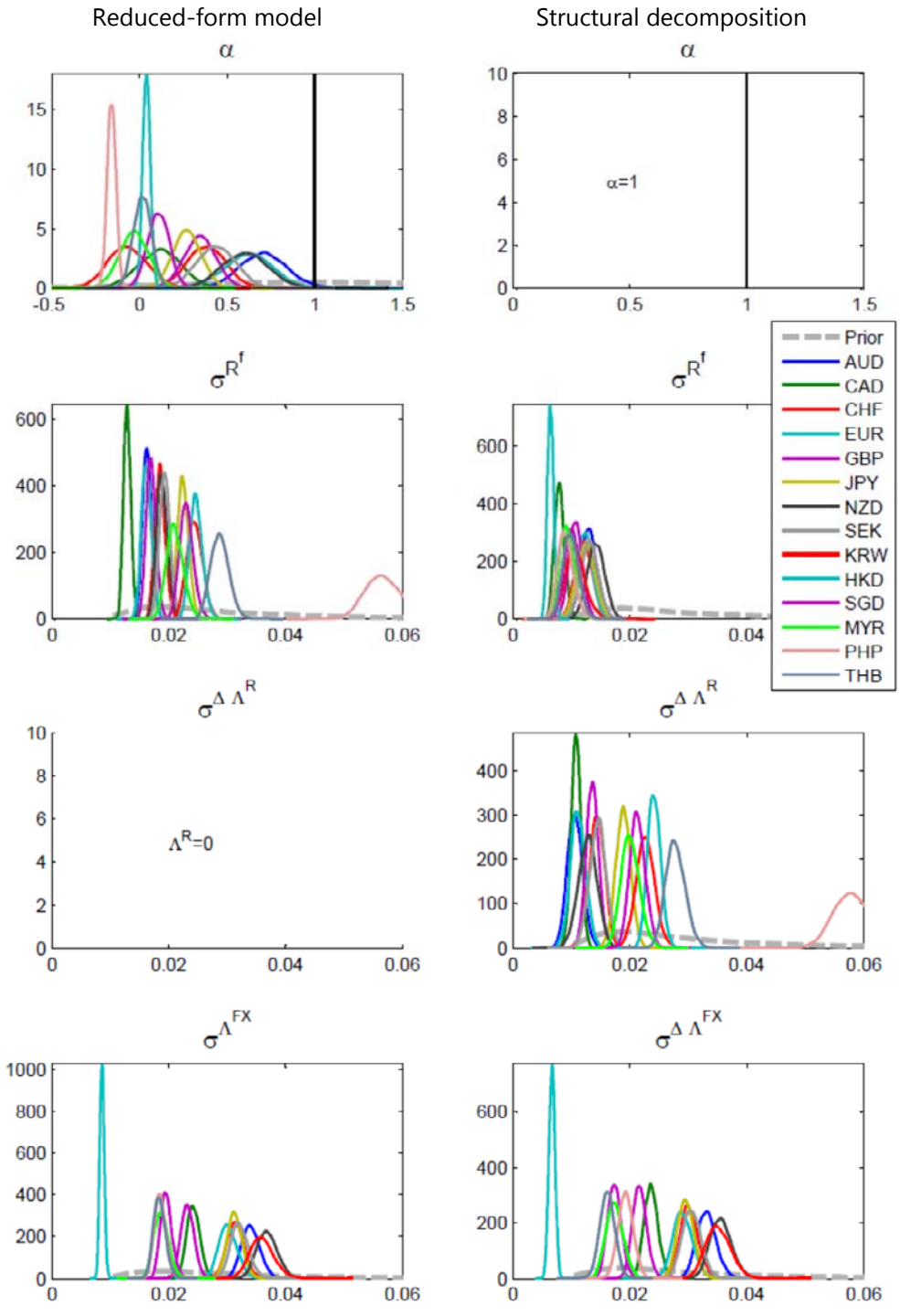
Real exchange rates and forecast sums of future relative returns Graph 1b



Notes: Real exchange rates (Δq_t , red lines) are % deviation from sample mean. Dashed black lines show expected relative returns ($-\Delta R_t$) constructed as 120 times the 10-year nominal swap differential (monthly rate), net of an AR(1) forecast of the relative inflation paths. See Table 1 for abbreviations.

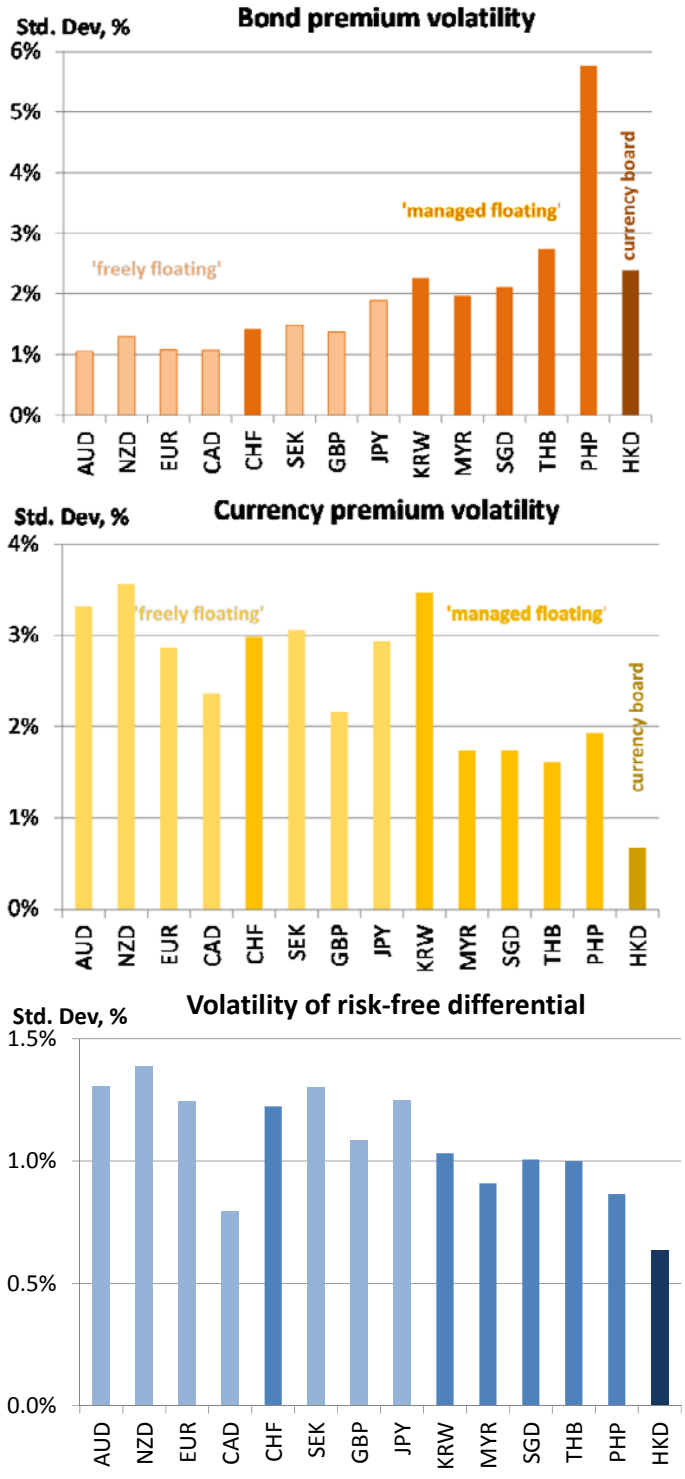
Prior and posterior densities:

(expected returns constructed from plain-vanilla interest rate swaps) Graph 2



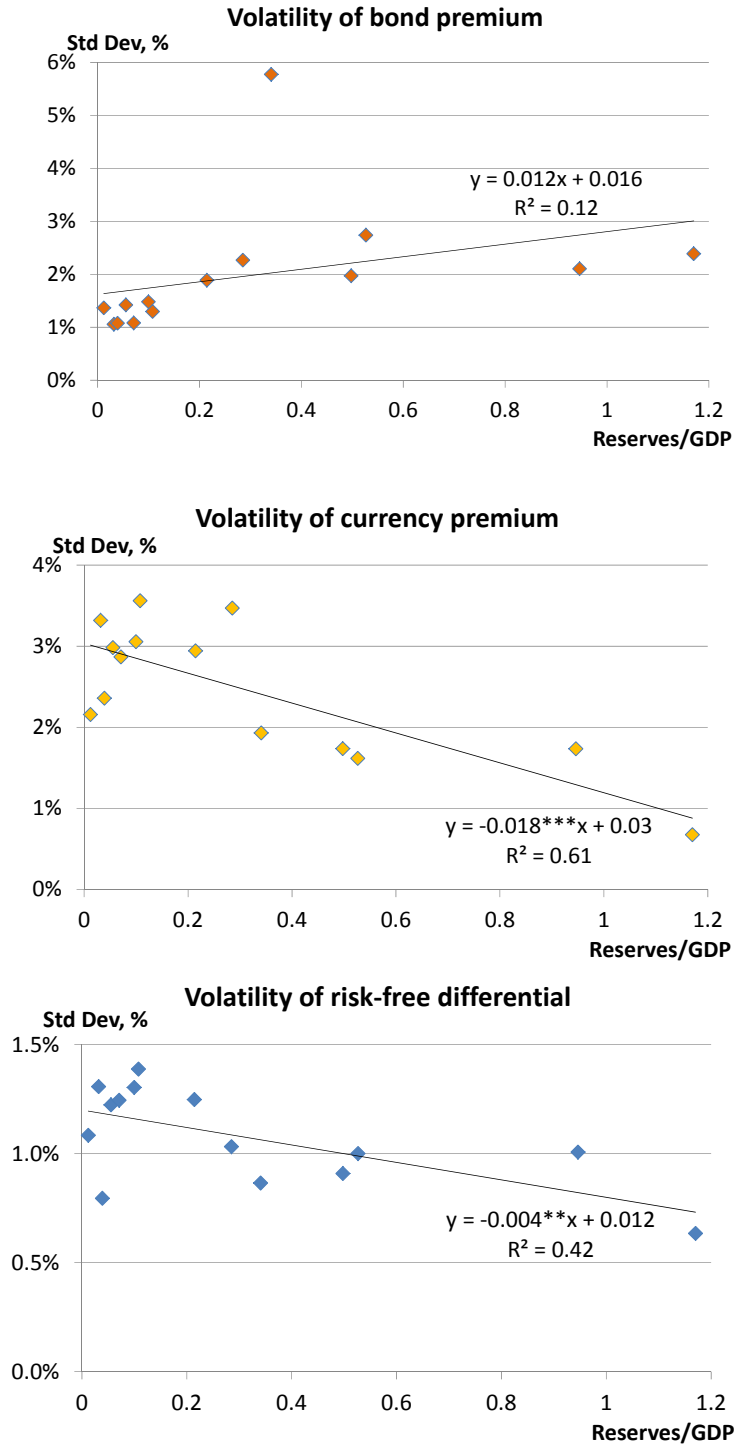
Notes: The posterior mode is the maximum of posterior distribution. The standard asset price model is subject to the restriction $\alpha > 0$ and Bayesian priors. α is the exchange rate response to expected interest returns. σ_{R^f}, σ_R, σ_{FX} and σ_π are the standard deviations of the innovations in risk-free relative returns, the bond premium, the currency premium and of relative inflation respectively. See Table 1 for abbreviations.

Can the exchange rate regime explain the risk-premium trade-off? Graph 3



Notes: See Table 1 for IMF de facto exchange rate regime over 2000–12. In these graphs, currencies are ordered by the ratio of currency premium variance to bond premium variance. The fixed exchange rate (HKD) is shown in a darker colour; currencies classified in the most freely floating category in all years, are shown in a lighter colour. More managed currencies generally have larger `bond premium' variance and smaller "currency premium" variance.

Intervention capacity and trade-off between bond premium, currency premium and relative risk-free returns. Graph 4

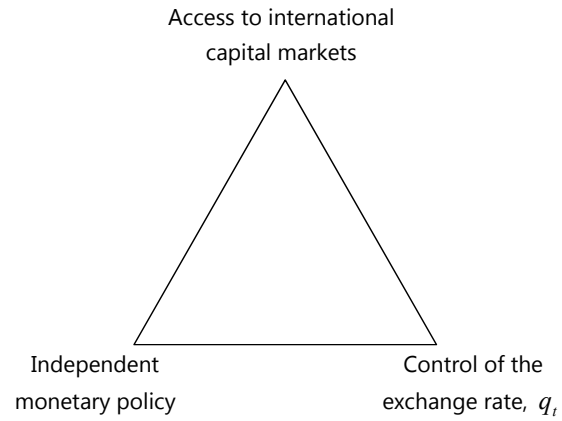


Notes: These graphs plot foreign exchange reserves/GDP – a measure of intervention capacity – against the variances of the unobserved components from the risk-augmented model. Reserves are a proxy for the exchange rate regime. The trade-off between bond premium variance and currency premium variance appears is related to the exchange rate regime. In particular, intervention capacity appears to be associated with a lower currency premium.

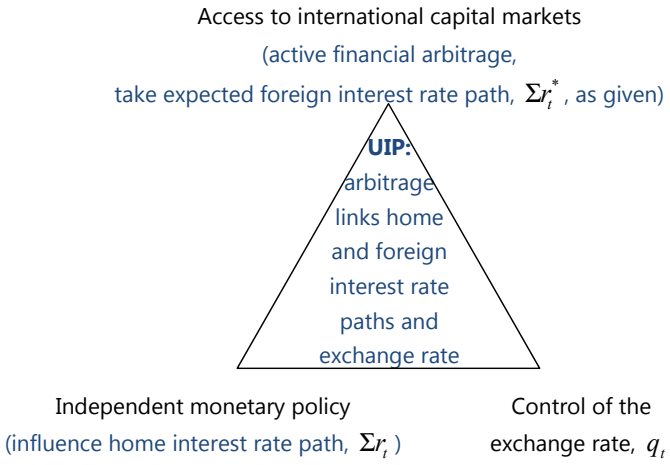
Source: Reserves/GDP (December 2011) from IMF, *International Financial Statistics*.

The monetary policy trilemma in a modern macroeconomic model — Graph 5

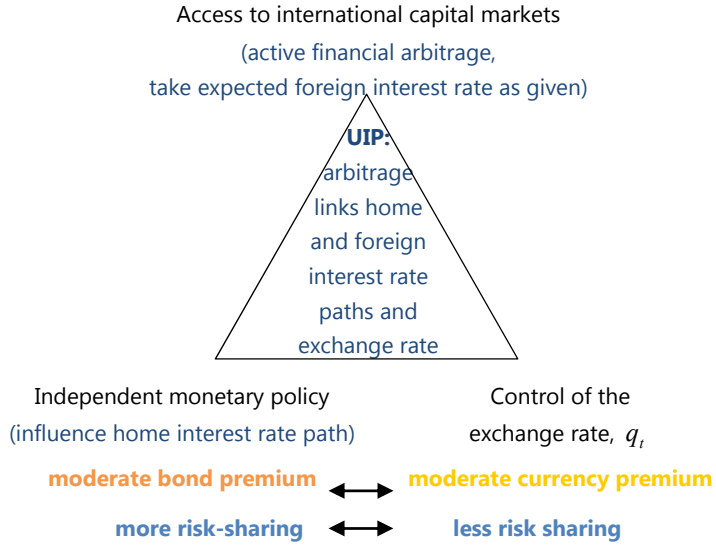
(a) Mundell's trilemma: of three desirable things, we can only have two:



(b) In a modern open-economy, UIP is what makes the trilemma bind



(c) Are trilemma trade-offs related to risk?



A Data appendix

Exchange rates and nominal interest rates are end-month rates. Real exchange rates are measured ex post. The inflation component of real interest rates is forecast on the basis of distributed lag equations. CPI data are assumed to be released within a month. Nominal 30-day interest rates, zero coupon swap rates and spot exchange rates are end-month rates from Bloomberg:

Bloomberg codes

Table A.1

	30-day interest rate	10-year interest rate swap	10-year zero coupon swap	exchange rate
AUD	ADBB1M Curncy	ADSW10 Curncy	I00110yIndex	AUD Curncy
CAD	CD001M Curncy	CDSW10 Curncy	I00710YIndex	CAD Curncy
CHF	SF001M Curncy	SFSW10 Curncy	I05710yIndex	CHF Curncy
EUR	EU001M Curncy	EUSa10 Curncy	I05310YIndex	EUR Curncy
GBP	BP001M Curncy	BPSW10 Curncy	I05510YIndex	GBP Curncy
JPY	JY001M Curncy	JYSW10 Curncy	I05610YIndex	JPY Curncy
NZD	NDBB1M Curncy	NDSW10 Curncy	I04910yIndex	NZD Curncy
SEK	STIBOR1M Index	SKSW10 Curncy	I08710yIndex	SEK Curncy
USD	US0001M Index	USSW10 Curncy	I05210YIndex	1
HKD	HIHD01M Index	HKSW10 Curncy	-	HKD Curncy
MYR	KLIB1M Index	MYSW10 Curncy	-	MYR Curncy
KRW	KRBo1M Curncy	KRSWo10 Curncy	-	KRW Curncy
PHP	PHSWND1M Index	PHSWo10 Curncy	-	PHP Curncy
SGD	SORF1M Index	SGSW10 Curncy	-	SGD Curncy
THB	TBFR1M Index	THSWo10 Curncy	-	THB Curncy

Nominal 30-day interest rates are Libor rates or a local equivalent rate where the local benchmark rate is more heavily traded (eg Australia and New Zealand bank bill rates). Ten year swap rates are available from February 1990 for JPY/USD, March 1992 for the HKD, December 1994 for AUD, CAD, CHF, GBP, and SEK, March 1996 for the NZD, August 1997 for the SGD, January 1999 the euro, March 1999 for the PHP, Nov 1999 for the THB, March 2000 for the KRW, and July 2004 for the MYR. The sample ends in March 2014. Consumer price indices and import and export price indices are from the IMF, *International Financial Statistics*. For Australia and New Zealand, quarterly price indices are interpolated so that observed inflation is the same for the three months between quarterly inflation data (there is no inflation news between data releases).

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Comment on: Exchange rates, expected returns and risk: what can we learn from Asia-Pacific currencies?

Hugo Vega

Uncovered interest rate parity (UIP) is probably the most popular component of small open economy models used for monetary policy analysis. Based on an arbitrage assumption, it predicts that nominal exchange rates respond to movements in nominal interest rates, both domestic and foreign. The intuition is simple: higher domestic (foreign) interest rates generate capital inflows (outflows) that demand domestic (foreign) currency, causing a nominal appreciation (depreciation).

As a theory, UIP is elegant, concise and intuitive. Sadly, empirical tests of its validity have failed systematically (see Engel (2013) for a literature review). Munro's paper is one of the more recent attempts to explain why this has been the case in the past and, after appropriate correction of the estimation technique, it provides renewed empirical evidence in favour of UIP.

In Munro's approach, estimation bias is the main suspect behind past failures to establish the empirical validity of UIP. The paper points out that observed interest rates are not risk-free and if risk premia associated with exchange and interest rates are correlated, reduced-form estimates of UIP will be biased.

In order to illustrate this appropriately, it is best to refer to the following risk-adjusted asset price exchange rate model:

$$\Delta q_t = -\alpha \Delta R_t - \Delta L_t^R - \Delta L_t^{FX} \quad (1)$$

$$\Delta R_t = \Delta R_t^f - \Delta L_t^R \quad (2)$$

Here, q_t stands for the real exchange rate (expressed in units of domestic good per unit of foreign good) and R_t is the infinite sum of expected relative home and foreign payoffs (the interest rate "differential").

In theory, the latter can be decomposed into its risk-free counterpart (R_t^f) and a "bond premium", L_t^R. The UIP condition (1) incorporates the bond premium as well but has an additional "currency premium", L_t^{FX}.

The parameter of interest of the model, α , should be equal to 1 if UIP holds.

Other papers have attempted to estimate the empirical validity of UIP before but they have neglected to account for the bond premium explicitly, generating biased estimates of α (changes in the bond premium generate positive co-movement between the exchange rate and the interest rate differential). They usually proposed the reduced form

$$\Delta q_t = -\alpha \Delta R_t + \dot{\varepsilon}_t \quad (3)$$

But if (1) and (2) describe the correct model, then estimates of α generated from (3) will be biased because ΔR_t and η_t are correlated. This is classic omitted-variable bias.

Once we realise this, the problem changes: the bond premium is not observable (because the risk-free interest rate differential, ΔR_t^f, isn't either) so it cannot be included in the model, nor used to remove the bond premium component from the observed interest rate differential. Classic econometrics usually deals with this problem using instrumental variables. Ideally, we would like to find a variable that is correlated with ΔR_t^f but not ΔL_t^R and use it as an instrument to estimate (3).

Such a variable is hard to come up with. Macro fundamentals (the main drivers behind risk-free rates) are intimately related to country risk premia. Thus, the paper chooses a different route: estimate (1) and (2) as a multiple equation system using Bayesian methods. A prior is imposed on α and the variances of the risk premia (they are treated as shocks and must be positive) to guarantee identification.

The paper finds that the sign restrictions help with the identification of the system. Reported estimates of the variance of the bond premium (ΔL_t^R) show that it heavily biases reduced form estimations of α.

Munro's risk adjusted estimates of α are much closer to 1. Actually, looking at the posterior distributions, there is a good probability that the parameter is actually near one for several currencies. However, in some cases, posterior gain over the prior seems to be small. The identification strategy loses effectiveness on some currencies. Still, for most countries analysed the posterior mode is to the right of the prior mode, indicating the prior is not too restrictive (see Graph 3 in the paper).

Furthermore, some of the currencies studied might be subject to structural breaks, particularly in the trends. Accounting for this might improve the paper's results.

Additionally, the paper also finds that Asian currencies seem to have higher "bond premium" variances but smaller "currency premium" variances. It postulates that this trade-off is correlated with measures of exchange rate regime. Using a sample of 14 currency pairs, it finds that more managed currencies tend to have larger bond premia; and more freely floating currencies tend to have larger currency premia. The conclusion is that risk plays a role in the monetary policy trilemma trade-offs.

If this is the case, it might be interesting to submit the Swiss franc-euro exchange rate to the test proposed in the paper in order to look at what has happened in the last few years in terms of bond and currency premium given the Swiss National Bank's foreign exchange rate policy. If the variance of the bond premium increased and that of the currency premium decreased because of active intervention in the FX market by Swiss authorities, that might provide additional validation for the paper's results. Testing this would require further development of the model because currently the variances of risk premia are assumed to be constant.

The validity of UIP as a theory of exchange rate fluctuations has a long history. This paper's renewed attempt to support it empirically is largely successful and provides new insights into the implications of exchange rate intervention for

monetary policy. If further empirical support can be found for the claim that fixed exchange rate regimes generate more volatile interest rates in an economy, that would be something which policymakers should take into account when deciding whether or not to intervene in FX markets.

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The influence of Chinese and US financial markets on Asia-Pacific[3]

Chang Shu, Dong He, Honglin Wang and Jinyue Dong[†]

Abstract

This paper presents some early results from ongoing research assessing the impact of China's financial markets on those in other Asian-Pacific economies, and comparing it with that of the United States (Shu, He and Wang, forthcoming). Our analysis suggests that China's influence on the regional stock and FX markets has grown over time, but its bond market is still isolated from those of the United States and Asia. US financial markets remain a strong driver, particularly during times of stress.

Keywords: China's impact, spillovers to Asian financial markets, US, structural VAR, sign restrictions

JEL classification: F20

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Introduction

China has rapidly become an important driver outside the United States for Asian financial markets. Market developments in the United States, whether driven by monetary policy, financial market or political events, have long been a dominant force in the global markets. The financial crisis in 2008–09 and, much more recently, the mid-2013 "taper tantrum", are prime examples of spillovers emanating from the US markets. Meanwhile, though, there have been an increasing number of cases where market moves in China sent shock waves through Asia and beyond. In November 2008, Chinese equities rose by 7.3% after a RMB 4.0 trillion stimulus package was announced. On the same day, Asian shares jumped by 3.4%. China's influence has become such that, apart from policy and macro news, even comparatively small credit events in China can move regional markets. For example, the near default of a Chinese trust product in January 2014 weighed down emerging markets for a number of days until a resolution was reached.

China's increasing regional influence arises, first and foremost, from its strong trade linkages and, to a lesser extent, from its financial linkages with Asia. As the largest trading nation in the world, China trades extensively with other Asian-Pacific economies. This reflects China's significant role in the Asian production chain as well as its expanding capacity in generating final demand for Asian exports. By comparison, China's direct financial linkages with Asian-Pacific economies have been much more modest in scale. This is reflected in China's small international investment position compared to those of the United States and many other economies (Table 1). China's liability in foreign direct investment as a percentage of GDP shows a smaller gap vis-à-vis the United States, as foreign direct investment was the earliest category of investment to be liberalised under the capital account. By contrast, China has limited foreign direct investment assets, and limited assets and liabilities in portfolio investment under more controls in these capital account categories.

As the United States and China have different degrees of integration with Asia, their respective influence on financial markets also differs. With its extensive financial linkages with the Asia-Pacific region, the United States can exert its influence through funding costs, portfolio rebalancing and risk appetite channels. China's strong trade ties yet limited financial linkages with other Asian economies suggest that China's influence is mainly a reflection of its impact on the real side. Its spillovers to regional financial markets may be through expectations and risk appetite channels. In addition, Asian assets are also known to be used as proxy trade for renminbi assets, and thus they are affected by developments in China's financial markets.

The relative influence of the US and Chinese financial markets on Asia-Pacific may be different in stress and tranquil periods. The negative spillovers from the United States can be particularly acute in periods of stress marked by high funding costs and a sharp rise in risk aversion. These conditions are accentuated by the asymmetric international investment positions of Asian economies. On the asset side, the government or government-related securities of advanced economies are held by the official sector, which tends to be a long-term investor. Yet the liability side tends to be dominated by foreign direct investment and portfolio investment held by private investors in advanced economies. This structure is susceptible to "risk-on, risk off" flows, which are often driven by developments in advanced economies, especially when global markets experience stress (McCauley (2012)).

International investment position

End-2013[1], as a percentage of GDP Table 1

	PI asset[2]	PI liability[2]	PI total[2]	FDI asset[3]	FDI liability[3]	FDI total[3]
China	3	4	7	7	26	32
IFCs						
Hong Kong SAR	408	190	598	493	527	1,020
Singapore	295	59	354	169	284	453
Selected Asian economies						
Indonesia	2	20	22	1	24	26
Korea	13	47	60	17	13	30
Malaysia	20	63	83	48	51	100
Philippines	4	29	32	4	11	15
Thailand	8	36	44	15	51	66
Advanced economies						
United States	55	92	147	42	34	77
United Kingdom	161	159	321	74	63	137
Germany	85	97	182	54	38	92

1 End-2012 figures for Indonesia, the Philippines and Thailand. [2] PI refers to portfolio investment. [3] FDI refers to foreign direct investment.

Sources: IMF; CEIC; authors' calculations.

This paper is part of an ongoing project studying the transmission of financial market shocks from the US and Chinese financial markets (including the stock, bond and currency markets) to those in other Asia-Pacific economies (Shu, He and Wang, forthcoming). The US influence on global financial markets has been well documented. Yet, there are few studies about China's impact on regional financial markets. A number of studies assess the renminbi's influence on regional currencies, eg Shu, Chow and Chan (2007), Henning (2012), Subramanian and Kessler (2012), Fratzscher and Mehl (2014), and Shu, He and Cheng (2014). He, Zhang and Wang (2009) examine the impact of US and Chinese financial markets on Hong Kong SAR, covering the stock, bond and FX markets. There is no similar study for the region as a whole.

The rest of paper is structured as follows. The second sectiondescribes the empirical framework and data for studying the influence of US and Chinese financial markets on the Asia-Pacific region. Section 3 reports some initial results. The final section summarises the major findings and considers the implications.

Empirical framework and data

We use a structural vector autoregression (SVAR) to model the complex interactions among the US, Chinese and Asian financial markets. The study is in the spirit of Ehrmann, Fratzscher and Rigobon (2011), who use SVAR models to study financial transmission within and between the United States and euro area, and cover the money, bond, equity and FX markets. Our study focuses on international transmission between financial markets. Our model contains three country/region

blocks, ie the United States, China and Asia, and covers the stock, bond and FX markets.

Specifically, the reduced and structural form vector autoregressions (VARs) are given, respectively, as:

(1) $$B(\mathbf{L})y_{\mathbf{t}} = \varepsilon_{\mathbf{t}},$$

and

(2) $$A(\mathbf{L})y_{\mathbf{t}} = e_{\mathbf{t}}.$$

In equations (1) and (2),

$$y_{\mathbf{t}} = \begin{pmatrix} US\_bond_t \\ US\_stock_t \\ China\_bond_t \\ China\_stock_t \\ RMB/USD_t \\ Asian\_bond_t \\ Asian\_stock_t \\ Asian\_currency_t \end{pmatrix},$$

and A and B are parameter matrices in the model. Also, $\varepsilon_{\mathbf{t}}$ is the innovations of the reduced form in equation (1), and e_t is the normalised and orthogonalised disturbances of the structural form. Based on the Bayesian Information Criteria, the lag length is selected to be 2 for the estimation.

Identification by sign restrictions

This study identifies the SVAR through sign restrictions. The identification procedure establishes the link between parameters in the reduced form and structural VARs, which allows the analysis of VAR dynamics in terms of structural shocks. Unlike the traditional Cholesky method, which requires an arbitrary ordering of the endogenous variables in the VAR, the sign restriction approach allows substantial flexibility in modelling, and permits pairwise interaction among all variables. Identification is achieved by imposing sign restrictions between some pairs of variables and using information from the variance-covariance matrix in the VAR.[4]

The following assumptions are imposed in our study for identifying the SVARs.

- "Cross-country, within-market" spillovers:

[4] This method for SVAR identification is relatively new. After it was introduced by Faust (1998), it has been further developed by Canova and De Nicolo (2002), Uhlig (2005), Hau and Rey (2004). Fry and Pagan (2011) provide a critical review of this approach.

US impact on China and Asia: US stocks have a positive impact on Chinese and Asian stocks. US bond yields have a positive impact on Asian bonds, reflecting the funding cost and "search-for-yield" effects (He and McCauley (2013)). The same effects might not be directly exerted on Chinese bonds, in view of China's capital controls.

China's impact on Asia: Chinese stocks have a positive impact on Asian stocks. In the meantime, the renminbi moves Asian currencies in the same direction, in line with earlier evidence about the renminbi's regional impact by Shu, Chow and Chan (2007), Henning (2012) and Subramanian and Kessler (2012), Fratzscher and Mehl (2014), and Shu, He and Cheng (2014). No assumption is made for the impact of Chinese bonds on Asian bonds.

- "Cross-country, cross-market" spillovers

Spillovers from equities to currencies: Hau and Rey (2002 and 2004) show that a rise in the share of wealth held in foreign assets due to higher foreign equity returns can trigger a relocation of equity funds away from the foreign country to the home country and a home currency appreciation. This reflects the need to reduce foreign currency exposure due to imperfect hedging of currency risks. Thus, a rise in US equity prices might induce a portfolio rebalancing by US-based investors to foreign assets, leading to a strengthening of Asian currencies; and a rise in Asian equity prices leads to a weakening of Asian currencies. The same channel does not apply in China's case with a closed capital account.

US bond shocks on Asian currencies: US bond yields have a positive impact on Asian currencies. Higher US bond yields will attract investment into US bonds, and the resultant falling interest rates in Asian assets leaves Asian currencies weaker.

- **"**Within-country, cross-market" spillovers

Interaction between bond and stock markets: A rise in bond yields leads to a fall in stock returns. A positive bond yield shock indicates a higher funding cost and a worsening of liquidity conditions, which can drive stock prices lower.

Bond yields and exchange rate: Asian bond yields have a negative impact on the exchange rate. That is, bond yields in Asia will attract foreign investment, leading to domestic currency appreciation.

Data

The eight-variable SVAR is estimated using daily data from 1 January 2002 to 30 September 2013. The data are obtained from the CEIC daily database. The data for the Asian block are taken as the simple average of Australia, Hong Kong SAR, India, Indonesia, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore and Thailand.

One issue to address in the modelling is the different time zones of the US, Chinese and other Asian financial markets. As Asian trading is ahead of the United States, shocks from Asian markets are always incorporated into US asset prices, while shocks to US markets can only affect Asian trading on the next trading day. Following the practice in the literature (eg Forbes and Rigobon (2002) and Ehrmann, Fratzscher and Rigobon (2011)), we use two-day rolling average returns in the analysis.

Some results

This section reports some initial results of the ongoing research comparing the impact of China and the United States on Asia-Pacific financial markets.

Impulse response

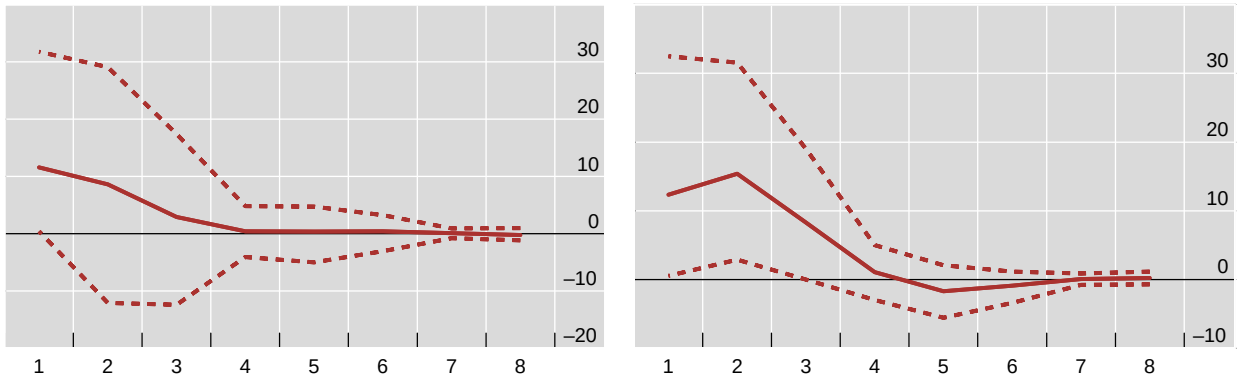
The impulse response results show that, in the case of Asian equities, the initial responses to innovations from the US and Chinese equities are comparable (Graph 1). One unit shock to US equity price (around 0.86%) will lead to a 0.12% rise in Asian equity prices upon impact, which rapidly dies down. Upon one unit shock of Chinese equities (0.96%), the rise in Asian equities lasts longer, and is the strongest on the second day, at 0.15%. The impact dissipates after three days.

Shocks to the RMB/USD rate and US bonds can move Asian currencies (Graph 2). Upon a one-unit shock in US bonds (1.89 basis points), Asian currencies will weaken by over 0.04% each day for two days. The response to a one-unit shock in the RMB/USD rate (0.21%) is around 0.03%, but becomes weaker on the second day. The finding of the renminbi's impact on Asian currency movements corroborates that of earlier research mentioned above.

By comparison, Asian bonds only respond to shocks to US bonds. Chinese bonds and other financial markets have no influence on Asian bonds.

Impulse response of Asian stock

In percentage points — Graph 1

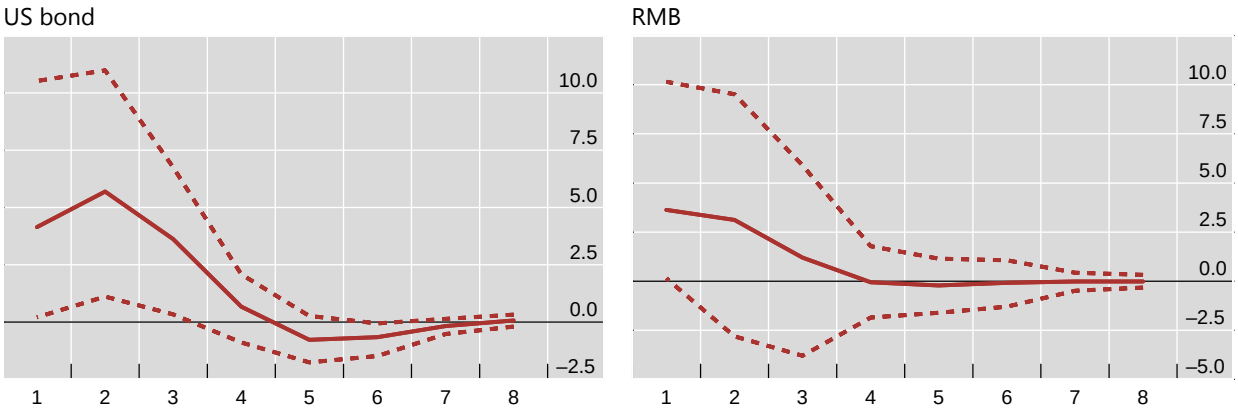


[1] Response to one unit of shock.

Source: Authors' estimates.

Impulse response of Asian currency

In percentage point Graph 2



[1] Response to one unit of shock.

Source: Authors' estimates.

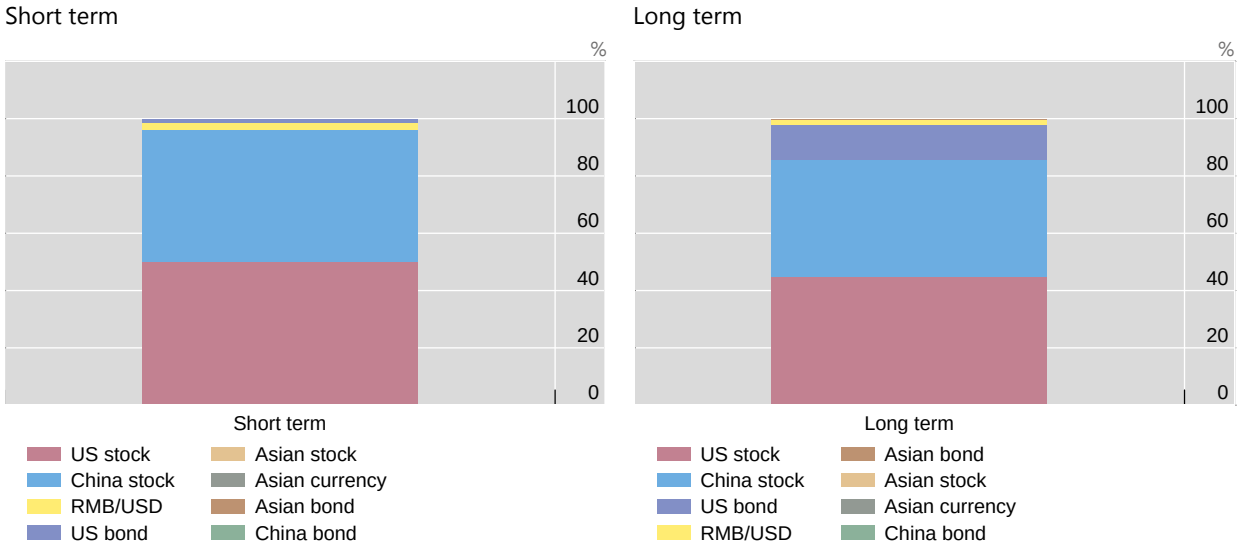
Variance decomposition

Variance decomposition is used to examine the relative importance of different shocks in driving Asian stock, bond and currency market movements. We focus on comparing the relative impact of the US and Chinese markets, and how this has evolved over time and in different market conditions.

Graph 3 shows how the volatility of Asian stock markets is driven by shocks to the eight endogenous variables, namely the US bond yield, US equity price, Chinese bond yield, Chinese equity price, the RMB/USD rate, Asian bond yield, the Asian exchange rate and the Asian equity price itself over the whole sample. The variance decomposition for the first period is referred to as the short term, and that for the fifth period the long term. Impulse responses reported in the earlier section suggest that the impact of shocks tends to dissipate within one to three days. For the overall sample period, the volatility of Asian stock prices is found to be mainly driven by spillovers from US equities (50.1%), closely followed by Chinese equities (46.0%) in the short term. In the long term, the US and Chinese equities remain the two most important drivers, but US bond yields also have some impact.

Asian stock market: variance decomposition

Graph 3



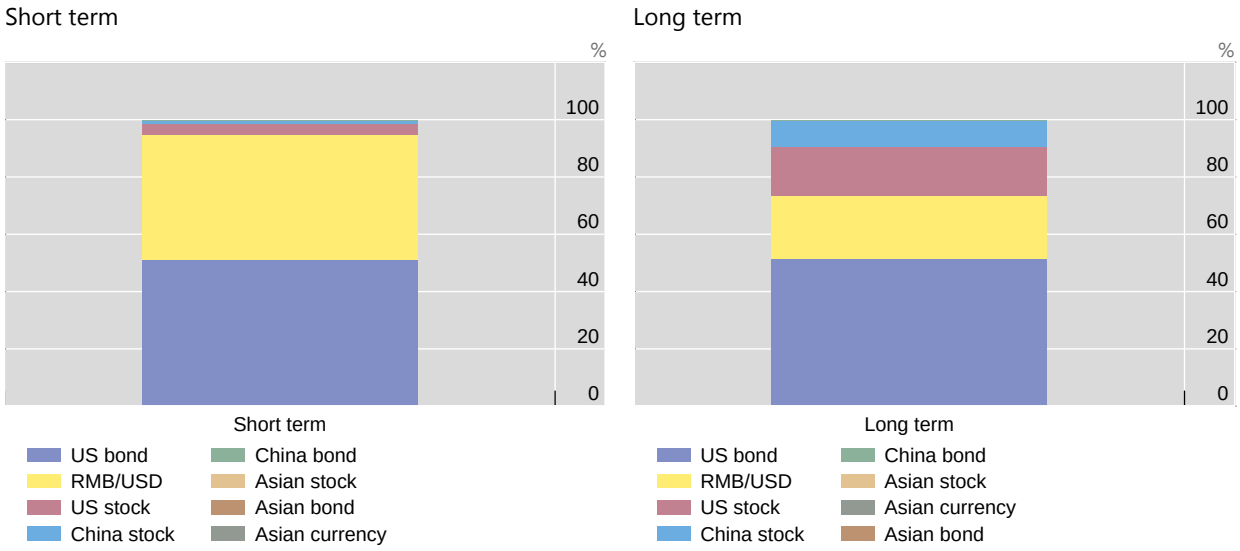
Source: Authors' estimates.

Shocks to US bonds and the RMB/USD rate are the dominant drivers of regional exchange rates, particularly in the short run (Graph 4). The renminbi's impact moderates in the long run, but that of US bonds rises slightly. A wider range of shocks also come into play over the long run, including those to US and Chinese equities.

On the Asian bond market, US bond market movements have a clearly dominant effect. This effect becomes even stronger in the long run. In complete contrast, all the Chinese financial markets, including equities, bonds and the exchange rate, have barely any influence on Asian bond movements.

Asian currency: variance decomposition

Graph 4



Source: Authors' estimates.

Estimation from subsamples shows that the US impact rises during periods of market stress, but the Chinese influence becomes more comparable with that of the United States in non-crisis periods. For example, during the global financial crisis and European sovereign debt crisis, the spillovers from the US equities accounted for two thirds of the variance of Asian equities in the short run, dropping to half over the long run. These compare with around one third in the non-crisis period. By comparison, the contribution of Chinese equities rises from around 20% to around 40% in the non-crisis period in both the short and long run.

China's influence on the regional stock markets and currency movements has been rising. In the period after the European debt crisis, China's stock market explains close to half of the short-run variation in Asian equity prices, compared to around a third before the global financial crisis. Similarly, the renminbi's impact has risen during the same period. China's move to a managed float exchange rate regime in July 2005 played an important role in the case of spillovers in currency movements. Barely having any influence on regional currencies in the early 2000s, the renminbi's impact began to be felt after the move.

Concluding remarks

The paper reports some early results from ongoing research that, for the first time, systematically examines China's impact on Asian-Pacific financial markets. The analysis points to the significant influence of China on the regional equity and FX markets. In normal or non-stress times, China's influence on Asian stock markets rises to a level comparable with that of the United States, although spillovers from the United States to Asian financial markets tend to be stronger than China's influence in periods of stress. The renminbi has also become capable of moving regional currencies after China shifted to a managed float regime in 2005. Nonetheless, China's bond market remains isolated from those of both other Asian countries and the United States.

China's rising influence and its interaction with that exerted by the United States have significant implications for financial markets and capital flows to Asia-Pacific. The influence of the United States on the world markets remains dominant, driving global liquidity conditions and risk appetite particularly during times of stress. Conceivably, the Chinese influence, as an important regional force, may to some extent provide a counteracting factor to capital movements should the US and Chinese markets move in opposite directions, thus moderating volatility in capital movements.

Looking forward, potential increases in the cross-holdings of financial assets within Asia may dampen the relative importance of influence from the United States while raising that of regional factors, which might help reduce volatility in capital flows. With rising income and financial development, cross-border holdings of financial assets and overseas investment by private sector entities are likely to grow (Lane and Milesi-Ferretti (2008a)). Conceivably, these, under the influence of gravity factors, will have a regional focus (Lane and Schmukler (2007); Lane and Milesi-Ferretti (2008b); Park (2013); Park and Mercado (2013)). Intra-regional financial flows may be further promoted by the internationalisation of major regional currencies, especially that of the renminbi. Regional economic and financial factors could start exerting a greater influence on Asian investors, particularly institutions, who might start developing views different from those of advanced economy investors on

global and regional trends. This could, in turn, start to act to counteract or moderate the "risk-on, risk-off" flows driven predominately by the thinking of investors currently located mainly in advanced economies.

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Comment on: The influence of China and US financial markets on Asia-Pacific

Ilan Noy[1]

China is playing an increasingly important role in the Asia-Pacific region's financial markets; this much seems obvious. The paper, however, sets out to document and most importantly quantify this increasing impact by comparing it to the long-dominant financial position of the United States in the region. Their empirical investigation allows the authors to distinguish between the impact of the United States and China on the small jurisdictions of Hong Kong SAR and Singapore, on the much larger Southeast Asian countries of Indonesia, Malaysia, Philippines, and Thailand, on the high-income, commodity-reliant countries of Australia and New Zealand, on the manufacturing powerhouses of Korea and Japan, and on India.

The links of some of these countries to China are already strong, and growing stronger. This is true for Australia and New Zealand and their trade exports (dairy products from New Zealand, and coal from Australia), of the Southeast Asian countries and their assimilation into China's supply chains and vertical integration, and of the Chinese-speaking Hong Kong and Singapore. The financial links, however, have not been as intensely scrutinised, and the authors are right to emphasise it.

Three possible markets and channels of impact are posited: sovereign bond, equity, and currency markets. It is the various channels of influence from one type of market in China or the United States to another in one of the Asia-Pacific countries that is investigated. The authors employ structural vector auto regressions (SVAR) with identification obtained by sign-restrictions motived by theory. The main impact the authors locate is between the equity markets, whereby the Shanghai stock exchange has an impact on the other stock exchanges of similar magnitude to that observed from the NYSE. Remarkably, the impact is almost identical across countries, with all of the countries investigated associated with a 40–50% spillover from fluctuations originating in either the Chinese or the US stock markets.

The main empirical difficulty is the trade-off between the theoretical credibility of the assumed sign restrictions on the SVAR, and the larger admissible parameter space that arises when not enough structure (in the form of sign restrictions) is imposed on the VAR. The authors choose to impose relatively few sign restrictions – those they feel are most theoretically palatable – but are paying a cost in terms of the accuracy of their estimated impacts.

The paper focuses on a short-term horizon of five days. If we are to believe the efficient market hypothesis, one should not look for any longer-term impact. But much research has cast doubt on this hypothesis, and it may be that some of the long-term trends in these markets (for example the almost continuous appreciation

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of the Chinese currency) also have an impact that is otherwise unidentifiable in the SVAR framework.

Another caveat that is worth keeping in mind, especially for regulators and policymakers, is that any VAR estimation is based on a linear model. As is true of the dynamic stochastic general equilibrium models that are frequently used by central banks, and which failed so spectacularly to predict the 2008 global financial crisis, these VARs are also not good indicators for either the direction or the magnitude of the impact that will result in periods of extreme volatility.

Whether this extreme volatility arises in the region, or elsewhere, is not necessarily of any importance. The main qualifier is that the impacts may be much larger in periods of high volatility. This problem will potentially be more severe if the crisis engenders multiple shocks that are not orthogonal to each other.

Finally, one should ask what implications the findings described in this paper have for long-term financial stability. In the aftermath of the global financial crisis, the issue of financial stability has moved to the forefront of public attention and will, it is to be hoped, remain there. Is the rising impact of China on the local currency, bond and equity markets of the Asia-Pacific region a force for stability, or is it another source of imported instability? Especially worrying, in this context, is the relative opacity of the securities traded in Shanghai, and the consequent large volatility in this market. The run-up in the Shanghai SE composite in 2006 and the equally precipitous decline in 2007 should serve as a cautionary note about the possible volatility that an increased role for China will create in the region.

China's stock markets may be somewhat developed, but China's domestic bond markets are clearly at an earlier stage of development. We are led to expect, given the results presented here, that their impact on the region will in the future increase as well. What form will this causal channel take, and whether it will also create a new source of instability in the region, is not yet clear. The 30 year-old lesson from the Latin American debt crisis again sounds a cautionary note as it illustrates the type of bond market spillover that is observed when investors panic.

Related to that question is the possible macroprudential policy toolkit that should be adopted and adapted to deal with this new type of exposure in the region. Should, for example, capital controls continue to be used as part of the macroprudential toolkit as was recently done in the aftermath of the crisis, and as is now advocated by the IMF? Will capital controls be an effective tool in dealing with the liquidity and volatility now coming out of China?

And last, but from an American perspective not least, is the increasing role of China a harbinger of a diminished role for US financial markets in the region? Is this really a zero-sum game?

Effectiveness of macroprudential and capital flow measures in Asia and the Pacific[1]

Valentina Bruno, Ilhyock Shim and Hyun Song Shin[2]

Abstract

We assess the effectiveness of macroprudential policies in 12 Asia-Pacific economies, using comprehensive databases of capital flow measures (CFMs) and domestic macroprudential measures. We show that banking sector CFMs and bond market CFMs are effective in slowing down banking inflows and bond inflows, respectively. Our findings also provide some evidence of spillover effects from these types of CFM. Finally, we find that domestic macroprudential measures have insignificant effects on cross-border lending, bank credit and total credit.

Keywords: banking inflow, bond inflow, domestic macroprudential measure, capital flow measure

JEL classification: F34, G15, G28

[1] This document is a shortened and modified version of the paper by the same authors entitled "Comparative assessment of macroprudential policies" that was presented at the RBNZ-BIS conference on cross-border financial linkages in Wellington, New Zealand, on 24 October 2014.

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Introduction

This paper aims to give a comparative empirical assessment of the impact of capital flow measures (CFMs) and domestic macroprudential measures across countries. In particular, we aim to control for the impact of global and local factors through our panel estimates and examine the effect of these policy actions on cross-border banking inflows, bond portfolio inflows and aggregate credit.

The impact of CFMs is determined in large part by the external environment, and our findings reflect the shift in the pattern of financial intermediation from the banking sector to the capital market. Turner (2014) illustrates the shift in the pattern of cross-border financial intermediation from the banking sector to the capital markets. In particular, he shows that the capital flows from global banks to emerging market economy (EME) banks had slowed to a trickle by 2012 and that, in their place, EME banks have increased their debt securities issuance. For non-banks, the growth in net issuance of international debt securities has been even more dramatic over the period 2010–12.

We focus on the experience of 12 Asia-Pacific economies in implementing CFMs and domestic macroprudential measures over the period 2004–13. For this exercise, we use a comprehensive database of domestic macroprudential measures and also a comprehensive data set of CFMs. In particular, we consider both CFMs that address the cross-border spillover of financial conditions through banking sector and bond market capital flows, and macroprudential policies that have a domestic credit focus such as maximum loan-to-value and debt-service-to-income ratios. Our policy data sets include 152 distinct CFMs on banking inflows and bond inflows and 177 domestic macroprudential measures taken by 12 Asia-Pacific economies during our sample period.

Our panel regression analysis finds the following results. First, banking sector CFMs are associated with a reduction in the growth of banking inflows before 2007, but not after 2007. Bond market CFMs are associated with a slowdown in bond inflows before 2009, but not during the surge in bond issuances after 2009. Second, we find some evidence of spillover effects from bond market and banking sector CFMs. In particular, banking sector CFMs are positively associated with an increase in international debt securities before 2007, and bond market CFMs are associated with an increase in cross-border bank lending after 2009. Third, we find that domestic macroprudential measures have insignificant effects on cross-border lending, bank credit and total credit.

We should bear in mind the issue of endogeneity (eg countries may adopt the policies in reaction to surges in credit or capital flows) when interpreting our results. For CFMs and domestic macroprudential measures are not introduced in a vacuum. They often reflect the external environment and the perception that surges in banking or bond inflows may lead to destabilising capital outflows in any subsequent reversal of such flows. If new macroprudential measures and CFMs are introduced only after a lengthy period of discussion within the government, central bank and other public authorities such as financial regulators, the implementation of such policies often coincides with the late stages of the boom. If the boom then subsides under its own weight, the introduction of the policy action and the subsequent slowdown of capital flows and credit growth would be a coincidence, not a causal effect. To this extent, the results reported below should be taken with some caution. More effort is needed to find empirical strategies that can address

the counterfactual question of what would have happened in the absence of these policy measures. Nevertheless, summarising the empirical associations between these policy measures and financial outcomes would be a necessary first step, and our exercise is offered in that spirit. In this context, our comprehensive databases of CFMs and domestic macroprudential measures allow us to reach conclusions that are based on comprehensive evidence.

Data

In assessing the impact of banking and bond inflow measures as well as domestic macroprudential measures on capital flows and aggregate credit, we consider the following 12 Asia-Pacific economies: Australia, China, Hong Kong SAR, India, Indonesia, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore and Thailand. The sample period spans almost a decade from the first quarter of 2004 to the third quarter of 2013 (or a few quarters earlier for some economies).

We consider the quarterly growth of cross-border banking inflows, bond portfolio inflows, offshore bond issuance, domestic credit and total credit as left-hand side variables. In particular, for banking inflows we consider the quarterly growth in external claims in US dollars of BIS-reporting country banks on the Asia-Pacific economies by residency, as given by the BIS locational banking statistics (*BIS Loans*). For bond inflows, we consider the quarterly growth in the amount outstanding of domestic debt securities in US dollars purchased by non-residents for the 12 Asia-Pacific economies (*BoP Bonds*). The data are obtained from the Balance of Payment and International Investment Position statistics of the IMF. For offshore borrowing in the form of bonds, we consider the quarterly growth in the US dollar amount outstanding of international debt securities issued by banks and corporations residing in the 12 economies, as given by the BIS international debt securities statistics (*BIS Bonds*). It should be noted that the proceeds from the issuance of these bonds could still find its way back to the issuing country.

We also include domestic bank credit and total credit as dependent variables. In particular, we use the quarterly and annual growth in bank credit in local currency value to private non-financial sectors, which is available for the 12 economies (*Bank Credit*), and the quarterly and annual growth in credit in local currency value extended by domestic banks, all other sectors in the economy and non-residents, which is available for 10 economies[3] (*Total Credit*), as given by the BIS database for total credit to the private non-financial sector. All dependent variables are winsorised at the 2.5% level to reduce the effect of outliers.

We include several control variables – both global and local – as possible determinants of banking and bond inflows. As a global factor, we consider the log of the VIX, which can be a proxy for the leverage of global banks (see Bruno and Shin (2015) or risk sentiment of global investors in bond markets (see Ahmed and Zlate (2013). For local factors, we use the log of real exchange rate, real GDP growth, CPI inflation, M2 growth, interest rate differential between the three-month domestic interbank rate and US Libor, and the sovereign credit rating.

[3] The total credit series for New Zealand and the Philippines are not available.

In this paper, we are interested in both CFMs and domestic macroprudential measures. We obtained information on CFMs taken by the 12 Asia-Pacific economies from 2004 to 2013 from the database included in Chantapacdepong and Shim (2014). In particular, they classify policy actions by direction (tightening inflows, loosening inflows, loosening outflows, tightening outflows), by target flow (bond inflows, equity inflows, banking inflows, real estate inflows, direct investment inflows, other inflows (such as remittances and export flows) and outflows), and by target group (non-residents, or both residents and non-residents). Among various types of capital flow measure, we use banking inflow measures and bond inflow measures in this paper.

In addition to CFMs, we also consider domestically oriented macroprudential measures to see their impact on bank credit and banking/bond inflows. In particular, we use the database for policy actions on housing markets compiled by Shim et al (2013). The database contains three types of non-interest rate monetary policy action (reserve requirements, credit growth limits and liquidity requirements) which affect the amount of general credit to the private sector provided by banks, as well as five types of prudential measure (maximum loan-to-value ratios, maximum debt-service-to-income ratios, risk weights on housing loans, loan-loss provisioning on housing loans and exposure limits on the real estate sector) specifically targeting housing credit. The database differentiates tightening actions (ie reducing credit) and loosening actions (ie increasing credit). The coverage of this database ends in June 2012, so we collected information on relevant policy actions taken by the 12 economies from July 2012 to December 2013.

Empirical analysis

We conduct panel regressions without country fixed effects. In particular, *BIS Loans*, *BoP Bonds* and *BIS Bonds* are regressed on indicators of *Banking Inflow Measures* and *Bond Inflow Measures* (capturing both tightening and loosening actions) and various control variables. Also, *Bank Credit* and *Total Credit* are regressed on *Macroprudential Measures* (the sum of non-interest rate monetary policy measures and prudential measures capturing both tightening and loosening actions), *Banking Inflow Measures* and *Bond Inflow Measures*, and the control variables. For each specification, we include time dummies (year dummies). When we calculate standard errors, we cluster them at the country level. Finally, we do not include country dummies because CFM indicators have little variation or are unchanged for some economies.

Table 1 shows regression results for the direct impact of banking and bond inflow measures on targeted flows. In columns 1 and 2 of Table 1, the coefficient on the VIX is negative and significant in both specifications, which is consistent with earlier studies finding a decrease in cross-border lending during periods of high volatility, corresponding to deleveraging by global banks. We find that bank inflow measures are associated with lower growth in bank inflows. The coefficient on the indicator *Bank Inflow Measures* capturing the sum of tightening (+1) actions and loosening (−1) actions in a quarter is negative and significant, meaning that a greater tightening on bank inflow measures reduces cross-border banking inflows (column 1). The coefficient on the interaction term *Bank Inflow Measures x VIX* is positive and significant, meaning that bank inflow measures at the margin alleviate

the effect on the change in cross-border banking flows during periods of high volatility. In column 2, we interact the *Bank Inflow Measures* indicator with a dummy variable equal to 1 in every quarter after 2007 and 0 otherwise (*post 07*), and with a dummy variable equal to 1 in every quarter in or before 2007 and 0 otherwise (*pre 07*). The results from this specification show that *Bank Inflow Measures* are effective in reducing the growth in cross-border lending during the period before the 2007 financial crisis. The financial crisis consistently reduced the magnitude of the cross-border banking flows. In this sense, it is not surprising to see that bank inflow measures were effective during the booming period of cross-border lending.

Direct effects of bank and bond inflow measures — Table 1

Dependent variable	(1) BIS Loans	(2) BIS Loans	(3) BoP Bonds	(4) BoP Bonds	(5) BIS Bonds	(6) BIS Bonds
VIX	-0.0804**	-0.0801**	-0.0393**	-0.0435**	-0.0511***	-0.0370***
	[0.027]	[0.019]	[0.029]	[0.016]	[0.006]	[0.000]
Bank Inflow Measures	-0.0645*					
	[0.068]					
Bank Inflow Measures x VIX	0.0186*					
	[0.068]					
Bank Inflow Measures x post 07		0.0054				
		[0.395]				
Bank Inflow Measures x pre 07		-0.0241**				
		[0.025]				
Bond Inflow Measures			-0.1121*		0.0968*	
			[0.099]		[0.092]	
Bond Inflow Measures x VIX			0.0324*		-0.0279*	
			[0.100]		[0.095]	
Bond Inflow Measures x post 09				0.0042		0.0189
				[0.740]		[0.134]
Bond Inflow Measures x pre 09				-0.0405***		-0.0063
				[0.004]		[0.703]
Constant	0.2367**	0.2340**	0.1539***	0.1667***	0.1961***	0.1200***
	[0.023]	[0.016]	[0.005]	[0.001]	[0.008]	[0.000]
Observations	445	445	445	445	445	445
R-squared	0.119	0.123	0.153	0.160	0.143	0.108

Note: This table shows results from regressions with year dummies and robust-clustered standard errors at the country level. *p*-values are reported in brackets. *BIS Loans* is the growth in cross-border banking inflows. *BoP Bonds* is the growth in the amount outstanding of domestic debt securities purchased by non-residents. *BIS Bonds* is the growth in the amount outstanding of international debt securities issued by non-financial corporations. *Bank Inflow Measures* or *Bond Inflow Measures* is the sum of tightening (+1) actions and loosening (−1) actions in a quarter. VIX is the Chicago Board Options Exchange Volatility Index. *Post 07* (*Pre 07*) is a dummy variable equal to 1 in every quarter after (in or before) 2007 and 0 otherwise. *Post 09* (*Pre 09*) is a dummy variable equal to 1 in every quarter in or after (before) 2009 and 0 otherwise. Control variables not reported in the table include the log of real exchange rate, real GDP growth, inflation, M2 growth, interest rate differential between the three-month domestic interbank rate and US Libor, and the sovereign credit rating.

In columns 3 and 4 of Table 1, we replicate the specifications used in columns 1 and 2 by using the growth in the amount outstanding of domestic debt securities purchased by non-residents (*BoP Bonds*) as our dependent variable. Correspondingly, we use the indicator *Bond Inflow Measures*. Column 3 presents results over the entire sample period. As in the case of *Bank Inflow Measures*, *Bond Inflow Measures* also statistically significantly reduce the growth in domestic debt securities purchased by non-residents. The coefficient on the VIX is again

statistically significant, as well as that on the interaction term between *Bond Inflow Measures* and the VIX, meaning that bond inflow measures attenuate the decrease in bond flows during periods of high volatility. Column 4 interacts *Bond Inflow Measures* with a dummy variable equal to 1 in every quarter in or after 2009 and 0 otherwise (*post 09*), and with a dummy variable equal to 1 in every quarter before 2009 and 0 otherwise (*pre 09*). Results from this specification show that bond inflow measures are effective in reducing the growth in the amount outstanding of domestic debt securities purchased by non-residents before the surge in bond issuances occurred after 2009.

In columns 5 and 6 of Table 1, we replicate the specifications used in columns 3 and 4 by using the growth in the amount outstanding of international debt securities issued by financial and non-financial corporations residing in the 12 economies (*BIS Bonds*) as our dependent variable. Column 5 presents results over the entire sample period. Different from the case with *BoP Bonds*, *Bond Inflow Measures* are statistically positively associated with the growth in international debt securities. This could be interpreted as a counter-reaction from corporations to the bond inflows measures as they may want to shift to (from) issuing offshore bonds from (to) issuing domestic bonds.

In Table 2, we try to gauge possible spillover effects from the introduction of banking and bond inflow measures. For instance, does cross-border lending increase when bond inflow measures are introduced? Similarly, are bond inflows affected by more stringent bank inflow measures? Regression results show that bond inflow measures are associated with an increase in cross-border bank lending after 2009 (column 1). Similarly, bank inflow measures are positively associated with

Spillover effects of bank and bond inflow measures

Table 2

Dependent variable	(1) BIS Loans	(2) BoP Bonds	(3) BIS Bonds
VIX	-0.0842** [0.018]	-0.0414** [0.022]	-0.0498*** [0.010]
Bond Inflow Measures x post 09	0.0296** [0.025]		
Bond Inflow Measures x pre 09	-0.0336 [0.308]		
Bank Inflow Measures x post 07		-0.001 [0.781]	0.0029 [0.297]
Bank Inflow Measures x pre 07		0.0064 [0.430]	0.0170** [0.033]
Constant	0.2482** [0.013]	0.1626*** [0.002]	0.1945*** [0.010]
Observations	445	445	445
R-squared	0.122	0.146	0.149

Note: This table shows results from regressions with year dummies and robust-clustered standard errors at the country level. *p*-values are reported in brackets. *BIS Loans* is the growth in cross-border banking flows. *BoP Bonds* is the growth in the amount outstanding of domestic debt securities purchased by non-residents. *BIS Bonds* is the growth in the amount outstanding of international debt securities issued by non-financial corporations. *Bond Inflow Measures* or *Bank Inflow Measures* is the sum of tightening (+1) actions and loosening (−1) actions in a quarter. VIX is the Chicago Board Options Exchange Volatility Index. *Post 07* (*Pre 07*) is a dummy variable equal to 1 in every quarter after (in or before) 2007 and 0 otherwise. *Post 09* (*Pre 09*) is a dummy variable equal to 1 in every quarter in or after (before) 2009 and 0 otherwise. Control variables not reported in the table include the log of real exchange rate, real GDP growth, inflation, M2 growth, interest rate differential between the three-month domestic interbank rate and US Libor, and the sovereign credit rating.

an increase in international debt securities before 2007 (column 3). These results could highlight possible spillover effects where policy actions on inflows into one sector lead to an increase in inflows to another sector. Such effects on bank and bond inflows did not happen during the first or second phase of global liquidity when bank and bond inflows, respectively, were increasing dramatically. Hence, a "coincidence" of bank (bond) inflow measures jointly with increased bond (bank) inflows is less likely.

Finally, in addition to the capital flow measures considered in Tables 1 and 2, we also consider domestically oriented macroprudential measures and investigate their impact on bank credit, total credit and banking inflows. Columns 1 and 2 of Table 3 show regression results when *Macroprudential Measures* are used in lieu of *Bank Inflow Measures* and *Bond Inflow Measures*. The impact of such measures is more ambiguous as they tend to have a positive or insignificant impact on cross-border lending (column 1) and on bank credit (column 2). These results may indicate some limitations of macroprudential policy measures or they may suggest that bank credit is slower-moving than capital flows.

In columns 3 to 6 of Table 3, we regress the growth of bank credit and total credit on all the policy measures so far considered: *Bank Inflow Measures*, *Bond Inflow Measures* and *Macroprudential Measures*. Results on one-quarter growth (between *t* and *t*-1, columns 3 and 5) and four-quarter growth (between *t*+3 and *t*-1, columns 4 and 6) are presented. Macroprudential measures continue to have an insignificant impact on bank credit and total credit. Also bank inflow measures do not seem to significantly impact credit.

Effects of domestic macroprudenital measures and bank/bond inflow measures

Table 3

Dependent variable	(1) BIS Loans	(2) Bank Credit Q	(3) Bank Credit Q	(4) Bank Credit Y	(5) Total Credit Q	(6) Total Credit Y
VIX	-0.0609**	-0.0029	-0.0028	-0.0098	-0.0021	-0.0070
	[0.025]	[0.498]	[0.564]	[0.480]	[0.777]	[0.676]
Macroprudential Measures	0.0227***	0.0015	0.0018	0.0015	0.0023	0.0034
	[0.006]	[0.235]	[0.188]	[0.806]	[0.125]	[0.598]
Bank Inflow Measures			-0.0016	-0.0022	-0.0009	-0.0023
			[0.204]	[0.609]	[0.465]	[0.509]
Bond Inflow Measures			0.0032	0.0142**	0.0023	0.0145*
			[0.190]	[0.047]	[0.101]	[0.077]
Constant	0.1634**	0.0145	0.0227	0.0885	0.0165	0.0968
	[0.026]	[0.402]	[0.269]	[0.206]	[0.512]	[0.249]
Observations	480	528	445	439	373	367
R-squared	0.136	0.297	0.293	0.469	0.381	0.557

Note: This table shows results from regressions with year dummies and robust-clustered standard errors at the country level. *p*-values are reported in brackets. *BIS Loans* is the growth in cross-border banking flows. *Bank Credit Q* is the one-quarter growth in bank credit to private non-financial sectors. *Bank Credit Y* is the four-quarter growth in bank credit to private non-financial sectors. *Total Credit Q* is the one-quarter growth in credit extended to private non-financial sectors by domestic banks, all other sectors of the economy and non-residents. *Total Credit Y* is the four-quarter growth in credit extended to private non-financial sectors by domestic banks, all other sectors of the economy and non-residents. *Macroprudential Measures* consist of non-interest rate monetary policy actions which affect the amount of general credit to the private sector provided by banks, and five types of prudential measure specifically targeting housing credit. *Macroprudential Measures*, *Bank Inflow Measures* or *Bond Inflow Measures* is the sum of tightening (+1) actions and loosening (−1) actions in a quarter. VIX is the Chicago Board Options Exchange Volatility Index. Control variables not reported in the table include the log of real exchange rate, real GDP growth, inflation, M2 growth, interest rate differential between the three-month domestic interbank rate and US Libor, and the sovereign credit rating.

By contrast, the results in columns 4 and 6 of Table 3 that bond inflow measures are positively correlated with the growth in bank credit and total credit suggest that bond inflow tightening measures may have induced domestic banks to increase domestic bank credit to compensate for the reduced amount of bond financing induced by bond tightening measures. The results are mostly consistent with the evidence in Table 2 on the existence of cross-flow substitution or spillover effects.

Conclusion

In this paper, we conduct a comparative empirical assessment of the impact of CFMs and domestic macroprudential measures taken in 12 Asia-Pacific economies over the period 2004–13 on capital flows and aggregate credit. Our panel regression analysis finds that bank inflow measures and bond inflow measures were effective in reducing the growth in banking inflows before 2007 and in slowing down bond inflows before 2009, respectively. In addition to the direct impact of CFMs on targeted flows, we find some evidence of spillover effects: bank inflow measures seem to increase the issuance of international debt securities before 2007, and bond inflow measures seem to increase the growth of cross-border bank lending and also the growth of domestic bank credit and total credit.

There are a few directions for further research. First, we can divide bond inflow loosening measures into two types: policy actions taken as part of a long-term capital account liberalisation plan, and those introduced to reverse or lift existing bond inflow tightening measures with the goal of attracting more capital inflows. The policy actions in the former group are of a structural nature, while those in the latter group are of a cyclical nature. This distinction is especially important when EME financial authorities try to understand the effectiveness of capital flow loosening measures to mitigate the negative impact of capital outflows triggered by global shocks such as a sudden increase in advanced economy interest rates. Second, data on banking inflows (*BIS Loans*), bond inflows (*BoP Bonds*) and international bond issuance (*BIS Bonds*) used in the paper are in US dollar terms. Thus, we can consider exchange rate effects to find out the net impact of policy actions.

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Comments on: Effectiveness of macroprudential and capital flow measures in Asia and the Pacific

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This paper by Valentina Bruno, Ilhyock Shim and Hyun Song Shin asks some important questions: what are the effects of capital flow management (CFM) policies? How do bond and bank CFMs affect the composition of capital flows? And what are the effects of domestic macroprudential policies on credit? These questions are important because a growing number of countries are deploying capital controls and macroprudential policies, and, if these policies are to be used wisely, then we need to understand how they impact our economies.

The authors conclude that bank and bond inflow CFMs do affect inflows, and they provide evidence that suggests that sectoral-type policies affect the composition of capital flows: after 2009 they find that controls on bond flows stimulate bank capital flows, and prior to 2007, they find that controls on bank flows affected bond flows. Perhaps somewhat surprisingly, the authors also find that tighter domestic macroprudential measures, in the single regression in which they are statistically significant (Table 3, column 1), increase the growth in external claims on domestic banks.

My remarks on this paper reflect a particular audience niche. As a central bank policymaker, I want to use research to provide quantitative guidance for decision-making. In the rest of this discussion I focus on two areas relevant for policymakers: the treatment effects of policy, with some discussion of the econometric measurement of these effects and the design of policy; and the metric used to assess or guide policy.

Treatments and doses

The essence of panel data analysis of the type used in this paper is to use cross-sectional and time variation to understand the effect of a "treatment" on dependent variables. These methods can be used to understand the effects of implemented treatments, but not hypothetical treatments. In the current context, we can think of CFM or macroprudential policies as the treatments of interest, and we are interested in how these treatments impact the macroeconomy (in particular capital flows and credit growth). Of course, the cross-sectional focus also requires us to account for other characteristics that may vary across time and across countries, which in turn may confound our assessment of the treatments.

Experimental data represent the ideal for assessing treatment effects, since a treatment is then randomised across treated and untreated groups, ensuring that the treatment is uncorrelated with any other factor that might influence the outcome. Yet with macroeconomic policies it is never possible to live up to this experimental ideal. As is well understood, macro policies are not randomly distributed on economies. Rather policies are implemented as policymakers respond to the circumstances that they face, including both the political and policy

frameworks within which they operate. Forbes et al (2015) note that countries that adjust their CFMs tend to have different characteristics than other countries. Macroeconomic and econometric policy analysis, then, needs to disentangle the effects of policy from the effects of these other macroeconomic drivers. As Bruno, Shim and Shin note at the beginning of their empirical analysis, they conduct panel regressions without country fixed effects, which thus assumes away differences between countries, and assumes the countries are all representative and drawn from the same data-generating process. While the authors are commendably upfront about this assumption, it does seem of questionable validity.

To assess the effect of capital controls, a counterfactual case needs to be developed indicating what would have occurred in the policy's absence. Yet if the treatment (the capital control or macroprudential policy) is not applied randomly to countries, then the effect of the treatment may be misestimated. Forbes et al (2015) use a propensity score matching approach to identify an untreated-group that forms the basis of the counterfactual, thus enabling one to correct for selection bias, to more accurately assess the impact of the treatment. Forbes et al's general conclusion is that most CFMs do not significantly affect target variables. It would be interesting to know whether the conclusions that Bruno, Shim and Shin reach about the effects of CFMs are robust to this alternative methodology.

From a policymaker's perspective, one of the frustrating aspects of the paper is that it does not precisely specify the type and quantity of the policy treatment. The analysis specifies a dummy variable which: (i) takes a value of +1 when a CFM or macroprudential policy is introduced or tightened; (ii) takes a value −1 when a policy is relaxed; and (ii) is otherwise 0. The treatment regressor is then the cumulation of these actions within a quarter. However, it is not clear that the CFM and macroprudential policies put into practice in different countries are really the same, and the analysis does not allow us to discriminate between policy variants.[1] In medicine, the type and dosage of drugs matter for outcomes – in conjunction with the underlying physiology of the patient – and the effects of CFM policy treatments are undoubtedly driven by the same general considerations.

CFM and macroprudential policies also have multidimensional properties or attributes, and these attributes may influence the efficacy of the policies that are implemented. For example, do tax-based restrictions have the same implications as quantity restrictions? Are the effects of, say, a tax on capital flows linear in the size of the tax, or do larger taxes create larger incentives for avoidance? Do caveats within a given policy matter for outcomes? Questions of policy design are not very well addressed by this kind of cross-country analysis unless the policies are specified in much finer detail. This criticism is by no means unique, and has been directed at previous papers in this literature (see Jinjarak et al (2013) and Straetmans et al (2013) for example).

[1] This is one of the "apples-to-oranges" problems discussed by Magud et al (2011).

Normative evaluations of CFMs

The paper by Bruno, Shim and Shin is empirical in nature, trying to establish the effect of CFM and macroprudential policies. It is worth straying into normative questions about these policies since one might be tempted to assume that, if CFM policies can affect capital flows or the composition of flows, then it will be desirable to implement them.[2]

The theoretical case for and against capital controls is not yet settled. As Straetmans et al (2013) eloquently articulate, the theory of the second best means that distortions such as capital controls may be welfare-enhancing if they mitigate welfare losses that arise from pre-existing distortions, such as incomplete markets, imperfect competition, asymmetric information or price stickiness. A variety of theoretical papers, such as Costinot et al (2014), Farhi and Werning (2012), Korinek (2011) and Jeanne and Korinek (2010), examine these issues and illustrate why controls may be beneficial.

Of course, the relative importance of the various theoretical mechanisms, the benefits of controls, and indeed the costs of deploying capital controls need to be evaluated empirically. It is by no means clear that an ability to affect capital flows for relatively short horizons of between one and four quarters is useful for thinking about whether such policies should be deployed.

In evaluating policies we need to consider not only the immediate circumstances, but the circumstances that may prevail in future, and thus any transition in the policies implemented. For example, Chile, a poster-child for capital controls, ultimately decided that the implementation costs of their capital control regime outweighed the macroeconomic benefits (Jeanne (2012); Gallego et al (2000)). Thus we need to consider not only the introduction of such policies but the possibility that they will later be removed. The Swiss National Bank's ceiling on the Swiss franc, and its subsequent removal, provide a more recent example.

We also need to consider the system-wide properties of the controls. Forbes (2007) finds that Chilean capital controls increased financial constraints for small traded-goods firms. These presumably undesirable consequences need to be weighed against the benefits of reduced capital flows. Likewise, the empirical results of Bruno, Shin and Shim suggest that, prior to 2007, controls on bank flows affected bond capital flows, but it is possible that controls on bank flows make banks safer at the cost of increased vulnerability in bond markets. Furthermore, the fact that the estimated effects of capital controls pre- and post-2007 and 2009 have different consequences suggests that we need to develop a deeper structural understanding of financial markets if we are to understand the consequences of CFM policies.

[2] This discussion is a variant of the third "apples-to-oranges" problem identified by Magud et al (2011): how do we measure success?

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